CARIBBEAN EXAMINATIONS COUNCIL

REPORT ON CANDIDATES' WORK IN THE CARIBBEAN ADVANCED PROFICIENCY EXAMINATION MAY/JUNE 2006

ENVIRONMENTAL SCIENCE

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INTRODUCTION

Environmental Science is a two-Unit subject with each Unit consisting of three modules: Unit I - 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. The examination for each Unit consists of three papers. Papers 01 and 02 are externally examined by CXC, while Paper 03 is examined internally by the teacher and moderated by CXC.

Paper 01 is comprised of twelve compulsory short-response questions, with four questions based on the contents of each Module. This paper contributes 30 per cent of the total assessment.

Paper 02 is comprised of nine questions, three from each module of which candidates are required to answer two. These are structured essay type items each contributing twenty marks or a total of 120 marks to the paper. This paper contributes 40 per cent of the total assessment.

Paper 03, the school-based assessment, contributes 90 marks or 30 per cent of the total assessment. Unit 1 is examined by a single project report of 2000 – 2500 words. This project should incorporate the relevant practical skills and should focus on at least one objective from any Module in the Unit. Unit 2 is examined by a journal of 2000 – 2500 words which incorporates the practical skills relating to site visits and laboratory exercises. The journal should focus on at least one objective from any Module in the Unit.

GENERAL COMMENTS

UNIT 1

In Unit I, candidates performed best on Paper 03, followed by Paper 01 and then Paper 02. The fact that candidates performed best on Paper 03 is expected since this is the School Based Assessment (SBA), and given the proper guidance candidates should perform significantly better on this paper than the others which are tested under examination conditions.

There was a general decline in the performance of candidates in Unit 1 when compared with the performance in 2005. It is apparent that the basic concepts within the syllabus were not properly grasped by many candidates and this was very evident in their performance in Unit 1 especially in Paper 02.

Candidates performed poorly on many of the test items in Unit 1. Some candidates showed some knowledge but the depth required to answer these questions satisfactorily was lacking. This suggests that some areas of the syllabus probably were not covered to the required depth or candidates are having difficulties grasping basic concepts.

There was no significant variation in the performance of candidates on the Modules.

Generally candidates' performance in this Unit was disappointing. Improvement is still needed in the depth and breadth of coverage and in candidates' ability to explain interactions, interrelationships and infer relationships.

DETAILED COMMENTS

UNIT 1

PAPER 01

Candidates' performance was fair on Questions 1, 3, 9 and 11. Overall, candidates performed best in Module 1, followed by Module 3 and then Module 2. The best performance was in Question 9 and the weakest in Question 12.

Module 1: Fundamental Ecological Principles

Question 1

In Part (a) of this question, candidates were required to identify specific processes occurring in the water cycle. In Part (b) candidates were required to identify the source of energy that drives the water cycle. Part (c) required candidates to outline the processes identified in (a).

While most candidates were able to correctly identify the specific processes and the source of energy in the water cycle many found it difficult to outline how the energy source drives each of the processes.

Note:

- Solar radiation provides energy to move the winds which circulate water in the atmosphere.
- Clouds move about by the winds and deposit their moisture as rain, drizzle, snow, hail, sleet.
- This returns water to reservoirs (lakes, oceans).

Question 2

In Part (a) of this question, candidates were required to define specific ecological terms.

Part (b) tested candidates' understanding of how biotic potential and environmental resistance interact to maintain populations within ecosystem carrying capacity.

Most candidates were able to define the ecological terms but had difficulty in outlining how biotic potential and environmental resistance interact to maintain populations within ecosystem carrying capacity.

Note:

- Natural populations have the capacity for growth under favourable conditions.
- Density-dependent and density-independent factors interact to increase environmental resistance;
- These either lower the birth rate, or increase the death rate, or both, and prevent the population density/size from rising beyond the carrying capacity.

Question 3

In Part (a) of this question, candidates were required to use appropriate examples to explain interactions that occur in two types of feeding relationships, commensalism and mutualism. Most candidates were able to use appropriate examples to explain the feeding interactions.

Part (b) tested candidates' ability to distinguish between predation and parasitism and most candidates were able to answer this question correctly. Sixty-one percent of candidates who attempted this question scored greater than 50 per cent of the available marks for this question.

Question 4

This item tested the candidates' knowledge of the impact of humans on abiotic and biotic components of a natural ecosystem.

Although a few candidates could only identify the impact, the majority were able to identify and outline the impact of humans on natural ecosystems.

Note:
Regarding abiotic components:

- Humans may severely disrupt abiotic conditions by adding substances to the ecosystem (pollution).
- This action can change physical conditions or can alter the chemical balance of the ecosystem.
- Humans may affect the rate of cycling of materials in biogeochemical cycles through extraction of materials or input of materials.
- Humans may impact on the volume of materials to be cycled in biogeochemical cycles.

In relation to biotic components:

- Human activity can directly impact on biotic components by killing or removing organisms.
- Tampering with biotic factors can reduce species diversity and thus simplify ecosystems, making them more susceptible to different forms of ecological stress (the ecosystem becomes less stable).
- Humans can influence biotic components by introducing competitors and pathogenic organisms, which can have devastating effects in disrupting feeding relationships and ecosystem balance.
- Humans can influence biotic components by eliminating competitors and pathogenic organisms. These can disrupt feeding relationships and ecosystem balance.

