2004 Environmental Science EV03: Written Examination 1

GENERAL COMMENTS

The examination paper continues to reflect the emphasis of the course on case studies and, where possible, on local environmental issues. This was evident in Short Answer Questions 1 and 3.

In previous reports emphasis has been placed on the need for students to be specific in their responses. Students continue to demonstrate improvement in this area with appropriate inclusion of specific examples and geographic locations.

Teacher(s) are to be commended for the sound preparation given to students as displayed in their responses on this examination.

SPECIFIC INFORMATION

Section A - Multiple Choice

This table indicates the approximate percentage of students choosing each alternative. The correct answer is indicated by shading.

	A	B	C	D		A	B	C	D
Question	**%**				**Question**	**%**			
1	19	20	55	6	**11**	21	70	7	2
2	2	11	86	1	**12**	4	83	9	4
3	10	83	3	4	**13**	6	8	16	69
4	55	6	8	30	**14**	2	81	16	1
5	2	0	1	97	**15**	2	0	0	98
6	3	8	1	87	**16**	11	0	81	8
7	12	25	56	6	**17**	4	78	16	1
8	8	47	13	32	**18**	8	84	6	2
9	2	5	86	6	**19**	51	28	5	14
10	1	5	91	2	**20**	23	16	60	0

Question 1

A vegetation sink is a plant or plants which remove CO_2 or other greenhouse gases from the atmosphere. A large plantation of sugar cane is the only response that meets this definition.

Question 4

An endothermic reaction is one that takes in heat. The only endothermic reaction listed is ice melting. All the others give out heat.

Question 7

Overall efficiency = product of efficiencies of individual steps
= 0.7 x 0.9 x 0.8 = 0.504 approx = 50%

Question 8

Total capital cost of option A (buses): 4 x 20 x $1 000 000 = $ 80 000 000
Total capital cost of option B (trams) = 20 000 000 + 20 x 1 000 000 = $ 40 000 000
Hence Option A (buses) is twice the capital cost of Option B (trams: B)

Question 13

Genetic swamping is when the genetic make up of a population is modified due to it being overwhelmed by a larger, genetically related, population. This will occur for a small, previously isolated population of a species when it comes into contact with a larger population.

Question 16
A captive breeding programme involves removing some individuals from an at risk population, breeding larger numbers of them in a protected environment, and then re-introducing them. This will increase the population, hopefully to viable numbers. It will have no effect on the other variables mentioned.

Question 17
From the graph

- Population in 1995 = approx 168
- Population in 2000 = approx 118
- Decrease = 168 - 118 = 50
- % decrease = $^{\text{decrease}}/_{\text{original population}}$ x 100 = $^{50}/_{168}$ x 100 = 30%

Question 18
Extrapolating the straight line graph until it intersects the population 50 line gives 2007.

Question 19
Inbreeding is the only possible cause given that the scenario refers to a population in a small isolated habitat fragment. There is no evidence for endemism, biodiversity is an advantage (not a threat) and genetic swamping requires contact with a new, large population (not possible in the scenario).

Question 20
The question states that the location for re-introduction was '**previously** occupied'. This implies that none of the species occupy the site now. Hence this will increase the species diversity by introducing a new species.

Section B - Short Answer

Question 1
Students were expected to demonstrate knowledge of the energy sources they had studied and knowledge of the greenhouse effect, and relate these to the impact on global warming. This year students demonstrated greater awareness of the difference between the fossil/non-fossil and renewable/non-renewable energy sources, than in previous years.

a

Marks	0	1	2	3	Average
%	1	5	12	82	**2.75**

This question required students to name the energy sources they had studied, and to identify emissions. Almost all students coped well with this question, which really was a necessary introduction to the remainder of question 1.

b

Marks	0	1	2	3	4	Average
%	14	17	22	26	22	**2.25**

A complete answer to this question required a reference to each of the following:

- what radiation reached the atmosphere from the sun,
- the absorption of each type of radiation and
- the relevance of this to the Greenhouse effect.

One common error was to spend most of the question discussing the ozone layer. The ozone layer does have an effect on ultraviolet radiation - and this comment was rewarded. However the ozone layer has little relevance to the greenhouse effect and global warming. Weaker students tended to equate ozone depletion with global warming. Teachers should make clear that they are separate issues.

