

CARIBBEAN EXAMINATIONS COUNCIL

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

MAY/JUNE 2003

ENVIRONMENTAL SCIENCE

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INTRODUCTION

Environmental Science is a two-unit course, each unit consisting of three modules. Unit I, which consists of Fundamental Ecological Principles, People and The Environment and Sustainable Use Of Natural Resources, was examined on open syllabus for the first time during the 2003 examination period. Unit II which consists of the three modules, Sustainable Agriculture, Sustainable Energy Use, and Pollution of the Environment, was piloted during this examination period. The examination for both units consisted of three papers. Papers 01 and 02 were examined externally by CXC, while Paper 03 was examined internally by the teacher and moderated by CXC.

Paper 01 consisted of twelve short-answer questions, with four questions from each module. Candidates were required to answer all questions in this paper, with a maximum of 90 marks contributing 30 per cent to the total assessment. Paper 02 consisted of nine questions, three from each module. Candidates were required to answer two questions from each module, a total of six questions. These were structured essay-type items each contributing twenty marks. In general, this paper was designed to test the candidates' comprehension and ability to apply knowledge. This paper contributed 40 per cent to the total assessment.

Paper 03, the Internal Assessment, comprised of four components. These were a research paper, a journal, a laboratory exercise and a project. While the journal, research paper and laboratory exercise focused on a specific module, the project was required to encompass all three modules.

GENERAL COMMENTS

UNIT I

In Unit I, candidates performed better on Paper 03 but exhibited about the same level of performance on Paper 01 and Paper 02. The fact that candidates performed best on Paper 03 is expected since this is the Internal Assessment, and given the proper guidance, candidates should perform significantly better on this paper than the others which were done under examination conditions. There were too many candidates obtaining less than 50 per cent of the marks available on this paper.

The problems identified in candidates' responses to questions on Paper 02 of the pilot examination still persist. Some candidates demonstrated a high level of knowledge and comprehension as well as the ability to apply and organise this knowledge. Unfortunately, too many candidates failed to demonstrate these abilities. For the most part, items that required application were poorly done. Candidates do not seem to understand what is required when a test item instructs them to discuss, describe or assess.

There were a number of test items in Paper 01 and Paper 02 on which many candidates performed poorly. Some candidates showed some knowledge but the depth required to answer these questions satisfactorily was lacking.

There was no significant variation in the performance of candidates in Modules 1, 2 and 3. Candidates performed best in Module 1, followed by Module 2 and Module 3. In the pilot examination of 2002, the order was reversed.

Generally, candidates' performance was disappointing. There was some indication that the depth of coverage with respect to certain areas of the syllabus had improved. However, improvement is still needed in the breadth of coverage and in candidates' ability to organise and apply knowledge.

DETAILED COMMENTS

UNIT 1

PAPER 01

The more able candidates performed satisfactorily. However, there were many candidates whose responses were inadequate especially where they were required to explain interactions and interrelationships. Candidates performed poorly on Questions 3, 6, 8, 11 and 12. Candidates' performance was better in Module 1 than in Module 2 or Module 3. The best performances were on Question 1, and the weakest on Question 11. Candidates struggled with questions that required the application of knowledge.

Module I: Fundamental Ecological Principles

Question 1

This question tested the candidates' knowledge of biogeochemical cycles, specifically the carbon cycle. The majority of candidates were able to identify the processes of photosynthesis and respiration indicated by the letters B and C respectively in Figure 1. In Part (b), most candidates were able to describe satisfactorily the process of photosynthesis. However, only a few candidates provided a complete description of the process of respiration. The impact of both these processes on the carbon cycle was identified by the majority of candidates.

Question 2

This question assessed candidates' understanding of common ecological terms and concepts and the biological organization in an ecosystem. In Part (a), most candidates were able to define the two terms chosen from the four given in Figure 2. Similarly, in Part (b), most candidates were able to redraw Figure 2 to show the correct biological organization in an ecosystem. In Part (c), most candidates were able to define the habitat better than the niche. Full marks for this part required the candidate to state their definitions as well as to identify the distinguishing characteristic of each.

Note:

While the habitat is defined as the physical location of the organism, the niche refers to the functional role of the organism including the eating habits, predator-prey relations and physical location. The niche therefore incorporates the habitat of the organism.

