# ENVIRONMENTAL SYSTEMS AND SOCIETIES

## Overall grade boundaries

### Standard level

| **Grade**: | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| **Mark range**: | 0 - 15 | 16 - 30 | 31 - 42 | 43 - 53 | 54 - 66 | 67 - 78 | 79 - 100 |

## Standard level internal assessment

### Component grade boundaries

| **Grade**: | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| **Mark range**: | 0 - 7 | 8 - 14 | 15 - 19 | 20 - 24 | 25 - 29 | 30 - 34 | 35 - 42 |

## General comments

The May 2011 session was marked by a significant increase in the number of new centres offering Environmental Systems and Societies. The issues continue to be similar to previous years and this may simply be a reflection of the skills that are harder to acquire for some candidates, and the learning curve associated with teaching a new course. Teachers are strongly encouraged to read this report in conjunction with previous session reports as the issues tend to be similar.

It is always a pleasure to see the types of practicals that teachers create for their candidates, and this endless outpouring of creativity is encouraging. One centre did a practical on diversity in areas that were reforested right after the civil war, and thus can date quite precisely the age of their study site. The investigation focused on diversity in older oak stands versus newer mixed pine and oak groves. Another centre looked at differences in landscaped versus unlandscaped parts of their campus. A third study that springs to mind is a study of invertebrate diversity above and below a point source pollutant in a river using kick net samples. One candidate commented on the difficulty of ensuring that these samples are repeatable and how different they can be based simply on the size of the rocks they happen to be kicking. It is pleasing to see candidates dealing with these rather tricky issues and realizing that their samples may or may not be representative. This is obviously a sign of good teaching.

The issues that continue to pose problems revolve around adequate design (especially suitable sample sizes and sampling techniques), proper treatment of data (this is closely linked to lack of data stemming from poor design) and robust discussions of the data in a broader context and an analysis of strengths and weaknesses of design. In this regard, it cannot be emphasized sufficiently that teachers need to spend time at the beginning of the course working on practical design because a well designed investigation lends itself naturally to strong performance on all criteria. The converse is also true; a weak design makes it difficult to obtain high marks on the second and third criteria.

# Candidate performance against each criterion

**Planning (PI)**

A poorly focused research question or one that is either too simple or too complex is likely to result in work that has adverse effects on all criteria. Teachers must provide guidance in this area, especially at the beginning of the course. This is a complex skill and is fundamental to the rest of the skills that internal assessment (IA) work seeks to promote.

The second part of this first aspect is the identification of variables. There seemed to be more candidates designing practicals with more than one independent variable, and often too many dependent variables. The latter problem can lead to investigations that are far too complex for candidates to take on board. This is an area where a teacher can become directly involved before the candidate starts the practical work. If the candidate has selected two independent variables, this should be pointed out and the necessary modifications made by the candidate prior to the start of the work. Variables that are to be controlled can be listed in this section or in aspect 2 together with the method that will be used to control them.

When describing the method, candidates continue to go on in detail about methods that can be looked up in any text book, and limit their comments about samples to "five samples were collected in the rain forest." It is crucial that candidates describe in detail how samples or sites were selected. Standard methods can be referenced by quoting a bibliographical source or including the teacher's instructions from the class where the technique being applied was taught. Laboratory work needs to have detailed descriptions of how treatments are prepared. For example, in a germination study, a candidate does not need to go into length about how dilutions of acid were made. However, how the seeds were planted, how the samples were watered, with what frequency, are all very important details in order to determine to what extent the candidate was able to design a method to control variables.

Far too many centres are failing to include sufficient repetitions in their work and this leads to poor data quality and hence poor data analysis. In laboratory work the minimum number of repeats per treatment is five. In field work this can be lowered to three in specific cases. For example running five 100 meter transects on a dune study may be impractical. Three would be acceptable.

Finally some of the planning work is so similar from candidate to candidate that it is evident that the method has been designed in a group. While group work is encouraged, planning practicals that are to be submitted for moderation must be an individual effort.