Module 2: People and the Environment

Question 5

This question was designed to test the candidates' ability to

(i) select important information from a population profile diagram;
(ii) use the information to make a prediction about the rate of growth of the population;
(iii) organise the information in a logical order to account for the prediction of the rate of growth of the population.

This question was done satisfactorily by candidates. The responses suggest that candidates grasped the basic concepts and were able to use the information presented to make predictions about which countries would have the faster growing population.

Question 6

This question tested candidates' knowledge of the reasons for growth in urban populations in developing countries and examined candidates' understanding of the ways in which human populations impact on biogeochemical cycles.

Candidates performed satisfactorily on this question. More than 51 per cent of candidates scored greater than 50 per cent of the total marks. Candidates were able to state reasons for urban population growth and to outline ways in which urban populations impact biogeochemical cycles.

Question 7

In this question candidates were presented with a model and a suggested relationship between the level of poverty and population growth in a poor country. Candidates were required to adopt a position and justify this position.

Candidates' performance in this question was below expectation. Most candidates had difficulty in the applying the required knowledge and less than 50 per cent of candidates who attempted this question scored greater than 50 per cent of the available marks.

Question 8

In this question candidates were required to use demographic statistics to

(i) calculate the percentage increase of the population;
(ii) predict the year when the population size would double.

Overall candidates performed poorly on this question. The responses suggest that candidates did not fully understand how to calculate percentage increase of a population and the doubling time of a population. Consequently the majority of candidates were unable to determine the year when the population size would have doubled.

Note:

Total number of births, b = 24/1000 x 2,400,000
= 57,600

Total number of deaths, d, = 4/1000 x 2,400,000
= 9,600

Increase in population size = (births – deaths) + (immigrants – emigrants)

Increase = (57,600 – 9,600) + (100 – 1100)

= (48,000 – 1000)
= 47,000

Percentage increase in population, r, = 47,000/2,400,000 x 100

r = 1.96 per cent (approximately 2 per cent)

Doubling time = 70 / percentage increase

= 70/1.96 = 35.7 **OR**

= 70/2 = 35 years

The year in which the population will double will be 2000 + 36 = 2036
OR 2000 + 35 = 2035

Module 3: Sustainable Use of Natural Resources

Question 9

This question tested candidates' knowledge of the types of natural ecosystems found in the Caribbean and their benefits to society.

Candidates performed best on this question with over 73 per cent of candidates scoring over 50 per cent of the available marks. Candidates were able to identify natural ecosystems found in the Caribbean and to correctly and fully outline the benefits of these ecosystems to society.

Question 10

In Part (a) of this question, candidates were required to list three demographic characteristics of a population that influence its rate of exploitation of natural resources.

In Part (b), candidates were required to outline how each of the listed characteristics in (a) affected natural resource use.

Candidates performed poorly on this question. While some candidates were able to list demographic characteristics of a population they had difficulty explaining how these characteristics influence the rate of exploitation of natural resources and how each characteristic affected natural resource use.

Question 11

This item tested candidates' understanding of the concepts of 'species depletion' and 'species extinction'.

Candidates performed very well on this item and were able to distinguish between 'species depletion' and 'species extinction' while at the same time identifying the causes of species depletion or species extinction successfully.

Question 12

This item examined candidates' knowledge of the method of cultivation practised by indigenous people and why the method is considered to be sustainable.

The performance on this item was not as expected. Candidates were able to identify the method of cultivation but were unable to describe this. Most candidates were unable to explain why this method of cultivation practised by indigenous people is considered sustainable.

The method of cultivation is 'slash and burn' and is considered sustainable because

- the damage to the forest is negligible;
- restoration of the forest ecosystem is possible after the plot is abandoned and vegetation regrowth occurs;
- soil fertility is restored and the plot becomes useful again for cultivation;
- burning provides ash which fertilises the soil, thus eliminating the need for artificial fertiliser input.

UNIT 1

PAPER 02

Candidates' performance was best in Module 3 followed by Module 1 then Module 2. Candidates' performance was exceptionally poor on Questions 4 and 8. The best performance was on Question 9 where 43 per cent of the candidates who attempted the question scored 50 per cent or more of the available marks. The weakest performance was in Question 8, where only 11 per cent of the candidates obtained greater than 50 per cent of available marks.

Module 1: Fundamental Ecological Principles

Question 1

This question required candidates to

(a) explain the meaning of 'range of tolerance' and 'limiting factors';
(b) identify limiting factors for an aquatic ecosystem;
(c) outline how limiting factors impact on population of organisms in an aquatic ecosystem.

It was attempted by over half of the candidates with 42 per cent of them giving satisfactory responses and 11 per cent of them scoring full marks on this question.

Parts (a) and (b) of this question were generally well done. The weaker candidates were unable to differentiate between 'range of tolerance' and 'limiting factors' and gave incorrect answers.

Note:

Range of tolerance

- There are maximum and minimum limits for physical conditions beyond which no members of a particular species can survive.
- A species may have a wide range of tolerance to some factors and a narrow range of tolerance for others (optimum range).
- Outside the optimum range, are the zone of physiological stress where survival is possible but difficult and the zone of intolerance where an organism will perish.
- Most organisms are least tolerant during juvenile or reproductive stages of their lifecycles.
- Highly tolerant species can live in a variety of habitats with widely different conditions.

Limiting factors

- Too much or too little of any abiotic factor can limit or prevent growth of a population even if all other factors are at or near the optimum range of tolerance.

