2008 **Environmental Science GA 1: Examination 1**

GENERAL COMMENTS

The Environmental Science course involves in-depth study of specific cases, with emphasis on local issues, and the use of field and practical work. Short answer Questions 2 and 3 on the 2008 paper tested this. It was noteworthy that these questions were done significantly better than the remaining questions. In many cases students' responses were very specific and had considerable depth, reflecting the way these areas have been taught. This was particularly obvious in Questions 3a. and 3b.

Students did not perform well on Question 1 in Section B, about the mechanism of the greenhouse effect. Given that the major emphasis of Area Study 1 of Unit 3 is on global warming, and the current media interest in this topic, this was disappointing. It may be that students' understanding was hampered by the often incorrect comments in the media, and teachers are encouraged to focus on the correct scientific understanding of the mechanism of the greenhouse effect. This is addressed in the more specific comments on this question below.

As has been noted in previous assessment reports, the interpretation of graphs seems to a weakness with many students. Teachers are encouraged to stress to students the importance of carefully reading what each axis is plotting and the meaning of the slope of the graph as a trend rather than relying simply on the absolute value.

There were very few instances of students being unable to complete the paper, hence the length seemed appropriate.

SPECIFIC INFORMATION

Section A – Multiple-choice Questions

The table below indicates the percentage of students who chose each option. The correct answer is indicated by shading.

Question	% A	% B	% C	% D	Comments
1	91	7	1	1	
2	9	4	86	1	
3	19	66	7	7	A significant number of students chose option A; however, the burning of natural gas produces heat, not kinetic energy as such.
4	79	10	7	4	The overall efficiency $= 0.40 \times 0.90 \times 0.95 \quad = 0.34 = 34\%$, option A.
5	8	80	8	4	
6	3	16	49	32	The percentage increase from 1960 to 2005 $= \frac{390-310}{310} \times 100 = 26\%$, option C. Surprisingly, only half of the students performed this calculation correctly.
7	1	84	2	14	Students were asked to find the period over which the **rate** of carbon dioxide concentration increase was the greatest; that is, where the slope of the graph the steepest, which was clearly 1970 to 1979, option B. The most common incorrect answer (option D) was probably due to students simply reading the highest value on the graph rather than the rate of increase.
8	63	31	5	1	The key to this question was that the increased **rate** of change in carbon dioxide concentration lasted only a year or two and then returned to the previous value. Hence, the factor would have been a **once off** occurrence, for a relatively short time – that is, a volcanic eruption (option C). Most students chose the obvious sources of carbon dioxide increase, namely a coal-burning power station (option A) or deforestation (option B). It is unlikely that the coal-burning power station would have ceased operation again in a couple of years, or that the area would be reforested in a year or two.
9	2	0	0	98	

Question	% A	% B	% C	% D	Comments
10	3	1	95	2	
11	9	0	5	86	
12	10	86	1	3	
13	87	6	2	4	
14	5	87	7	2	
15	1	89	6	4	
16	4	87	5	4	
17	15	35	45	5	The sampled area was 300 m × 300 m, that is, $\frac{1}{10}\times 10$ or $\frac{1}{100}$th of the total area. Since the average number in each sampled area was $\frac{10+12+8+10}{4}=10$, then the estimated number in area A is $10\times 100=1000$, option C.
18	69	9	16	6	Students needed to multiply the two probabilities together $0.15\times 0.45=0.0675$, option A.
19	8	75	10	7	Robyn wanted the individuals for the captive breeding program to come from two distinct populations – that is, to be genetically different – in order to reduce inbreeding, option B.
20	5	76	17	2	The variation from year to year is +/– 4 around the mean of 52.3. Hence, the difference between 1995 (50) and 2000 (53) is within normal statistical variation and option B is correct. This question was relatively well done, which is a significant improvement over similar questions in previous years.

The multiple-choice section of the paper proved to be relatively straightforward, with an average score of about 75 per cent. Questions 6–8 related to a graph of carbon dioxide concentration against time (years) for a particular measuring station. This group proved to be a demanding set of questions, as was intended. Questions 17–20 related to a study of a marsupial species in two separate areas.

Section B – Short answer questions

For each question, an outline answer (or answers) is provided. In some cases the answer given is not the only answer that could have been awarded marks.