One common mistake made by teachers is to suppose that a technique, such as the Lincoln index or Simpson's index, or the calculation of biomass will lead to a good investigation per se. A practical in which a candidate is learning a technique, is almost by definition, of limited use for planning an investigation. Once the technique has been learned it may be applied in a new setting to answer a specific question.

As the course is a transdiciplinary subject, we are seeing more and more survey investigations and this is of course desirable. However, this is quite a new approach for some teachers and probably candidates as well, and will probably require some direct instruction in survey design. Some of the surveys submitted for moderation were so general or vague that they really do not lend themselves to assessing against IB criteria. This must be addressed by teachers. Survey questions probably will need to be designed so that they can be scored numerically and thus lend themselves to mathematical analysis, if they are to be used to assess and moderate these skills.

**Data Collection and processing (DCP)**

In aspect 1 of DCP there are problems with candidates including labels in data cells, not including labels anywhere, and reporting data to differing numbers of decimal places. Teachers should read previous subject reports for more information on this. Aspects 2 and 3 of this criterion are inextricably linked. Failure to produce any data processing results in no marks awarded for aspect 2 and no marks awarded for aspect 3 which calls for the presentation of processed data. When raw data are graphed, and in the absence of any processing, the candidate will receive zero marks for aspect 2 and zero marks for aspect 3. The error carried forward approach is not applied here.

It is impossible to carry out a good analysis of data when these are insufficient. If either the teacher's or the candidate's design calls for one pH sample from each of five locations in a stream, there is no significant analysis that can be carried out with these data and therefore the candidate is likely to perform poorly on DCP. As has been indicated before, this is such a simple concept and skill that it is frustrating to see candidates continue to lose marks for this type of mistake.

The emphasis in aspect 3 should be placed in selection of the appropriate format for presentation and excellence of production. It is expected that graphs will be extremely neat, drawn with rulers, appropriately labelled, with error bars, lines of best fit, etc. It is also expected that candidates will produce those graphs that help with interpretation. A candidate may be penalized for drawing a huge number of meaningless graphs (even if some useful ones are included). For example, if a candidate is carrying out an investigation of the effect of pH on growth of peas, with 20 peas for each of three treatments, if the practical includes a graph of the growth of each pea individually as well as a graph with average growth for each pH, the candidate would probably lose a mark for data presentation.

When the practical is too prescriptive, the candidate may be penalized because there is no choice of method of analysis. For example, when a candidate is told to use Simpson's index to measure diversity in a field, they have lost any possibility of selecting an analytical technique and may lose a mark. On the other hand, if the candidate used the Index to explore diversity in two or three sites, sampling five quadrants in each and taking averages and standard deviations, this may very well be acceptable, as the candidate had to determine what to do with the various data points generated at each site.

Candidates in this subject are expected to apply simple descriptive statistics to their data. When they do not, either because they neglect to do so, or because their design fails to generate sufficient data, they will not achieve maximum marks.

**Discussion, evaluation and conclusion (DEC)**

In Discussion, evaluation and conclusion, aspect 1 and aspect 3 can pose a challenge for candidates. Aspect 2 should be relatively straightforward for most. A good discussion follows naturally from a good design and good data analysis. If the data are of poor quality, it will probably be difficult to produce a sophisticated, meaningful discussion at least as far as analyzing the quality of the data. The discussion should place the findings in context, often by comparing results to theory. The findings themselves should be analyzed: Are there important differences among the data? Are there trends? Do these trends support/refute accepted theory? Are the standard deviations in the data so huge as to make differences meaningless? If a line of best fit was generated by the software, what is the value of r or r2? What does this say about the correlation? The discussion should be thought provoking and will almost certainly be the most challenging (and perhaps lengthiest) part of the report.

The vast majority of candidate investigations would improve enormously through the collection of more data (of good quality of course). Few candidates point this out in their evaluations. The absence of this single improvement, very often results in the loss of a mark because it is crucial to verifying the findings of the work. This additional data can be at each study site for example (more repeats) or in time (different seasons). In the evaluation, data quality issues that may have been noted in the discussion should be addressed. Was the standard deviation very high? How can it be reduced? Is the data representative in the candidate's opinion? If not, how can that be addressed? What improvements will address the issues that have been identified? All these questions should be answered in this section of the report. Some centres have put tables to good use in this section.