Most students included a diagram. It was more difficult to get full marks without a diagram. The mechanism of the greenhouse effect is central to this part of the course, and students need to be aware of the basic facts, especially the role of the different types of radiation and the differential absorption of them.

c

Marks	0	1	2	3	Average
%	18	23	24	35	**1.75**

There were many 'off topic' answers to this question. Many students rushed into some general comments about the fossil energy source - for example, why it was a fossil fuel; an obvious need was seen in some students to be drilled in answering the question asked, rather than some good other question that wasn't asked!

d

Marks	0	1	2	Average
%	6	14	80	**1.73**

This question was well done. The disadvantage did not have to be an environmental impact. Many students commented on the expense of their non-fossil source, and this was an acceptable response.

e

Marks	0	1	2	Average
%	27	19	54	**1.26**

This question was generally well done. The most common, though not widespread, error was to describe the impact of the enhanced greenhouse effect on land use, rather than the other way round as asked. An example of an incorrect response was *'that global warming would increase sea-levels and this would flood low laying farmland*'.

Question 2

a

Marks	0	1	2	3	Average
%	3	23	41	33	**2.02**

Students were required to describe three energy **transformations**. Suitable examples were chemical to heat, heat to mechanical, potential to kinetic, kinetic or mechanical to potential. The most common error was to refer to three energies, rather than three transformations. Many students listed two transformations only (that is, involving three energies).

b

Marks	0	1	2	3	4	Average
%	6	7	15	27	45	**2.98**

Students were expected to:

- indicate what potential energy involved (for example stored energy, potential to be used) **AND**
- indicate what kinetic energy consisted of (for example energy of motion) **AND**
- explain the pile driver's operation

Students were not expected to provide very technical descriptions or definitions.

c

Marks	0	1	2	Average
%	30	3	67	**1.36**

A fairly straightforward calculation of energy efficiency was required, and most students completed this well.

$\%\ \text{efficiency} = {}^{\text{Energy out}}/_{\text{Energy in}} \times 100 = {}^{7560}/_{37800} \times 100 = 20\%$

0.2 or $^{1}/_{5}$ was accepted, although the use of % in expressing efficiency is to be encouraged.
One mark was given where the answer was incorrect, but a correct formula and substitution were provided.

d

Marks	0	1	2	3	Average
%	21	21	34	24	**1.6**

This question was less well done. For full marks, reference to each of the following was required: energy is being conserved in total; what happens to energy that doesn't go into useful work, the operation of the pile driver.

e

Marks	0	1	2	3	4	Average
%	8	16	39	30	6	**2.09**

This question required reference to the meaning of the term 'renewable', fuel usage in the pile driver and global warming.

It should be noted that burning of wood would not necessarily produce less pollution than the use of diesel fuel; diesel fuel produces both CO_2 and water as combustion products, wood produces only CO_2; wood as a fuel is unlikely to be more energy efficient than diesel. Hence lower pollution is not likely to be a positive advantage of wood.

Some students entered into a discussion of the difference between plantation and forest wood sources or the impact of the removal of trees as carbon sinks; both of these were considered reasonable comments and rewarded.

Question 3

Marks	0	1	2	3	4	5	6	Average
%	2	3	5	19	35	27	9	**3.98**

This question was intended to encourage students to think through a more detailed scenario, and evaluate options, using the renewable and non-renewable sources they had studied in depth. The following points were expected in answers:

- Identification of a renewable and non-renewable energy source
- Comment on their relative efficiencies
- Reference to economic considerations (not necessarily Life Cycle costs).
- Mention of environmental impact (could be either positive or negative)
- Identification of the energy requirements and demands of the town (for example, that solar may be suitable for a small town, but impractical as the main source for a large city with electrical public transport and industrial demands).
- Comparison of or conclusion about the suitability of the two sources for the situation.