- Although organisms are affected by a variety of abiotic factors in their surroundings, one factor usually outweighs the others in determining population growth. This is the limiting factor.

- This factor is the primary determinant of growth in an ecosystem.

- Limiting factors are important because they can easily be upset by human activities.

Part (c) of this question posed great difficulty. This part of the question required candidates to apply their knowledge in outlining how limiting factors impacted on the population of organisms in an aquatic ecosystem. Candidates who scored satisfactorily on this question were able to

(i) write clear and concise statements;
(ii) link related bits of information;
(iii) organise information in a logical order.

Question 2

Parts (a), (b) and (c) of this question tested candidates' understanding of feeding relationships and energy transfers demonstrated by pyramids of energy and pyramids of numbers. Part (d) required candidates to account for the difference in the shape of the pyramid of energy and pyramid of numbers for a given situation.

Candidates exhibited satisfactory performance in Parts (a) and (c) of this question which required them to list or state reasons but not to provide an explanation.

Parts (b) and (d) proved challenging to the majority of candidates and these parts of the question were not well done. Candidates experienced difficulties in accounting for the shape of the pyramid of numbers and relating it to the pyramid of energy given.

Forty-three per cent of candidates gave satisfactory responses to this question.

Question 3

In this question candidates were presented with a statement relating to the role of natural ecosystems in human existence. Candidates were required to adopt a position and justify the position adopted.

While candidates were able to identify five reasons why natural ecosystems are vital to the existence of human beings, the majority were unable to justify their statements. Most of the points made were irrelevant and did not support the reasons given. Only 38 per cent of candidates gave satisfactory responses.

Candidates who scored satisfactorily on this question were able to write clear and concise statements and organise information in a concise and logical order.

Module 2: People and the Environment

Question 4

Part (a) of this question required candidates to describe, in terms of birth and death rates, how the rate of a given population that was depicted graphically changed between a given time period.

Part (b) tested candidates' understanding of how social parameters accounted for changes in growth rates.

Part (c) required candidates to outline an environmental impact due to rapid changes in population growth rate of a Caribbean country.

Only 23 per cent of candidates achieved a satisfactory mark on this question. Most candidates did not understand the relationship between birth rates, death rates and population growth and so did not perform well in Parts (a) or (b). Candidates performed much better on Part (c) of this question, however, their responses were far too general.

Question 5

Part (a) of this question tested candidates understanding of the terms 'total fertility rate' and 'life expectancy'. Part (b) tested candidates' ability to use selected demographic statistics to outline relationship between total fertility rate and the life expectancy for the Ethiopian population. Part (c) required candidates to suggest TWO reasons for the low percentage of Ethiopian women using contraceptives. Part (d) was designed to allow candidates to suggest an approach for decreasing the fertility rate of Ethiopian women.

Most candidates did not define 'total fertility rate' as the average number of children a woman would have throughout her child-bearing years (usually considered to be between 15 - 49 years). Few candidates were able to define 'life expectancy' as the average number of years a newborn is expected to live.

Most candidates failed to grasp the relationship between total fertility rate and life expectancy and as a result the responses offered by candidates did not address clearly the relationship between the two demographic factors.

Question 6

This question was designed to test candidates' understanding of population growth and its relationship with sustainable development. Part (a) examined candidates understanding of the relationship between population growth of a country and its ability to achieve sustainable development.

Part (b) tested candidates' understanding of how selected social indicators relating to women will impact on the sustainable development of a country.

Overall, 36 per cent of candidates achieved a satisfactory score on this question.

While many candidates exhibited an understanding of how social indicators impact on sustainable development they encountered difficulty discussing this from a female perspective.

Note:

Level of Education

The level of education impacts on the fertility rate of women since women with more education

- tend to have fewer children;
- usually marry later, so that their number of child bearing years is reduced, and the time between generations is increased;
- have an increased probability of knowing how to control their fertility, improving the health of their family, thus decreasing infant and child mortality;
- have access to other options besides having babies.

Economic Status

- In many societies, women have low social and economic status.
- They are limited to low-paying, low-skilled jobs.
- Marriage is usually the only way for a woman to achieve social influence and economic security.
- Marrying at a young age tends to increase child-bearing age and fertility rates.
- Improving the social and economic status of women provides them with economic opportunities, improving their self-confidence and reducing their fertility rates.

Access to Family Planning Services

- Many women now have access to family planning services.
- Family planning services provide information on reproductive physiology, contraceptive use as well as the actual devices.
- People may be encouraged by socioeconomic factors to want smaller families, but this will not become a reality without the availability of these services.
- It allows control of the number of children produced or/and spacing of children’s birth.

- These services are linked to lower fertility rates.

- Represents an effective method of controlling the rate of growth of population.

Module 3: Sustainable use of Natural Resources

Question 7

Candidates' knowledge and understanding of environmental impacts associated with the exploitation of minerals was tested in this question.

Most candidates were unable to describe adequately the given environmental impacts associated with exploitation of minerals in the Caribbean. Most candidates treated this question in a general manner and failed to link the impacts to mineral exploitation.

This question was attempted by over 50 per cent of the candidates and 43 per cent of candidates gave satisfactory answers.

Question 8

Part (a) of this item focused on the reasons for natural resource conservation. Part (b) required candidates to discuss the role of specific natural resource conservation measures.

Many candidates performed well on Part (a) which required candidates to suggest reasons for natural resource conservation.