Question 1

Question 1 addressed the issue of the mechanism of the greenhouse effect and global warming. Data was given in two graphs, and students needed to use this data when answering the questions. Question 1 was not answered very well.

1a.

Marks	0	1	2	3	Average
%	29	15	21	35	1.7

A suitable answer would have been, ‘The greatest proportion of the radiation reaching the outer edge of the atmosphere is visible light, with a slightly smaller proportion of infrared, and a much smaller proportion of ultraviolet.’

The data in Figure 1a showed that the sun, with a surface temperature of a few thousand degrees, emits electromagnetic radiation. The distribution by wavelength peaks in the visible region, with a significant amount in the infrared region and a much smaller amount in the ultraviolet region of the spectrum. Hence, this is the distribution of radiation reaching the outer edge of Earth’s atmosphere, as there is no significant absorption in space.

1b.

Marks	0	1	2	3	Average
%	31	30	19	19	1.3

A suitable answer would have been, ‘From graph 1b, ultraviolet and infrared radiation are significantly absorbed in Earth’s atmosphere. Hence the radiation reaching Earth’s surface will have a higher proportion of visible radiation than that reaching the outer edge.’

As radiation passes through Earth's atmosphere, most of the ultraviolet and infrared radiation is absorbed by the ozone layer and by greenhouse gases (mainly water vapour in the upper atmosphere) respectively. The atmosphere is transparent to visible light. Hence, most of the radiation reaching Earth's surface is visible. A number of students elaborated further on the fact that ultraviolet is absorbed by the ozone layer.

1c.

Marks	0	1	2	3	Average
%	26	29	24	21	**1.5**

Most visible light reaching Earth's surface is absorbed, and Earth (because it is at a temperature of approximately 20°C) reradiates this energy as infrared. Some visible light is reflected out as visible light; for example, off flat water, snow and clouds.

For full marks, the terms 'absorbs visible' and 'reradiates infrared' were required. There was no requirement to mention reflection, although this was rewarded if full marks had not already been gained.

1d.

Marks	0	1	2	3	Average
%	29	28	26	17	**1.4**

A suitable answer would have been, 'The reradiated infrared is absorbed by greenhouse gases in the atmosphere, hence heating the atmosphere.'

The key terms required were 'infrared', 'absorbed by greenhouse gases' and 'warming' or 'heating'. There seemed to be a common misunderstanding that infrared radiation is bounced back by greenhouse gases, rather than absorbed.

1e.

Marks	0	1	2	3	4	Average
%	11	20	27	29	13	**2.1**

	natural greenhouse effect	**enhanced greenhouse effect**
major contributing gas	• water vapour	• carbon dioxide
other gases contributing	• carbon dioxide • methane • sulfur dioxide	• methane • oxides of nitrogen and sulfur • CFCs

The major contributing gas to the natural greenhouse effect is water vapour, simply because of the amount of it in the atmosphere – approximately one per cent in the lower atmosphere, compared to about 0.03 per cent (300 ppm) of carbon dioxide. The major contributing gas to the enhanced greenhouse effect is carbon dioxide, which most students knew.

Other gases contributing to the natural greenhouse effect include carbon dioxide, methane and sulfur dioxide (from volcanoes). Note that CFCs do not occur naturally. Gases contributing to the enhanced greenhouse effect include methane, oxides of nitrogen and sulfur and CFCs. One mark was deducted if incorrect gases were mentioned (for example, oxygen or nitrogen).

Question 2

Question 2 was the on the fossil and non-fossil energy source studied. It was generally well done.

2a.

Marks	0	1	2	Average
%	6	46	48	**1.5**

Students needed to give a brief outline of Melbourne's energy needs. Most students who attempted the question gained at least one mark. For the full two marks, some expansion was required; for example, listing some of the needs (such as lighting, transport, factories and heating) or referring to base load and peak demand.

2b.

Marks	0	1	2	3	4	Average
%	1	6	26	41	26	2.9

Students needed to explain how the fossil energy source they had studied does or could contribute to Melbourne's energy needs. Students needed to refer explicitly to Melbourne' needs, link the fossil fuel to Melbourne and outline a distinct advantage of the nominated fossil fuel.

2c.

Marks	0	1	2	3	4	Average
%	3	5	31	36	26	2.8

Students needed to explain how the non-fossil energy source they had studied does or could contribute to Melbourne's energy needs. Students needed to link the non-fossil fuel specifically to Melbourne's needs and outline a distinct disadvantage of the nominated non-fossil fuel.