Question 3

This question assessed the candidates understanding of how the mechanism of evolution, through the process of natural selection, results in adaptation to the environment. The question focused on the use of camouflage by predators as a means of effectively catching their prey. This question was poorly done by the majority of candidates. Candidates were required to apply the principles of natural selection to account for this adaptation. Instead, many candidates addressed the effectiveness of camouflage as a means of obtaining food. Few candidates who attempted to apply the principles of natural selection focused only on the 'survival of the fittest' and neglected to include the other aspects of overproduction, variation and limitation to population growth.

Note:

Many more offsprings will be produced than will survive to maturity (overproduction). Only some of them will exhibit this colour trait (genetic variation). These are the individuals that will compete successfully for limited resources such as food, survive, and reproduce and pass on this trait (survival of the fittest). Natural selection therefore results in a population with this dominant colour trait.

Question 4

This question tested the candidates' knowledge of energy flows within ecosystems and the interaction between organisms in communities. Part (a) of this question was well done. The majority of candidates satisfactorily distinguished between a food chain and a food web. However, in Part (b), the majority of candidates experienced difficulty explaining why most food webs do not have more than three or four levels.

Many candidates recognized that energy was lost at each level, but failed to provide a complete explanation.

Note:

Energy transfer between levels is inefficient and only 10 per cent of the energy is transferred. At each level, energy is utilised by organisms to maintain their bodily function while some is lost as heat. Consequently, as the trophic levels increase, the available energy dramatically decreases. There would not be enough food resource or energy available to support organisms at the higher trophic levels.

Module 2: People and the Environment

Question 5

This question assessed the candidates' ability to interpret a demographic graph, specifically a pyramid-shaped population age/sex diagram. Parts (a), (b) and (c) were well done by the majority of candidates. However, there were a few candidates who did not recognize the diagram as typical of the population of a developing country which is expected to grow rapidly or exponentially.

Most candidates did not provide a complete explanation for the expected population growth that was suggested in their answer to Part (c).

Note:

The largest percentage of the population is in the pre-reproductive age group, 0-14 years. When the members of this group mature, they will become the parents of the next generation. They will produce a larger group of children who in turn will produce a larger group of children, resulting in an exponential population growth.

Question 6

This question examined candidates' knowledge of demographic terms as well as their ability to interpret demographic tables. In Part (a), candidates generally provided satisfactory definitions for the terms 'total fertility rate', 'infant mortality rate' and 'replacement fertility rate'. In Part (b) however, only a few candidates responded as expected. The majority of the candidates selected Barbados as the country which will have the faster growing population because of its lower infant mortality rate of 14.2 per thousand. The explanation provided for this was that with less infants dying then more people will be added to the population, hence, increasing the growth rate of the population. On the contrary, based on demographic studies, there is an inverse relationship between infant mortality rate and total fertility rate. The population of St Kitts and Nevis, with a higher mortality rate of 25 per thousand, will compensate by having a total higher fertility rate. Conversely, the lower infant mortality rate of Barbados will result in a lower total fertility rate. St Kitts and Nevis should therefore have the faster growing population.

Question 7

This question focused on the geographical variation in consumerism as quantified by the difference in carbon dioxide emissions. In Part (a), the majority of candidates were able to define consumerism. In Part (b), candidates were required to suggest three reasons for the difference in the 1996 per capita CO₂ emissions between North America and Central America, and the Caribbean as indicated in Table 2. The majority of candidates were able to suggest two reasons, with few being able to suggest a third. Some candidates' responses were considered incomplete because the link to the increased CO₂ emissions was not established. For instance, a response that "North Americans use more motor vehicles" is considered incomplete. However, "North Americans use more motor vehicles which are a major source of CO₂ produced from the combustion of gasoline" is considered a complete response.

Question 8

This question examined candidates' understanding of the relationship between population growth and poverty as quantified by the Gross National Production (GNP) of a country. Most candidates were able to define poverty in Part (a). Also, most candidates correctly identified the trend between Natural Increase in Population and Per Capita GNP from the data in Table 3, in Part (b) (i). However, Part (b) (ii) was more challenging to candidates where they were required to suggest a reason for the trend they had identified.

Note:

There were two acceptable approaches.

If a population increases at a rate greater than the rate of increase in the production of goods and services, more and more people will lack access to basic resources. More people will fall into poverty as a result. Therefore the greater the natural increase in population growth, the lower the GNP.