The conclusion must make direct reference to the results for full marks. General statements about the state of environment still abound. As additional material there is no harm in providing them but they do not replace the conclusion. This can be confusing for some candidates. A practical on the effects of pH on germination may lead them to conclude quite rightly that they now have a better appreciation for the issue of acid rain, but this is not the sort of conclusion that is expected. Rather the candidate should refer back to the research question and write a conclusion that is solidly grounded in the data. One key point here is that it is perfectly possible that the experiment does not allow the formulation of any conclusion. Such a statement must also be supported by data.

## Recommendations and guidance for the teaching of future candidates

Moderators mentioned a number of administrative issues:

- When a candidate receives zero marks for work not submitted, this candidate MUST be flagged as atypical and alternate work submitted along with the atypical work.
- Please ensure that you are using the correct ES&S / PSOW form and that you are assessing with the correct criteria. The ES&S criteria are NOT the same as Group 4 subjects.
- Please make copious comments on your candidate's work. This serves as feedback for improvement. It is always a concern when moderators receive portfolios without a single teacher comment.
- Teachers must send ONLY the work to be moderated. Sending the whole portfolio is expensive, and makes the identification of the work to be moderated that much more difficult.
- Please do NOT include any biological or other samples. This is exceedingly bad practice. While it is possible that the teacher has requested pressed leaves for a dichotomous key, these should absolutely NOT be included in the moderation sample. The same goes for samples of earth that are placed in cellophane envelopes or pressed under sticky tape.
- Please limit packaging. Some portfolios include a sleeve for each practical, a sleeve for the portfolio, all of which is placed in an envelope and this process repeated for each of the five portfolios. In keeping with the subject that we teach, please limit the amount of waste that will be generated through this process.

# Standard level paper one

## Component grade boundaries

| **Grade**: | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| **Mark range**: | 0 - 7 | 8 - 14 | 15 - 21 | 22 - 26 | 27 - 31 | 32 - 36 | 37 - 45 |

## The areas of the programme and examination that appeared difficult for the candidates

Basic ecological concepts e.g. pyramid of numbers or food chains were poorly understood.

Many candidates had not memorized the exact definitions of important terms such as gross primary productivity, gross secondary productivity, carrying capacity, ecological footprint.

Candidates continue to confuse the phenomena of the ‘greenhouse effect’, the ‘ozone hole’ and ‘acid deposition’, despite the importance of the distinctions between them being emphasised in these reports previously.

The calculation of the efficiency of conversion of total insolation to NPP based on Figure 5 was very poorly done; this admittedly was difficult.

Some candidates do not understand differences in the treatment of questions containing the command terms: evaluate, compare, explain, identify, list, state.

## The area of the programme and examination in which candidates appeared well prepared

The part-questions on age/sex (population) pyramids, the demographic transition, trophic pyramids and food-chains, and waste disposal were better done than some of the others.

Interpreting data in diagrams or the cartoon in question 6 was, on the whole, well done.

Waste disposal methods were well understood.

## The strengths and weaknesses of the candidates in the treatment of individual questions

**Question 1**

a) Most, but far from all, were able to identify the illustrated demographic pyramids. The basic knowledge of the three countries e.g. that Japan is an MEDC and Ethiopia is an LEDC was expected but candidates are not expected to know in detail about all countries of the world. However, some appreciation and overview of this should be gained in taking the course.

b) Slightly smaller proportions were able to assign the countries to an appropriate stage of the demographic transition model.

c) Many candidates had some notion of what an ecological footprint was; fewer were able to give an accurate, concise definition. A common error was not to relate resource need to area of land and water required.

d) Most candidates recognised that a stage 1 ecological footprint would be greater than that of stage 4.

e) Far fewer were able to give an account of the reasons for the difference and candidates struggled to obtain full marks. Many discussed matters such as birth and death rates and population sizes rather than factors such as meat consumption, waste production and $CO_2$ emissions. Only a minority gained full marks.

f) The command term 'evaluate' posed difficulties for nearly half the candidates. Some did little more than expand on the definition given previously. Few provided BOTH a strength and a limitation of using ecological footprint as a way of measuring resource use.