Part (b) proved to be challenging. Candidates were unable to distinguish between 'rehabilitation' and 'restoration' conservation measures and so were unable to effectively discuss their roles in natural resource conservation.

Overall only 24 per cent of candidates gave satisfactory responses to this question.

Note:

Rehabilitation – practice allows recovery of habitats and population of organisms.

– contributes to restoration of depleted or degraded ecosystems.

– promotes conservation of life support systems.

– promotes/contributes to conservation of rare, threatened or endangered species.

Restoration – allows for habitats to recover.

– allows species to reinvade former habitats.

– creates situations for natural ecosystem to repair itself.

– promotes basic life supporting systems and repairs degraded natural systems.

Preservation – allows for non-consumptive use of natural resources.

– promotes natural ecosystem function without human intervention.

– ensures that natural areas are left intact since as populations increase so does the demand for land and natural resources.

– by not permitting human use or intervention, natural areas are left intact.

In-situ and ex-situ conservation – allows for the implementation of measures in the management of organisms or landscape to enable protection, enhancement or restoration.

– allows for the implementation of captive breeding and reintroduction programmes to repopulate areas with certain species.

– provides genetic resource pools that are useful in maintaining natural populations.

Question 9

This question required candidates to describe environmental impacts associated with the exploitation of forest resources in the Caribbean. Candidates were required in Part (b) to suggest recommendations for addressing the environmental impacts that they discussed in Part (a).

Part (a) of this question was well done. Part (b) was generally well done by the candidates who performed well in Part (a). However, some candidates failed to suggest ONE recommendation for EACH impact identified.

Candidates' performance was the best on this question with 62 per cent achieving a satisfactory score and 43 per cent of the candidates who attempted this question earned over 50 per cent of the total mark.

UNIT 1

PAPER 03B

Generally the majority of candidates' performance was satisfactory and was an improvement over last year's performance. Improvement in the depth and breadth of coverage with respect to certain areas of the syllabus is still needed. Greater effort is necessary to improve candidates' ability to organise and apply knowledge.

Question 1

This question, required candidates to calculate changes in population size over a number of years given a number of population parameters. The majority of candidates used the information appropriately.

Question 2

In Part (a) of this question the information given was used to draw and interpret the bar chart satisfactorily. Candidates, however, struggled to provide an explanation for the trend in the variation of the population.

Question 3

This question tested candidates' knowledge of population sampling techniques for moving and stationary organisms. The responses of most candidates were satisfactory.

DETAILED COMMENTS

UNIT 2

In general, candidates performed best in Module 2 followed by Module 1 and then Module 3.

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. This suggests that some areas of the syllabus were not covered to the depth Paper 01 required.

PAPER 01

In Paper 01, candidates' performance was in the order Module 1, followed by Module 3 and then Module 2. Only a small percentage of candidates exhibited the requisite level of knowledge, comprehension and application.

Module 1: Sustainable Agriculture

Question 1

In Part (a) the majority of candidates correctly identified three characteristics of subsistence agriculture systems. Similarly, in Part (b), the majority of candidates satisfactorily outlined two applications of technology that are used to improve agricultural productivity.

In Part (c), however, some candidates had difficulty stating a disadvantage of one of the technological applications that they had outlined in Part (b).

Candidates should be aware of the advantages and disadvantages associated with the application of all technology to agriculture especially in a Caribbean context.

Question 2

This question assessed candidates understanding of the importance of agriculture to the economies of the Caribbean. This question was well done by the majority of candidates.

Question 3

In this question candidates were required to outline TWO positive impacts and ONE negative impact of genetic engineering on the environment. While it was obvious that many candidates had some knowledge of the application of genetic engineering in agriculture, many struggled to describe its impact on the environment. In general, candidates were more able to describe the positive impacts on the environment than the negative impacts.

Some examples of the negative impacts are:

> *The introduction of genetically altered organisms with enhanced survival characteristics into the ecosystem may result in the displacement of endemic species and the disruption of natural population balances.*
>
> *Genetically engineered organisms might mutate, producing changed organisms with unforeseen and unpredictable consequences.*

Question 4

This question examined candidates' understanding of the features of sustainable agriculture. The responses of many candidates suggest that they had limited or no knowledge of this concept. A few candidates correctly described three features of sustainable agriculture as required. Some features of sustainable agriculture are given below.

- Ecological soundness: This requires maintenance of the quality of natural resources and enhancing the vitality of the entire agro-system. Soil is managed and the health of crops, animals and people is maintained through biological processes.

- Economic viability: Risks are minimised, thus, reducing financial inputs and expenditure. Farmers produce enough for income and self –sufficiency. Yields of produce must justify inputs.

- Adaptable: Communities should be capable of adjusting to the constantly changing conditions for farming, changing market demands and population growth and policies through the development and use of new and appropriate technologies including social and cultural changes.

- Humane: There must be recognition of the fundamental dignity of all human beings, preserving the cultural and spiritual integrity of society and a respect for all forms for life.

- Socially just: Resources should be distributed equitably to meet the basic needs of society. Adequate capital, technical expertise and market opportunities must be available to all.

Module 2: Sustainable Energy Use

Question 5

In Part (a)(i), many candidates satisfactorily explained energy but only a few correctly distinguished between energy and power. In Part (a)(ii), the majority of candidates adequately distinguished between renewable source of energy and non-renewable source of energy.