The lower the per capita GNP, the less the ability of the population to meet its basic needs, that is, the greater the percentage of the population living in poverty. Poverty causes premature death and health problems which are preventable. Infant mortality rates tend to be high and life expectancy low. Couples tend to have large families in the hope that some of their offsprings will survive. Countries with lower GNP will therefore have a higher rate of natural increase.

Module 3: Sustainable Use of Natural ResourcesQuestion 9

This question required candidates to differentiate between renewable and non-renewable resources. Most candidates satisfactorily defined the term natural resource and were also able to categorize and justify forests as a renewable natural resource. However, the categorization and justification of beaches were more difficult for the majority of candidates.

Note:

The existence of a beach is dependent on the relative rate of sediment deposition to its removal, called the sediment budget. As long as sediment deposition rate is equal to or exceeds removal rates, the beach will remain stable or expand in size. However, if sediment removal rates are higher, the beach will contract. In fact, there are beaches that undergo cyclic expansions and contractions within a twelve-month period. If sediments are removed from a beach, it can be replaced by the natural processes that transport sediments to that beach. For this reason, beaches can be classified as renewable resources.

Question 10

This question examined candidates' understanding of the environmental impacts of natural resource use. In Part (a), the majority of candidates explained overharvesting of coastal fisheries as the removal of large quantities of fish. However, they did not include in their

response the idea of exceeding sustainable yields, that is removing so many fish that too little breeding stock is left to maintain numbers.

In Part (b), the majority of candidates were unable to outline three environmental and or social impacts resulting from the overharvesting of coastal fisheries.

Question 11

This question assessed candidates understanding of the term biodiversity and the relationship between biodiversity and natural resources in the Caribbean. The majority of candidates were able to define biodiversity in Part (a). There were some candidates who did not include the three components of biodiversity, species, genetic, and ecosystem diversity, in their responses. Part (b) was challenging for the majority of candidates as they failed to make the link between conserving biodiversity and maintaining water resources in the Caribbean.

Note:

In addressing this part, candidates must first recall that forest ecosystems are an important part of the biodiversity of Caribbean countries. Forests impact on water resources through their ability

- (i) to assist in cloud formation and hence the amount of precipitation
- (ii) to facilitate underground recharge of aquifers and decrease soil erosion in watersheds and so maintain the quality of water in rivers.

Question 12

This question examined candidates' knowledge of the measures and tools available for natural resource management and conservation. Candidates were required to explain the role of 'ethical considerations' and 'aesthetical considerations' in natural resource conservation in the Caribbean. It was critical for candidates to justify his or her view. However, the responses suggest that most candidates do not fully understand what is meant by 'ethical and aesthetical considerations' with respect to natural resource conservation.

UNIT 1

PAPER 02

Candidates performed better in Module 2 but exhibited similar performances in both Module 3 and Module 1. Candidates' performance was exceptionally poor on Questions 2, 3, 6 and 7. The best performance was on Question 5 while the weakest performance was on Question 7.

Module 1: Fundamental Ecological Principles

Question 1

This question tested candidates' understanding of the role of density dependent and independent factors in controlling the rate of population growth in an ecosystem as well as their understanding of the concept of carrying capacity. This was the least popular question in the Module with only 22 per cent of candidates attempting it. In Part (a), the majority of candidates identified the population growth exhibited in Figure 1 as exponential. In Part (b), the majority of candidates did not provide a suitable explanation of 'density dependent factors' and were not able to properly explain the impact of two density dependent factors on the growth rate of the population during the time period OA.

In Part (c), approximately half the number of candidates sketched the expected graph showing the population size exceeding the carrying capacity, before collapsing and falling below the carrying capacity. However, the majority of candidates did not adequately explain the shape of their graph in terms of the impact of density dependent factors and the meaning of the term 'carrying capacity'.

Question 2

Parts (a) and (b) of this question examined the candidates' understanding of nutrient flows within ecosystems and the role these play in the self self-sustaining nature of an ecosystem. Part (c) focused on species diversity and its relationship to ecosystem stability. This question was attempted by 30 per cent of candidates, making it the second most popular within the module. Most candidates drew an adequate diagram but were weak in using their diagram to explain the self-sustaining nature of natural ecosystems. Candidates also displayed poor knowledge of the specific organisms involved in the nutrient recycling process in an ecosystem. Part (c) was poorly done by most candidates. In their response, candidates needed to show that as the diversity of an ecosystem increases, its ability to withstand stresses such as a disease increases. Few candidates responded appropriately to this part. Although the majority of candidates obtained less than 60 per cent of the marks for this question, few candidates scored more than 80 per cent of the available marks.