**Question 2**

a) This question was amongst those better answered; most were able to give an advantage and a disadvantage for the three methods of waste disposal. Some gave excellent detail: a few answers were too vague to receive credit, for example by saying that there were dangers of 'pollution' or 'harm to the environment' in a particular policy. A few candidates appeared to believe that incineration resulted in complete disposal of waste leaving no residue or ash.

b) A minority of the candidates gained a mark for stating a method of waste disposal, other than those mentioned in the question together with give a name of material managed in this way. Composting for organic material and deep sea disposal of nuclear waste were mentioned. However, many repeated one of the methods mentioned in the question, e.g. recycling. A few candidates mentioned illegal disposal methods such as fly tipping.

c) When asked to outline two factors on a national scale which affect the choice of disposal method, many included irrelevant information on local issues. The very best answers included mention of the legal regulations in a particular country, technological and educational level and cost. Many found it difficult to consider the factors at a national rather than local level.

d) Many responses were very bland, adding little to the information given in the question. Here as elsewhere, there was confusion between the 'greenhouse' effect, the 'ozone hole' and acid deposition. Many rewrote the question in another form. The very best answers – just a small minority – gave good detail, naming the gases released. One candidate attempted a diagram on how methane extraction from landfill sites worked.

**Question 3**

a) About half of the candidates realised that the discrepancy in numbers between consumers and producers was probably due to the latter being very large, e.g. trees.

b) Slightly over half of the candidates got the mark for a food chain from an ecosystem they had studied. Not naming an organism led many to miss this mark. Many drew a food web (sometimes very well) rather than a chain; some drew pyramids; some of the chains were extremely improbable; a few had the arrows going in the wrong direction; some candidate wasted much time drawing exquisite pictures of beautiful flowers, bounding rabbits, coiling snakes and pouncing foxes. The best responses had just sufficient detail clearly naming a sequence of species from an English woodland, African savanna or New Mexico desert.

c) Most candidates named the biomass pyramid; some gave the productivity pyramid already mentioned in the question, a vague 'trophic pyramid' or even food chain.

d) Again the word 'evaluate' confused some candidates. Many stated that a pyramid of numbers showed the *number of species*, not realising that it showed numbers of *individuals* and gave no information on the *biodiversity* within an ecosystem. As in 1(f), many did not evaluate with a strength and weakness of the pyramid of biomass.

e) Relatively well done, although the relationship to the 'pyramid structure' was not always emphasized. Deforestation and hunting (poaching) were the examples most quoted, although use of pesticides and urbanisation also appeared in responses.

**Question 4**

a) and (b) Very few candidates got the two definitions completely correct. Even when candidates understood what was required it was the *unit time, unit area* component of the definition that eluded them. Candidates are expected to know and understand such a fundamental concept in ecology.

c) Almost no candidates were able to calculate the efficiency of conversion of insolation. Many did not attempt. There was a wide range of answers, based on calculations using combinations of almost every figure in the diagram. Again, candidates should be familiar with this type of energy flow diagram and be able to interpret it.

d) Less than half the candidates understood what was required, and were able to provide a succinct list. Many answers were very bland: 'much energy is lost'.

e) This part-question was answered rather better, some candidates giving useful detail on the '10% rule' and the Second Law of Thermodynamics.

f) A minority of candidates were able to work out what was required here, mentioning such details as reflection from a water surface and the level at which terrestrial and aquatic food chains were cropped, but a greater number resorted to generalizations on 'heat loss'.

**Question 5**

a) (i) Almost all were able to identify the two countries in the bar-chart having the highest total $CO_2$ emissions and the highest LULUCF emissions.