In Part (b), candidates were required to provide reasons for the low efficiencies of energy conversion processes. Only a few responded satisfactorily to this section. Many candidates seem not to understand the concept of efficiency in relationship to energy conversion processes.

The efficiency of an energy conversion process is the ratio of the energy output to the energy input. In all conversion processes some amount of energy is converted into forms of energy other than that which is required such as heat. This amount of energy is usually not utilised and become lost to the system. This is usually a substantial proportion of the energy and the amount of useful energy output is small in comparison to the amount of energy input, hence the low efficiency of the process.

Question 6

In Part (a), candidates were provided with a schematic diagram of a fossil fuel generating plant and were required to outline the process occurring at three labelled steps. Only a few candidates described the processes occurring at each of the stages (i), (ii) and (iii).

At (i), combustion of fossil fuels provide heat energy to the boiler; at (ii), the boiler generates high pressure steam from water which is channelled to the turbines, (iii) the steam is used to rotate the coil in a magnet to produce electrical energy.

In Part (b), candidates were required to describe one way in which an electrical generating company may handle electricity demand when it exceeds the company's generating capacity. Some candidates' responses suggest they had no knowledge of this area of the syllabus. However, there were excellent responses from other candidates.

Some demand management measures available to power companies include load shedding and public awareness programmes to shift some domestic demand to off peak hours.

Question 7

This question examined candidates' understanding of the ecological and social cost associated with the use of fossil fuels to generate electricity. The majority of candidates satisfactorily outlined two ecological costs but struggled to provide a social cost. An example of a social cost is outlined below.

Particulate matter is emitted as a by-product of fossil fuel combustion. Particulates cause and aggravate respiratory illnesses and may lead to chronic bronchitis. Society has to bear the cost of treating the disease and the loss in productivity that may result.

Question 8

In Part (a), many candidates demonstrated some knowledge of the relationship between energy use and global warming but many provided an incomplete outline.

In Part (b), some candidates experienced difficulty identifying one environmental impact of global warming of particular concern to all Caribbean countries. Some candidates identified the formation of hurricanes as a concern. However, the Caribbean is a region that has always been affected by hurricanes. The concern in this regard should be the increased frequency of hurricanes and the formation of more powerful ones. Some other concerns are;

- sea level rise damaging coastlines;
- change in seasonal weather patterns.

Generally, candidates who correctly identified the environmental impact satisfactorily described a way of mitigating the effects of the environmental impact they identified.

Module 3: Pollution of the Environment

Question 9

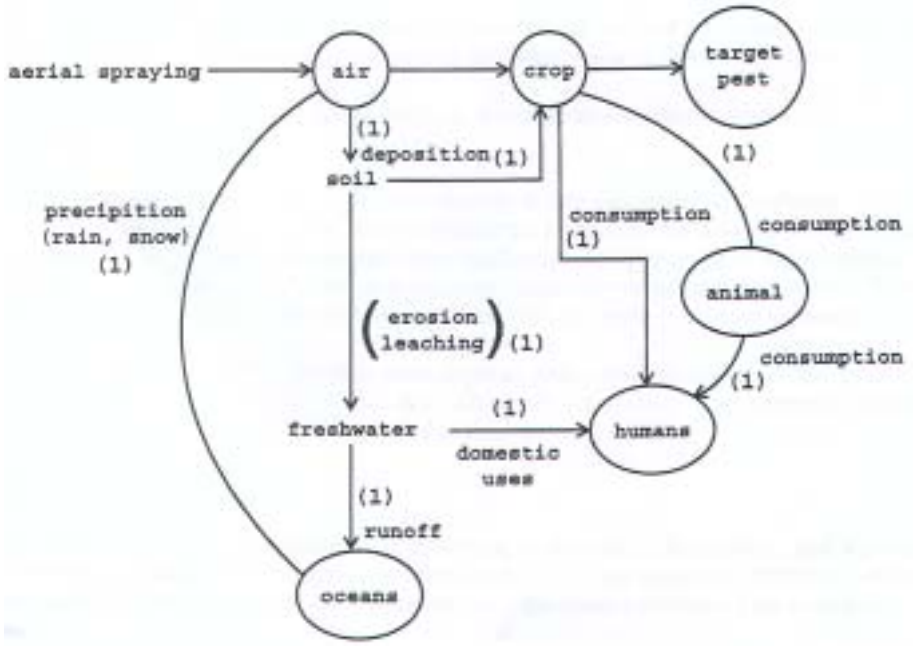
This question examined candidates' comprehension of how the persistence and mobility of a chemical influence its environmental impact. Many candidates demonstrated knowledge of both terms but not many provided a complete response.

> *Persistence refers to the ability of a pollutant to resist decomposition. Stable pollutants take a long time to breakdown which allows the concentration in the environment to increase to toxic levels through accumulation. The impact of a more stable pollutant will be long term and more significant in comparison to a less stable pollutant.*
>
> *The ability of a pollutant to move through the environment is called its mobility. By floating on air currents, dissolving in water, or adhering to soil particle, pollutants can move long distances from where they are released. A greater mobility allows a more widespread environmental impact of a pollutant.*

Question 10

In this question, candidates were provided with a diagram showing an incomplete "intended pathway of a pesticide when aerially sprayed". Candidates were required to complete two possible pathways by which the sprayed pesticide may enter the oceans and humans. Although some responses were excellent, other responses were incomplete or incorrect. An example of an **incorrect** incomplete pathway is given below:

> *Pesticide from the crops is transported to the oceans by surface runoff and leaching.*
>
> ***This pathway is incomplete because the link between the pesticide on the crop and in runoff is absent.***
>
> A complete statement would be:
>
> *Pesticide deposited on plants may be washed off by rain and transported by surface runoff to water bodies such as rivers or to gullies where it flows to the ocean.* (See diagram below.)