Note:

Ecosystem stability is the ability of an ecosystem to withstand significant changes over time and to repair any damage after any disturbance. Generally, complex ecosystems with high species diversity tend to be more stable because alternative links between different species exist. Several species may also be able to carry out the same function. A change in the density of one species is less likely to affect the density of others. For instance, if a disease severely changes the density of one species, then another can take over and perform the function. Therefore, the stability of an ecosystem increases with diversity.

Question 3

This question tested candidates understanding of predator-prey relationships and its role in the process of evolution. This was the most popular question in the Module with 48 per cent of candidates attempting it. The question was done poorly by the majority of candidates. In Part (a), most candidates did not provide an explanation that accounted for all the variations

in the predator and prey populations as shown in Figure 2. In Part (b), the responses of candidates indicated that they do not understand what is meant by the ‘productivity of an ecosystem’. As a result, the majority of responses were incorrect. The productivity of an ecosystem refers to the amount of organic matter produced and depends on the number of primary producers within the ecosystem. Candidates were expected to discuss how predator-prey interactions can impact on the primary producers in the ecosystem. In Part (c), candidates were required to apply the principles of natural selection to explain how predator-prey relationships can lead to the selection of certain traits. A good approach in answering this question included an example of a trait of either the prey or predator to explain how it may become dominant as a result of the relationship. Although this was the most popular question in the module, only few of candidates scored 50 per cent or more of the marks available.

Module 2: People and the Environment

Question 4

This question examined candidates understanding of temporal and spatial variation in human population growth and the role of family planning in controlling population growth. In Part (a), most candidates adequately described the trend in human population growth from the graph in Figure 3. However, in Part (b), many candidates could not provide two reasons to account for the rate of growth of human population from 1900 to 2000. Similarly, in Part (c), few candidates could provide two reasons to account for the difference in the rate of growth of the populations in developed and developing countries. In assessing the role of family planning in controlling the rate of population growth in their country, candidates were expected to look at factors such as access to programmes, awareness, extent of the use of and success in achieving government population targets. Although candidates gained marks in this part, their responses were too general and not specific enough to their own country. Candidates should be able to make specific references in assessing the role of family planning in their country. This question was the most popular in this module, and a large number of candidates obtained 50 per cent or more of the marks available.

Question 5

Parts (a) and (b) of this question tested candidates understanding of indicators used to quantify consumerism. In Part (c), the focus was on the impact of consumerism on the ability of Caribbean countries to achieve sustainability.

Parts (a) and (b) were fairly well done by the majority of candidates. In Part (c), many candidates experienced difficulty assessing the impact of consumerism on the ability of Caribbean countries to achieve sustainability. This part was poorly done by the majority of candidates. Candidates do not seem to grasp clearly the concept of sustainable development and were unable to establish the relationship with consumerism. Although this was the least popular question in this module, the best performance was recorded on it with most of candidates scoring 50 per cent or more of the available marks.

Question 6

This question examined candidates' understanding of the prerequisites for sustainable development. This was the second most popular question and was attempted by 37 per cent of candidates. In their discussion, the majority of candidates did not adequately establish the importance of population management, environmental management and conservation in achieving sustainable development. Candidates' responses were poorly organised and lacked depth. A small number of candidates gained 50 per cent or more of the marks available for this question. As was the case in the previous year, candidates continue to perform poorly on questions that require them to organise and use their knowledge.

Module 3: Sustainable Use of Natural Resources

Question 7

Candidates' ability to evaluate the factors affecting natural resource use was tested in this question. Candidates were required to assess how location, role of foreign investors and government policies affected the exploitation of natural resources in the Caribbean. A good approach would have been for candidates to make reference to a specific resource in their response. Many candidates did not take such an approach and as a result experienced difficulties responding to the question appropriately. Although this was the second most popular question in the Module, it was the most poorly done question in the Module as well as in the Paper.

Question 8

This question focused on the environmental impacts of natural resource use associated with the tourism industry. In Part (a), candidates were required to discuss two ways in which tourism impacted negatively on both beaches and forests. In Part (b), candidates were required to discuss the importance of eco-tourism to the Caribbean. This was the most popular question in the Module and was attempted by about 40 per cent of candidates. This question was fairly well done with approximately half the number of candidates gaining more than 50 per cent of the available marks. In Part (a), the majority of candidates adequately discussed the impact of tourism on forests, however, many found beaches more challenging. Candidates did not seem to have grasped the concept that a beach is a resource that experiences impacts from use.