Question 4

This question was based on a scenario. Students were given a fairly detailed description of a situation and asked to comment on some aspects of it.

a

Marks	0	1	2	3	Average
%	13	13	26	48	**2.09**

Students were expected to demonstrate understanding of the term 'endemic'- that is, found only in this location. Some students thought 'endemic' meant this was the only species in the area. Most who knew the meaning of 'endemic' were able to give a reason for protection – that is, if they were wiped out here the sub species would be extinct.

b

Marks	0	1	2	Average
%	29	33	37	**1.07**

To gain full marks, answers needed to include reference to population viability analysis as 'an estimate of the probability of extinction' AND specific reference to the number (population size) of individuals of the species.

c

Marks	0	1	2	3	4	Average
%	7	11	34	36	13	**2.36**

Most students were able to provide two strategies; for example removing predators, supplementary feeding, captive breeding programmes and re-introduction. To obtain full marks, the strategies had to be relevant to this scenario and make some reference to it.

Question 5

This was another scenario question that required students to apply their knowledge of threats to biodiversity to it to a practical situation.

a

Marks	0	1	2	Average
%	10	39	52	**1.41**

'Vulnerable' is a category that indicates a level of threat to the survival of a species – but which is less threatened than species categorised as 'endangered' and 'critical'. To obtain full marks, students were expected to indicate where 'vulnerable' was on the spectrum of threat to survival.

b

Marks	0	1	2	3	4	Average
%	2	5	27	39	27	**2.81**

Two possible threats to **this** population were required; for example, predators, inbreeding, competition, trauma of human activity. For full marks, some description was required, and the threats had to relate in some way to this scenario and population, rather than a general threat.

c

Marks	0	1	2	3	4	Average
%	8	8	35	36	14	**2.39**

Most students were able to mention two strategies. Again, for full marks, the strategies had to address the threats mentioned in b), and there had to be some explanation of how the strategies would address the threats. Suitable strategies included keeping dogs and cats locked up (or banning them), fencing to keep predators out, captive breeding programme and re-introduction, wildlife corridor to another area, introducing/swapping individuals from another population to avoid in-breeding.

Question 6
This question addressed the requirement within the Study to analyse and evaluate data relating to biodiversity.

a

Marks	0	1	2	Average
%	11	4	85	**1.74**

As has been stated in previous reports, calculation of averages is one of the skills expected of students.

Total = 16 + 14 + 13 + 15 + 17 = 75. Average = $^{\text{Total numbers}}/_{\text{persons}} = {}^{75}/_{5} = 15$

One mark was available where students with an incorrect answer had shown the correct formula and substitution.
A very small number of students misinterpreted the question and calculated the average number of fish caught for each person over the five years.

b

Marks	0	1	2	Average
%	31	35	34	**1.02**

As stated in advice elsewhere, students are expected to be able to make some general comments on the adequacy of sampling and significance of variation, without doing actual calculations of mathematical measures of variation.
In this question, any reasonable comment on adequacy was rewarded, whether arguing for or against adequacy.

From the data, obvious examples of shortcomings were:
- the very short period of the year and day in which data was collected (arguing against adequacy)
- very small variation compared to mean (arguing for adequacy)

c

Marks	0	1	2	3	4	Average
%	7	3	7	19	63	**3.28**

As in previous years, a calculation of an index was asked for, and then an interpretation of the meaning of the index in the scenario. Students are not expected to know or memorize any particular indices, but should encounter some - and do some calculations - in their practical and fieldwork. All information required about Simpson's index was included in the question. Mathematical errors were penalized only once.

D for 1998 = 0.738
D for 2002 = 0.622

Hence Simpson's index showed a significant drop in biodiversity over the five year period.

d

Marks	0	1	2	3	Average
%	19	24	31	26	**1.65**

Students needed to understand that total numbers of fish and biodiversity are different. Hence indices are required rather than only raw numbers. To gain full marks students needed to demonstrate understanding of this distinction, include reference to the meaning of the values of Simpson's index in the previous question, and refer to the arguments of Albert and/or Gillian.

e

Marks	0	1	2	3	4	Average
%	18	30	33	14	5	**1.58**

This question required more in-depth thinking about the situation. The strategies suggested had to address the difference between biodiversity (which had decreased) and the total number of fish (which had not changed). Hence strategies which simply increased the number of fish (for example a total ban on fishing) were not rewarded as much as responses which specifically addressed the differences in species numbers. Suitable strategies could include: banning the taking of certain species, a captive breeding program and reintroduction of the species at risk; and biological controls on the dominant species.