Possible pathway of pesticide

Question 11

In Part (a), many candidates could not satisfactorily define a secondary air pollutant. In Part (b), some candidates experienced difficulties outlining the formation of a secondary air pollutant. It was, however, encouraging to see that some candidates correctly outlined the formation of the secondary air pollutant using a chemical equation rather than describing the process. This is an indication that some candidates are being provided with the depth of content required.

In Part (c), candidates were required to describe the environmental impact of the secondary pollutant identified in Part (b). Generally, candidates who correctly identified a secondary pollutant satisfactorily responded to this section.

Question 12

This question examined candidates' understanding of the role of legislation and incentives in controlling pollution. This should have been a relatively easy question. However, while there were some excellent responses, there were too many candidates with very poor responses.

UNIT 2

PAPER 02

In Paper 02, candidates performed best on Module 1, followed by Module 3 and then Module 2. Too many candidates continue to struggle especially in questions requiring them to assess, discuss, evaluate or justify. It is recommended that greater emphasis be placed on these types of questions.

Module 1: Sustainable Agriculture

Question 1

This question assessed candidates' understanding of types of soil degradation associated with "excessive irrigation, their occurrence and sustainable agriculture practices to address them."

In Part (a), only a few candidates correctly listed two types of soil degradation associated with irrigation. Some candidates were unable to recall the correct terms to describe the type of soil degradation and resorted to the use of statements.

In Part (b), the majority of the candidates were unable to outline satisfactorily the steps leading to the occurrence of the soil degradation indicated in Part (a).

In general, candidates who adequately explained the occurrence of both types of soil degradation were able to recommend a sustainable agriculture practice to address each of the form of degradation they identified. Twelve per cent of candidates achieved 50 per cent of the total marks.

Question 2

Parts (a) and (b), examined candidates' understanding of mechanisation and the factors that limit the mechanisation of agriculture in the Caribbean. Many candidates submitted an incomplete response indicating that mechanisation was the utilisation of machines in agriculture. A complete definition of mechanisation is as follows:

> *Mechanisation is the application of engineering principles and technology in agricultural production, storage and processing on the farm.*

Part (b) required candidates to apply their knowledge of mechanisation. The majority of candidates were able to describe at least three factors limiting mechanisation of agriculture in the Caribbean. Some additional factors are provided below.

- *Limited incentives for the development of indigenous design and manufacture of farm equipment.*
- *Relatively poor extension services, poor credit facilities or access to credit facilities especially when farmers cannot meet initial payments or collateral.*
- *Appropriateness of technology; need may exist to modify technology to suit particular conditions existing in Caribbean countries.*

Part (c) of this question required candidates to justify the statement below;

"Agro systems are different from natural unmanaged ecosystems."

Only a few candidates satisfactorily responded to this section. The overall poor performance of candidates on this question was due mainly to the poor performances, on this section. As in previous examinations, candidates continue to experience difficulties when responding to questions testing higher-order cognitive skills.

Twenty-nine per cent of candidates achieved 50 per cent of the total marks.

Question 3

This question examined candidates' knowledge of aquaculture management and the environmental issues associated with this practice in the Caribbean.

The majority of candidates adequately distinguished between aquaculture and mariculture in Part (a).

In Part (b), many candidates struggled to describe three management techniques used for increasing yields in aquaculture. This may in part be due to the use of the expression 'management techniques' instead of 'ways of increasing yields' in aquaculture. Only a few candidates responded satisfactorily to this section. The management techniques for increasing yields in aquaculture falls under the categories of stocking rate, disease control, supplemental feeding, pond environment control, weed control and fish pond fertilisation.

In Part (c), candidates were required to discuss three environmental issues resulting from the practice of aquaculture in the Caribbean. As was the case in Part (b) of this question, only a few candidates responded satisfactorily to this section. Some environmental issues relating to the practice of aquaculture includes the use of chemicals, water demand, management of waste water and competition for land space.

Sixteen per cent of candidates achieved 50 per cent of the total marks.

Module 2: Sustainable Energy Use

Question 4

In Part (a), candidates were provided with a graph showing the projected annual demand for electricity and another showing the projected annual world production of oil for the period 1900 to 2050. Candidates were required to make inferences from both graphs and suggest the impact on Caribbean countries if the projections were realised.

Many candidates satisfactorily demonstrated their ability to interpret information presented in a graphical manner. However, some candidates included in their response a description of the general trend shown by both graphs without extracting critical and specific information presented by the graph.

In Part (b), the majority of candidates suggested appropriate alternatives and adequately discussed their advantages and disadvantages. The performance on this question was the best on this paper. 86 per cent of candidates achieved 50 per cent of the total marks.

Question 5

This was the least popular question in the Module. In Part (a), candidates were required to explain the functions of the control rods and primary water circuits in a nuclear reactor. The majority of candidates responded satisfactorily to this section.

In Part (b), candidates were required to evaluate the following statement:

"Caribbean countries should satisfy their growing demand for electricity through the use of nuclear energy rather than building new conventional fossil fuel power plants."