Question 9

This question tested candidates' knowledge of measures to conserve natural resources. The measures focused on were environmental impact assessment, protected areas, and environmental legislation. This was the least popular question in the Module. Few candidates responded appropriately, with approximately 30 per cent of them scoring 50 per cent or more of the available marks. The majority of the responses suggested limited knowledge and understanding of the role these measures play in conserving natural resources.

GENERAL COMMENTS

UNIT 2

Generally, candidates performed well on this Unit. Candidates performed best on Paper 03 followed by Paper 01 and then Paper 02. The performance on Paper 03 indicated some improvement in the Internal Assessment. However there were too many candidates obtaining less than 50 per cent of the marks on this paper.

A greater percentage of candidates demonstrated an acceptable level of knowledge, comprehension as well as the ability to apply and organise this knowledge. This has translated into improved performance on both papers. There were a number of questions in Paper 01 and Paper 02 on which candidates performed poorly, since the depth required to answer these questions satisfactorily was lacking. Candidates performed about the same in Modules 1 and 2 but not as well in Module 3.

Generally, candidates' performances were encouraging and showed improvement over the pilot of Unit I.

DETAILED COMMENTS

UNIT II

PAPER 01

Module I: Sustainable Agriculture

Question 1

This question tested the candidates' knowledge of the factors that contributed to sugar cane being a major crop in the Caribbean as well as the definition of the term agriculture. The majority of candidates satisfactorily outlined three contributing factors. However, in defining agriculture, some candidates did not include the fact that it also provides products for animal consumption and industrial raw material.

Question 2

This question examined candidates' knowledge of the characteristics of subsistence and commercial farming and their environmental impacts. The majority of candidates satisfactorily listed three characteristics of subsistence and of commercial farming. In stating an environmental impact of subsistence farming, some candidates stated impacts which were characteristic environmental impacts of commercial farming. Examples included pesticide pollution and water pollution from fertiliser use. Candidates performed well on this question.

Question 3

This question tested candidates' understanding of the mechanism of salinisation and its impact on agricultural productivity. Few candidates provided a correct explanation of the process of salinisation and could describe more than two impacts on agricultural productivity. Candidates performed poorly on this question.

Question 4

This item tested the candidates' knowledge of the contribution of agriculture to the economies of Caribbean countries. The majority of candidates were able to describe four ways in which agriculture made a contribution to Caribbean economies. This question was fairly well done. Some candidates 'listed' instead of 'described' the contributions.

Module 2: Sustainable Energy Use

Question 5

This question examined candidates' understanding of kinetic and potential forms of energy in relation to a hydroelectric power plant. The majority of candidates were able to define kinetic and potential energy by making appropriate references to Figure 1 in the question. Also, most candidates were able to state an advantage and a disadvantage of hydroelectric power plants. This question was very well done.

Question 6

This question tested candidates' knowledge of energy sources in the region and of the factors limiting the ability of Caribbean countries to increase their electrical generating capacity. The question was fairly well done by the majority of candidates. Approximately half of the candidates gained 50 per cent or more of the available marks. Most candidates were able to state at least two correct limiting factors.

Question 7

This question tested candidates' knowledge of nuclear fission and the environmental concerns associated with the operation of a nuclear power plant. In Part (a), the majority of candidates were able to name the process that produced energy in the reactor. However, in Part (b), many candidates did not explain the fission process satisfactorily but instead explained the process of converting the heat produced by the fission process to electrical energy. In Part (c), the majority of candidates stated correctly at least two environmental concerns associated with a nuclear power plant. Candidates performed well on this question with most candidates scoring 50 per cent or more of the available marks.

Question 8

This question examined candidates' understanding of the difference between energy conservation and efficiency. Many candidates differentiated between both terms but could not give appropriate examples, especially of energy efficiency in Part (a). Part (b) was more

difficult for candidates. Candidates were required to state an environmental impact associated with the use of non-renewable sources of energy, and then outline one way in which energy efficiency or conservation could limit that impact. Although some candidates identified the impact, many did not satisfactorily outline the way that the impact could be limited by energy conservation or efficiency. Many candidates scored 50 per cent or more of the available marks on the question.