(ii) Fewer were able to explain why emissions from LULUCF were high for some countries, although a number gained some credit for mentioning deforestation. Many did not appear to understand which activities lead to carbon emissions. A common answer was agriculture but not relating this to deforestation.

(iii) Less than 25 percent of candidates understood that the negative value for the USA of LULUCF was due to reforestation, tree-planting. However, a few candidates, perhaps from centres in the USA, were able to include excellent local detail.

b) Most candidates were able to gain at least some credit. Some answers, however, were bland, lacking real detail.

**Question 6**

a) Almost all were able to name two renewable sources of energy, although a small minority included nuclear.

b) Most candidates were able to interpret the cartoon provided; a wide range of interpretations were offered, but credit was given to any reasonable suggestion.

c) A little less than half the candidates were able to define carrying capacity. Many had a notion of what the concept involved, but failed to mention the key concept of *sustainability*.

d) The question on the comparison of the carrying capacity of Germany and Australia was not well answered. It is accepted that detailed knowledge of these countries is not expected, but some candidates' answers were very naive: these included answers such as 'Australia is a tiny island'; 'Australia is much smaller than Germany'; 'Australia's rabbits are killed by the hot weather', which did not gain credit. However the best answers mentioned the arid climate and low biological productivity of desert vegetation of the continent's interior.

## Recommendations and guidance for the teaching of future candidates

These do not differ greatly from suggestions made following the last few examination sessions.

- Candidates need to understand fully the command terms used in both questions and assessment statements. The commonly used terms 'explain', 'evaluate' and 'compare and contrast' need to be understood clearly.
- Definitions and the meanings of key terms should be known and perhaps memorized. Productivity, for example, requires a statement of 'per unit area per unit time'.
- Candidates should be encouraged to give named examples. An apposite example can sometimes convince an examiner that a candidate understands a concept.
- Although there was perhaps some improvement, from previous sessions, many candidates failed to separate 'ozone depletion', 'greenhouse' and 'acid deposition', and realise that the symptoms, causes and remedies of these differ. This needs to be emphasized in teaching.
- Too many candidates fail to write anything in response to some part-questions. A guess might just gain a vital mark; a blank space can gain no credit whatever.
- Responses to questions which exceed the text box size should be avoided wherever possible. The size of the text box gives an indication of the amount that a candidate needs to write to gain maximum marks. There should be no need to expand outside of the box, but if this occurs ensure candidates clearly indicate responses on additional pages.

# Standard level paper two

### Component grade boundaries

| **Grade**: | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| **Mark range**: | 0 - 9 | 10 - 18 | 19 - 24 | 25 - 32 | 33 - 41 | 42 - 49 | 50 - 65 |

## General comments

G2 responses showed very diverse reactions to the paper. For example, one centre felt that the case study was relatively difficult, while others praised it as an interesting, relevant, realistic and effective tool for testing candidates. The criticism of some of the terminology used is acknowledged.

Section B was deemed by most to be very fair, covering a wide range of topics, with a balance of group 3 and 4 elements, a need for in depth case studies and thorough understanding of topic 7 required.

A few teachers questioned the lack of questions on experimental design, though that this was addressed in question 3 on measuring diversity. It is worth noting that candidates performed relatively poorly in this area. There was one comment about the lack of coherence in the sub-parts of each question in Section B which made it difficult to "write a comprehensible essay." We would like to clarify that there is no expectation that Section B questions be written as continuous prose or that subsections are linked. Indeed it is preferable if candidates clearly label different sections of the question for clarity.

Questions 2 and 5 were particularly popular.

## The areas of the programme and examination that appeared difficult for the candidates

Candidates were generally able to recall facts but difficulties were experienced when the facts needed to be applied to a situation or a scenario needed to be evaluated. Examples of this included the explanation of how eutrophication is an example of positive feedback, and the evaluation of the conservation approach in the Kristianstads Vattenrike Biosphere Reserve. Candidates generally understood the topic of global warming well but found it more difficult to differentiate global warming with climate change. Global warming may have many different effects dependent upon location and candidates need to be able to be specific about these. There are still too many candidates who link stratospheric ozone depletion with global warming.