In evaluating this statement, candidates were expected to discuss the environmental issues associated with the operation of a nuclear and a fossil fuel power plant. Candidates were expected to address issues such as waste production and disposal, land availability and geology, economic cost and availability of expertise. An example of evaluation based on economic cost is provided below.

> *Constructing nuclear plants is quite costly. Utility companies would need to recover their cost through higher electricity bills to customers. Such plants are quite large and take years to build. Fossil fuel power plants are much smaller, less expensive and easier to build. In the Caribbean the infrastructure already exists for such plants and it is cheaper to expand fossil fuel plants. Nuclear power plants have a limited life span between 20 to 30 years after which it has to be decommissioned. Decommissioning is expensive because the disposal of all radioactive material produced including the reactor must be executed safely. Fossil fuel plants function for many years and there are no disposal problems associated with decommissioning.*

Forty-two per cent of candidates achieved 50 per cent of the total marks.

Question 6

In Part (a), the majority of candidates satisfactorily explained energy conservation and provided a suitable example. However, many candidates did not adequately distinguish energy conservation from energy efficiency.

An acceptable response follows.

> *Energy conservation is the moderation or elimination of wasteful energy consuming tasks or activities. Energy efficiency refers to the use of technology to accomplish activities or tasks with less energy.*

In Part (b), candidates were required to evaluate the following statement:

> *"The implementation of measures to conserve and use energy more efficiently is the best and cheapest means of making more energy available."*

Only a few candidates adequately responded to this section. A satisfactory response is provided below.

> *Conservation measures, by saving energy, reduce the demand for fossil fuels.Efficiency measures reduce the amount of energy used for a particular task, decreasing energy demand and fossil fuel use. Reduction in demand will extend the life of fossil fuel reserves. This extends the time to explore and develop new energy alternatives. This buys time to explore and develop new energy alternatives.Conservation and efficiency cost less than the development of new sources or supplies of energy. Economic benefits accrue from the adoption of these measures. These technologies generate business opportunities including development, manufacturing and marketing of these technologies. Energy efficient technologies decrease the emissions associated with the use of fossil fuels and their environmental impact.*

In Part (c), many candidates suggested two ways in which the transportation sector in their respective countries could conserve energy. However, candidates must be reminded that a discussion requires assessing both the advantages and disadvantages of suggestions. Forty-one per cent of candidates achieved 50 per cent of the total marks.

Module 3: Pollution of the Environment

Question 7

In Part (a), candidates were provided with a graph showing the percentage coral cover between 1970 and 2000 for a Caribbean Island Z and were required to outline the trend. Many candidates satisfactorily answered this section. However, candidates must be reminded that they are expected to specify the changes shown by the graph in their responses.

The percentage coral cover remained relatively constant at about 78 per cent from 1970 to 1980. Between 1980 and 1985, the coral cover had been reduced to about 35 per cent. There was a five per cent recovery in coverage up to 1990, followed by a decline to a low of about five per cent in 2001.

In Part (b), only a few candidates identified the correct pollutant based on the high turbidity and faecal coliform levels in the coastal waters of Island Z. Many candidates identified the water pollutant as turbidity and faecal coliform rather than sediments and sewage. In Part (c), it was obvious that some candidates did not understand what was meant by the 'nature' of the pollutant.

The expected response is that sediments are soils eroded from agricultural lands, forest lands or from degraded river banks.

Generally, candidates who correctly identified the water pollutants in Part (b) satisfactorily explained the relationship between the loss of coral cover and the pollutant.

In Part (d), only a few candidates satisfactorily described the secondary treatment of water to remove faecal coliform before discharge into the environment. Twenty-two per cent of candidates achieved 50 per cent of the total marks.

Question 8

In Part (a) while many candidates adequately explained the function of incinerators, only a few candidates had specific knowledge of a 'refuse derived fuel incinerator'.

In Part (b), candidates were required to discuss the use of incinerators as a MAJOR method of solid waste disposal in the Caribbean. Many candidates examined the advantages and disadvantages of using incinerators as directed. However, only a few candidates offered a conclusion based on their discussion. Thirty-one per cent of candidates achieved 50 per cent of the total marks.

Question 9

In Part (a)(i), all candidates correctly recommended that the game birds caught at Top Hill Estate should not be eaten. However, only a few candidates satisfactorily justified their position by explaining how the processes of biological accumulation and biological magnification could result in the concentration of the pesticide found in the soil exceeding safe levels for the game birds.

In Part (b), many candidates correctly identified bioremediation or phytoremediation as technological processes that can be used to remove hazardous contamination from soil. However, many candidates demonstrated an incomplete knowledge of the process.

In Part (b), candidates were asked about the Basel Convention and the reason for its development. It was clear that some candidates had no knowledge of this convention although they chose to do this question. Ten per cent of candidates achieved 50 per cent of the total marks.

UNIT 2

PAPER 03B

Generally candidates' performance was satisfactory. There is still the need for overall improvement in the depth and breadth of coverage with respect to certain areas of the syllabus. Greater effort is required to improve candidates' ability to organise and apply knowledge.

Question 1

This question was designed to test candidates' understanding of

(i) the role of coastal vegetation and ecosystems in the maintenance of beaches

(ii) the potential impacts of anthropogenic activities of sewage disposal and removal of coastal vegetation and sea-grass beds on coral reefs, beaches and coastal waters.

Candidates performed poorly in this question. Many candidates did not address the role of coastal vegetation and ecosystems in the maintenance of beaches.