Module 3: Pollution of the Environment

Question 9

This question tested candidates' understanding of the difference between pollution and pollutant and the environmental pathways of chemical pollutants. The majority of candidates satisfactorily differentiated between pollution and pollutant in Part (a). In Part (b), many candidates were able to outline at least one pathway by which dry chemicals emitted in the air may cause pollution in the ocean. However, in some cases the outlines were incomplete. For example, if the dry chemical emissions become deposited on land, it must be washed from the land by rainwater, into rivers, where it is transported to the ocean. Alternately, it may become bounded to soil particles and transported by wind to rivers and thence to the sea or directly over oceans where it is deposited. Candidates performed very well on this question.

Question 10

This question examined candidates' knowledge of carbon monoxide and its impact on human health. The majority of candidates selected carbon monoxide from the pie chart as the gas which was a pollutant in the troposphere and identified the major source as vehicular emissions. In Part (c), some candidates suggested the poisonous nature of the gas as the characteristic feature that made it dangerous to human beings. The expected response was that it was a colourless and odourless gas and hence undetected by human beings. For Part (d), the more competent candidates adequately explained the bonding of carbon monoxide to haemoglobin and how this deprived the body of oxygen. Candidates performed well on this question.

Question 11

Part (a) of this question tested candidates' knowledge of how the characteristics of persistence and synergistic effect determine their environmental impact. Part (b) tested candidates' understanding of the movement of pesticide through the food chain. Many candidates explained the role of persistence but very few candidates correctly explained the synergistic effect of the pollutant. In Part (b), only a few candidates adequately explained the difference in pesticide concentration in the producer and the tertiary consumer. Some candidates, rather than explaining the mechanisms, only stated them; bioconcentration and biomagnification. Candidates performed satisfactorily on this question.

Question 12

This question examined candidates' understanding of the term carcinogenic and their knowledge of the processes of bioremediation and phytoremediation. The majority of candidates satisfactorily defined carcinogenic. In Part (b) (i), many of the candidates' responses were incomplete. Candidates seemed to be aware of the process of bioremediation but did not fully understand it. Few candidates satisfactorily explained the process of phytoremediation while some candidates did not attempt this part. About 40 per cent of candidates scored 50 per cent or more of the available marks.

PAPER 02

Candidates performed relatively well on this paper. In general, responses were more organised and indicated greater depth in some areas, in comparison to performance in the pilot examination of Unit I, Paper 02. However, candidates demonstrated weak performances on Questions 3, 7 and 9. Candidates performed best on Module 2, followed by Module 1 and then Module 3.

Module 1: Sustainable AgricultureQuestion 1

This question tested candidates' understanding of the environmental impacts of pesticide use and alternative methods of controlling pest in agriculture. The majority of candidates satisfactorily outlined two negative and two positive environmental impacts of pesticide use. Candidates also adequately described two alternative methods of controlling agricultural pest. However, few candidates responded adequately to Part (c), where they had to assess the effectiveness of any of the alternative methods if implemented in their country. Many candidates did not discuss the specific conditions or reasons that would impact on the effectiveness of the implemented method. Notwithstanding, candidates performed well, with the majority of candidates scoring 50 per cent or more of the available marks. This was the most popular question in this module.

Question 2

This question examined the causes and impacts of soil erosion and methods of soil conservation. About 59 per cent of the candidates scored 50 per cent or more of the available marks. This was the least popular question in the Module. In Parts (b), many candidates did not explain correctly how compaction promotes soil erosion.

Candidates were expected to state that compaction of the soil decreases infiltration of rain water, increases runoff thereby increasing soil erosion.

Many candidates could not provide more than two advantages of no tillage farming method and very few stated a disadvantage.

Candidates were expected to state that some disadvantages of the method are that it is time consuming, requires greater use of herbicides to control weeds and aeration of the soil is lacking.

Question 3

This question tested candidates understanding of the difference between organic and inorganic fertilisers, the use and negative impacts of inorganic fertilisers, and the sustainable nature of organic agriculture. The majority of candidates adequately distinguished between inorganic and organic fertiliser in Part (a). In Part (b), some candidates suggested that the ease of application was the reason that high inputs of inorganic fertilisers were required to maintain yields in commercial agriculture.

However, the need for high inputs of inorganic fertiliser arises because the intensive cultivation of a single crop depletes the soil of specific nutrients which have to be replaced.