Most candidates showed that they understood the principles of negative impacts on ecosystems and showed some understanding of the link to a systems approach. The majority of candidates, however, used language very poorly in these cases. Terms were used, such as stability, feedback, equilibrium, food chains and webs, without showing an understanding of how these concepts are interlinked. There was a lot of vague language used to give an ecological reason for preserving species diversity and very few candidates were able to define biodiversity, most just defining species diversity. Although many candidates were able to indicate Simpson's Diversity Index as a measure of species diversity, very few were able to show how this would be collected in the field.

Although there was little need to show an appreciation of data analysis in paper 2, very few candidates showed an understanding that a correlation does not necessarily mean causation. Many candidates also did not appreciate that numbers of species should be given in a whole number without decimal places.

Candidates generally found part (c) of the section B questions most challenging. Very few candidates were able to show a good understanding of the relative importance of factors that determine the sustainable use of freshwater resources. Those who referred to case studies in their answers generally wrote much better responses. Candidates also did not show a good understanding of the role of participation in environmental decision-making. Responses often used international agreements as examples but these did not receive credit unless they demonstrated an understanding of grass-roots involvement in the process. The best responses used specific case studies, including Agenda 21, in their responses.

## The areas of the programme and examination in which candidates appeared well prepared

Candidates coped well with the new layout of the paper due to e-marking and managed in general to stick within the allocated spaces with writing. There was little evidence of candidates spending excessive amounts of time on the case study at the expense of Section B as has been the case in the past, thus showing a real improvement in time management skills.

Candidates in generally showed a sophisticated understanding of value systems for example, a good overview of the differences between technocentric, ecocentric and anthropocentric viewpoints. Use of examples was in general a bit more effective than in previous sessions, with the strongest candidates showing an in depth understanding of specific case studies.

Candidates showed a good understanding of several areas of the course including factors affecting human populations, global warming, soil ecosystems, pollution, reasons for preserving species diversity and strategies for reducing the impacts of eutrophication.

## The strengths and weaknesses of the candidates in the treatment of individual questions

**Section A**

**Question 1 - Case study**

In general this was answered well. Candidates seemed engaged by the case study.

a) Candidates were mostly able to recognize the areas with most phosphates and nitrates, though not all made a really clear distinction between the causes of nitrate release and phosphate release, which are of course, different.

b) The majority of candidates had a good understanding of eutrophication, but found it hard to explain positive feedback - tending instead to simply describe positive feedback. The model showing strategies for reducing impacts threw some candidates as the terminology was slightly different. Candidates who applied what they did know about different strategies were credited. A number of candidates seemed to think the model referred to environmental issues in general rather than eutrophication specifically.

c) Most candidates coped well with the data on toads and were able to use this to infer the likely reason for sand being the preferred habitat. Simply writing out that “the toads like sandy habitats” was not credited.

d) A number of candidates correctly identified the approach to conservation as being area-based or with a focus on collaboration with local people. Evaluations were often weaker - with only one point made or very vague statements.

e) When candidates were required to evaluate the link between toad population and ozone concentration, few put the counter arguments that correlation is not the same as cause or mentioning other factors which may be responsible for the decline in toads.

f) Answers were generally good though not all candidates completed the calculation to find "the number" of species that are endangered/critically endangered, and so did not achieve the mark.

   Candidates appeared to have many arguments for preserving species diversity. Weaker responses were vague or simply circular arguments e.g. it is morally right to preserve species is not an argument in itself so was not credited.

## Section B

### Question 2

This was a very popular essay. Knowledge of basic definitions was disappointing. Candidates often did not have a precise understanding of pollution or of the types, with many responses that were only partially correct. Responses to part (b) were generally adequate, with stronger candidates writing about the effects of specific pollutants. Some candidates did not identify specific pollutants, but wrote about general pollution issues. A number did not write about atmospheric pollution, but pollution more generally. A large number of candidates are still confusing the issues of Global warming, tropospheric ozone pollution and stratospheric ozone depletion. In part (c), many candidates were able to show an appreciation that reducing, reusing and recycling would reduce the need for energy and materials but they did not necessarily link this explicitly to a reduction in atmospheric pollutants. The strongest responses used specific case studies to highlight the nuances between these strategies. Evaluation rather than simple description was required.