Question 2

This question was designed to test candidates' ability to

(i) identify appropriate water quality parameters for monitoring in a particular situation
(ii) explain the significance of water quality parameters
(iii) design a monitoring plan to track potential impacts as a result of a specific activity.

Overall, candidates performed well on Parts (i) and (ii) of this question. Most candidates were able to identify appropriate water quality parameters for monitoring and to explain the significance of selected water quality parameters.

Most candidates found it difficult to design a monitoring plan to track potential impacts as a result of the developers' activity. Candidates did not outline adequately the steps expected in a water quality programme. Also candidates did not explain adequately the significance of the parameters they chose. Most candidates appeared to lack the depth of knowledge required to perform well on this question.

Question 3

In Part (a) of this question, candidates were required to make appropriate recommendations to correct the problems experienced as a result of the developers' activity. Candidates were required, in Part (c), to outline five ways in which an Environmental Impact Assessment (EIAs) could have helped in mitigating the impacts.

Candidates' performance on this question was satisfactory. Most candidates demonstrated an understanding of the role of EIAs in impact mitigation.

THE INTERNAL ASSESSMENT

It is important to emphasise the paragraph below.

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

(i) the collection and collation of data;

(ii) the analysis, interpretation and presentation of such data;

(iii) the selection of techniques, designs, methodologies and instruments appropriate to different environmental situations;

(iv) the development of appropriate models as possible solutions to specific environmental problems.

In general, the required criteria were applied effectively. There were a few instances where the marking was too generous.

A few of the Internal Assessment pieces submitted did not conform to the requirements of the respective Unit. The assignments must conform to the criteria outlined in the Syllabus in order to allow candidates to access the full range of available marks.

Few students were penalised for exceeding the word limit. Care should be taken when calculating the final scores after deducting the penalty as there were a few instances of incorrect totals after the deduction of the penalty mark.

There was still a heavy reliance on secondary data and too little evidence of primary data collection. Candidates are again encouraged to design projects that will encourage the collection and collation of primary data. This enables better and more effective data presentation and analysis, one of the weaker areas of assessment.

The recommended formats for different assessment pieces should be used since this allows for easy completion of task by candidates and for standardised evaluation. Whenever the recommended format is not used then the teacher is required to provide the mark scheme used so as to ensure that the candidates' work is adequately assessed. Teachers should ensure that the correct moderation forms are used and observe the instructions for distributing scores to the three modules.

Reminder: The CXC criteria at the bottom of the Moderation Sheet **must** be applied when recording and distributing marks to the three Modules. A remainder of one mark must be allocated it to Module 3. A remainder of two marks, one mark allocated to Module 2 and one to Module 3. Attention is drawn to the fact that **Fractional marks should not be awarded**.

In both Units, a major area of concern is still Communication of Information. Some candidates were able to communicate the information in a fairly logical manner with few grammatical errors. However, there were still too many candidates who presented information with several grammatical errors. This reduced the overall quality of the final report.

DETAILED COMMENTS

UNIT 1

Improvement was noted in the quality of the assignments submitted. However, literature review is still a major problem in many of the pieces submitted. Too often the literature review was either irrelevant or inadequate.

As in previous years some areas in which the projects in Unit 1 may be improved are indicated in the reminders below:

- Each activity of the Internal Assessment should relate to at least ONE specific objective.
- Research topics should be more concise and focused. (Many of the titles while understood were not concise).
- Data collected should be described clearly.
- Diagrams and illustrations should be appropriate and well integrated in the text to increase their effectiveness.
- Appropriate analysis should be undertaken at all times and these should be as comprehensive as possible.
- Discussion of findings, conclusion and recommendations should be based **only** on what was presented in the literature review and the data that are collected, presented and analysed. **No new material should be introduced in the discussions**.

- Greater attention should be paid to literature review. This is still one of the weak areas in Internal Assessment pieces submitted for moderation.

- Conclusions must be clear, based on findings, valid and related to the purpose of the project. In addition, recommendations must be based on findings and must be fully derived from findings.

- Bibliographic references should be written using a consistent convention. In addition, should be there at least four up-to-date references.

UNIT 2

For Unit 2 please note that there has been a change in the requirements and this is available in an **AMMENDMENT TO THE SYLLABUS IN ENVIRONMENTAL SCIENCE Effective for Examinations from May/June 2006)**.

The overall quality of the submissions for this Unit was good. Many of the students included an introduction to the journal which 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.

Again, candidates showed weakness in analysing and interpreting 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 laboratory exercises these were missing in most cases.

LABORATORY EXERCISES

Significant improvement was noted in the overall quality and relevance of laboratory exercises as required in the syllabus. In general, most candidates submitted an adequate number of laboratory exercises with satisfactory coverage of the criteria to be assessed. Only in very 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

Some improvement was noted in the overall quality of journal entries. This year, more candidates were able to link journal entries and laboratory exercises. The area of greatest improvement was reflected in the candidates providing the required number of journal entries.

The main area of weakness identified was that of interpretative comments. This may be improved if students develop the “habit of keen observation, relevant and precise reporting, concise recording and the ability for critical thinking, problem solving and decision making”. Other areas of weakness were linked to the fact that site visits were not always appropriate and in some instances objectives were not always tied to specific objectives in the syllabus.

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 submissions, candidates visited different sites and so could not make any comparisons since they examined different processes and occurrences. This was ineffective as there was no basis for comparisons.