Few candidates correctly discussed two or more negative impacts of inorganic fertilisers in Part (c). Many candidates also found it difficult to explain the sustainable nature of organic farming. This was the second most popular question in the module. Candidates performed satisfactorily on this question.

Module 2: Sustainable Energy Use

Question 4

Part (a) of this question examined candidate's knowledge of the nature and process of formation of fossil fuels. Part (b) examined their understanding of the environmental impacts associated with the extraction. Part (c) examined candidates understanding of the economic constraints associated with the use of fossil fuels to generate electricity in Caribbean countries. The majority of candidates obtained at least 50 per cent of the available marks. Parts (a), (b), and (c) were fairly well done by candidates. Although some candidates found Part (d) more challenging, they could adequately discuss at least one economic constraint. This was the most popular question in the Module.

Question 5

This question tested candidates' knowledge of renewable and non-renewable energy sources and of solar energy and hydropower as feasible alternatives to replace fossil fuels in the Caribbean. The majority of candidates satisfactorily distinguished between renewable and non-renewable energy sources and identified appropriate examples. In most cases, candidates were more aware of the physical conditions that favour solar energy than hydropower. Only the more competent candidates satisfactorily commented on the potentials and limitations of solar energy and hydropower as feasible alternatives to replace fossil fuels in the Caribbean. This was the second most popular question in the module and the majority of candidates obtained at least 50 per cent of the available marks.

Question 6

This question examined candidates' understanding of the enhanced greenhouse effect and possible environmental impact on Caribbean nations. Candidates adequately explained the relationship between the increase in greenhouse gases in the troposphere and energy use from Figure 1 in the question. In Part (b), many of the candidates' explanations of the impact of the change in the concentration of greenhouse gases on global temperatures were incomplete. Candidates were expected firstly, to explain how the greenhouse gases in the troposphere function to maintain earth's temperature, then to explain how the increasing concentration increases the heat energy trapped in the troposphere hence causing the rise in global temperatures. Candidates also had difficulty discussing two environmental impacts of concern to Caribbean nations due to global warming. Approximately 50 per cent of candidates scored 50 per cent or more of the marks available. This question was the least popular of the module.

Module 3: Pollution of the EnvironmentQuestion 7

This question tested candidates' knowledge of the ozone layer, ozone depletion, its impact and action taken to reverse the depletion of the layer. This question was the least popular of the Module and only 23 per cent of candidates who attempted this question obtained 50 per cent or more of the available marks. In Part (a), many candidates did not describe satisfactorily the location and function of the ozone layer. The majority of candidates correctly identified chlorofluorocarbons (CFCs) as the major group of chemicals involved in the depletion, but were unable to describe properly the process of depletion in Part (b). Few candidates adequately described two impacts of ozone depletion in Part (c). In Part (d), the majority of candidates stated one action, instead of two, taken to reverse the depletion of the layer.

Few candidates indicated that because gases that enter the stratosphere remain there for many years and that a single chlorine atom destroyed many ozone molecules, it will take years for the layer to recover.

Question 8

This question examined candidates' understanding of the reasons for the increase in the volume of solid waste and the advantages and disadvantages associated with disposal methods. This was the most popular question in the module. About half of the candidates scored 50 per cent or more of the available marks. In Part (a), many candidates did not give two correct reasons for the increase in the volume of solid waste. In Part (b), many candidates discussed at least two problems associated with open dumps and explained how landfills solved these problems. In Part (c), many candidates correctly suggested reusing and recycling as approaches to decrease the volume of solid waste in their country. However, in most cases, candidates' justification of their choice was weak.

Question 9

Part (a) of this question tested candidates' knowledge of the type (classification) of water pollution source. Part (b) focused on the sewage pollution and methods of monitoring it, while Part (c) tested candidates' knowledge of the impacts of sewage pollution on a river ecosystem. This was the second most popular question in the module, but was the most poorly done. Few of the candidates who attempted this question scored 50 per cent or more of the marks available. Although, candidates identified Site A as a 'point source' of pollution, the majority did not adequately define 'point source'.

An acceptable definition of a 'point source' is a single identifiable source that discharges pollution into the environment.