### Question 3

This was a less popular question and one that was answered poorly by many candidates. Most candidates defined biodiversity adequately and were able to suggest some methods for collecting the data. Few candidates scored full marks on this part question. Part (b) was generally done adequately, though most candidates could not think of more than three ways of unsustainable practices affected biodiversity. Surprisingly few candidates defined the term unsustainable agriculture, and a number made no distinction between direct and indirect causes. Part (c) was very poorly answered. Most candidates did not grasp that they had not simply to list the factors which affect water use, but also rank them in some way in order to assess which were most important. A worrying number of candidates seemed to think freshwater resources were fish.

### Question 4

This was a reasonably popular question. Part (a) was answered well, with the strongest candidates defining degradation before they went into the ways in which human activity can degrade soils. The command term was outline - so candidates who developed one human action in detail did not score well. Part (b) was tackled well by candidates provided they understood that there is a difference between soil organisms and soil per se. Many did not. There were some very interesting responses to part (c) with some well balanced evaluations from many candidates. Providing a detailed example of community participation was more problematic - as many candidates wrote simply about international protocols - which was not what was required.

### Question 5

This was a very popular question. Most candidates answered part (a) well, though at only four marks, a detailed exploration of all the factors involved in demographic transition was not required, and wasted time. Part (b) was answered well, particularly by candidates who were able to provide examples to support their assertions. There was a wide range in quality of answers for part (c).

Candidates who performed well chose appropriate environmental problems and had responses which were well balanced; however, many candidates did not evaluate the technologies they identified. Some candidates did not clearly identify two contrasting environmental problems. Problems could be contrasting in terms of scale or cause.

## Recommendations and guidance for the teaching of future candidates

- There needs to be a greater emphasis on learning key definitions. These are all listed in the glossary. The candidates should be made aware of the importance of scientific definitions for scientific terms.
- Specific, well developed case studies would help candidates enormously. Candidates should be taught local case studies for example, where they have studied how the principles and concepts of the course are embodied in a real life example. The holistic study of ecosystems in the field trip would make these case studies more vivid for candidates. They would also be able to discuss them in a nuanced way, rather than simply at a superficial level. Case studies help candidates hang ideas around a central point and make it much easier for them to recall relevant information. If possible contrasting case studies should be gathered to allow candidates a range of possible responses.
- Candidates need to be reminded of the importance of clear legible handwriting.
- When the command term 'outline' is used - a range of brief points is required rather than one very well developed point.
- Candidates should be taught to expect that part (c) of each section B question will demand higher order thinking skills. Purely descriptive responses will not score highly. The command terms are more likely to involve discussion or evaluation in order for candidates to demonstrate their analytical skills.
- Evaluation requires both sides of an argument to be explored.
- If relevant, begin with defining a key term in an essay e.g. soil degradation for question 4.
- Candidates should be encouraged to use the information in the resource booklet to draw conclusions. They will not be simply expected to copy out text from the resource booklet, so if they find themselves doing this for a question they should think again.
- Candidates should be encouraged to think critically about data, not simply making the obvious point, but applying what they have learned from, say, TOK about the strength of scientific knowledge claims and issues such as cause and correlation, margins of error and so on.
- The differences between the issues of Global warming, tropospheric ozone pollution and stratospheric ozone depletion need to be clarified. This point is repeated most examination sessions.
- Another useful strategy is to have candidates evaluate various scenarios within the different topics, particularly from different environmental viewpoints.
- It is also important that candidates have the opportunity to collect and analyze data and to be able to apply the skills they learn in their practical scheme of work to the examination questions.
- Advise candidates to break answers into sections rather than write as continuous prose.
- Encourage candidates to use and apply their own case studies to questions, and not to use the resource booklet case study to answer Section B questions. Candidates are likely to have more in-depth knowledge of their own case studies.