In Part (b), many candidates identified sewage as the type of pollution being monitored at Site A, but could not explain why faecal coliform was used to monitor it. A few candidates satisfactorily described the procedure used to determine the presence of faecal coliform. In Part (c), few candidates satisfactorily described the impacts of the processes of eutrophication and deoxygenation on the river ecosystem resulting from sewage pollution.

THE INTERNAL ASSESSMENT

The Internal Assessments submitted were of a fairly high standard. The assessment criteria appeared to be clearly understood and most projects reflected the stated assessment criteria. Generally, the topics chosen were appropriate and were given adequate treatment. The variety of tasks undertaken were encouraging and students demonstrated initiative and good judgement.

LABORATORY EXERCISES

While laboratory exercises are arranged in all modules, for assessment purposes, the exercises submitted should focus on the content of Module 1 in the case of Unit 1 and on Module 3 in the case of Unit 2. In some instances, the objectives of the exercises were not stated clearly or identified. This made it difficult for this component to be evaluated effectively.

There were two main areas of concern for measuring certain basic parameters. In some instances, better use could have been made of the criteria provided for marking CAPE Internal Assessment. These should always be seen as a guide to allow teachers and candidates to complete the required exercises satisfactorily.

In a few instances, the minimum required number of exercises were not submitted. However, the laboratory exercises presented this year clearly reflected a concentration of efforts on quality rather than quantity.

There was an effort by teachers and candidates to select exercises that provided an opportunity for the integration of subject areas. This is highly desirable in the study of environmental science.

In general, there was improvement in the way candidates reported their findings and the conclusions derived from the stated findings.

RESEARCH PAPER

There was evidence of great effort by candidates to obtain data based on fieldwork to supplement secondary data for the research paper. This reduced the reliance on secondary data and allowed for comparisons during analysis. It was evident that candidates enjoyed interacting with respondents when obtaining information. The questionnaire and interview forms for acquiring information were popular.

In almost all cases, the content of the modules was adequately reflected and the choice of the topic areas fairly well represented.

Deficiencies were detected in the writing of the bibliography. Candidates should refer to the CAPE syllabus for an acceptable format of presenting bibliography.

JOURNAL

Journal entries should be based on **ONE** site or location and not on different sites. This approach allows for observation of changes over time. Choosing different sites or locations reduces the adequacy and effectiveness of interpretative comments and follow-up activities.

Although some flexibility is allowed, as far as is possible, entries should provide information and allow interpretation over a given area even if different sites within the geographical location were visited. In this case, comparisons can be made and interpretative comments and follow-up activities can be adequately addressed.

This component should be planned early to allow sufficient time for the minimum required number of entries to be completed.

Interpretative comments and follow-up activities were not always included and in some instances these were not well presented. The format suggested in the syllabus should be followed as far as is possible. If any modification is made then **ALL** expected headings should be included and completed accordingly.

THE PROJECT

There was an improvement in this aspect in that care was taken to ensure that the project spanned all three Modules.

There is need for greater attention to be paid to the selection and wording of titles. In many instances, titles were too wide and vague. This resulted in candidates having difficulties with data collection to address the many issues.

When completing this component, teachers and candidates are encouraged to use the mark scheme given in the syllabus as a guide for assessing the project.

Teachers are also reminded that the final mark awarded should not be fractional.

While there was an improvement in the use of graphs, figures and tables, there is still limited use of statistical approaches in the analysis and presentation of results and data.

There was poor use of language and limited use of scientific terms and expression. The use of standard English should be encouraged as there was heavy use of colloquial expressions by some candidates.

Literature review was poor in some instances. This aspect needs to be addressed by teachers early in the course so that there can be some improvement by the time the projects are to be submitted.

While the analysis was done accurately in most cases, the variety of approaches was limited. Candidates should be encouraged to use a variety of approaches in the analysis of their data.

In a few instances, candidates had quite a lot of data which they were unable to analyse and discuss adequately. As a result, the conclusions drawn were either flawed or not based on the data presented. In some instances, conclusions were not in line with stated objectives on the project. Candidates should be encouraged to pay attention to the objectives when analysing their results and drawing conclusions from their research project.

PRESENTATION OF PORTFOLIO

Candidates should be encouraged to submit the various pieces as one combined document. This reduces the likelihood of pieces being misplaced. While most candidates made a great effort in the presentation of their portfolios, in a few cases, the presentation was very poor. Handwritten work **MUST** be legible. In fact, there were some very legible and well presented handwritten pieces. However, candidates are encouraged to present typed or word processed reports where possible.