Students should be warned against giving a list of advantages or disadvantages when only one is asked for as assessors will only mark the first one listed.

Question 3

Question 3 was also very well done. It was noticeable this year that far fewer very general responses were seen.

3a.

Marks	0	1	2	3	4	Average
%	0	1	6	20	72	3.7

Students were asked to describe a population of the threatened animal species they had studied during the year. Answers needed to be particularly specific to that population, describe the location and size of the population and give a description of its habitat.

Most students performed very well on this question.

3b.

Marks	0	1	2	3	Average
%	0	3	22	75	2.7

Students had to outline the main threat to the species they had studied. Again, it was important that answers related specifically to the particular species studied.

This question was also answered very well.

3c.

Marks	0	1	2	3	Average
%	2	17	48	33	2.2

This question required the threat category of the species studied to be stated (either vulnerable, endangered or critical) and then justified using specific evidence. Many students ignored the 'trends' part of the question.

Since students should have been reasonably well prepared for questions on their studied species, some numerical estimate of population and time was expected for full marks.

3d.

Marks	0	1	2	3	Average
%	2	10	35	53	2.4

For Question 3d. students needed to describe a realistic management strategy that has been or could be used to protect the species they had studied. Reponses needed to go into some detail and relate specifically to the population described in part a. and the threats outlined in part b.

3e.

Marks	0	1	2	3	4	Average
%	7	17	38	27	11	**2.2**

Students were asked to evaluate the effectiveness of the management strategy described in part d. The term 'evaluate' requires that some element of judgement of success or otherwise be given, and firm data was required to support the evaluation. Students were expected to present some quantitative or semi-quantitative data.

Although the question did allow for a detailed plan to be discussed if the management plan has not yet been implemented, it was very difficult to achieve full marks this way. As an evaluation of a management plan is often asked for in the examination, teachers and students should be warned against studying a species for which no element of evaluation is possible.

Question 4

4a.

Marks	0	1	2	3	Average
%	7	18	32	43	**2.1**

A suitable answer would have been, 'Endemic to the area means that the species does not exist elsewhere. Hence, if this population dies out, the species is extinct, and it is therefore more in need of protection.'

4b.

Marks	0	1	2	3	Average
%	2	11	44	43	**2.3**

A number of different advantages or disadvantages were acceptable, including the following.

Advantage
- removing them from the at risk area

Disadvantage
- trauma associated with catching and relocation
- unforeseen unsuitability of the relocation area

4c.

Marks	0	1	2	3	Average
%	5	20	42	34	**2.1**

Many different strategies for protecting the population of the Giant Gippsland Earthworm (GGE) were given for this question. As the data provided on the examination paper was the only information students had about the GGE, even strategies that were barely relevant to an earthworm were generally rewarded, such as a wildlife corridor.

Students are again advised not to provide a list of strategies where only one is asked for. As this question asked for a description, simply mentioning three or four strategies, without providing any expansion or description, only achieved one mark.

Question 5

This question presented a scenario with a substantial amount of data relating to populations of Australian marsupials in mountain areas of Victoria.

5a.

Marks	0	1	2	3	4	Average
%	11	20	30	29	10	**2.1**

The first part of Question 5 asked students to explain how species richness and species diversity, which had been defined in the stem, are important in determining biodiversity. Students were required to support their comments by referring to the data in the stem.

The question was not particularly well done, with the major shortcoming being to make little or no reference to the scenario or the data in the question stem.

5b.

Marks	0	1	2	3	Average
%	16	13	29	41	**2.0**

The obvious reason for not logging area 3 was that it contained the only population of the critically endangered Leadbeater's Possum. Most students realised this and answered appropriately; however, some students missed this point entirely.

5c.

Marks	0	1	2	3	4	Average
%	8	5	11	19	58	**3.2**

Students needed to calculate an index and then interpret the meaning of the index in the scenario.

area 1

Species	No. of individuals	$p = \frac{\text{No. of individuals}}{\text{Total no.}}$	p^2
Common Brushtail Possum	54	0.45	0.2025
Leadbeater's Possum	0	0	0
Common Ringtail Possum	30	0.25	0.0625
Yellow-bellied Glider	6	0.05	0.00250
Sugar Glider	12	0.10	0.0100
Feathertail Glider	6	0.05	0.00250
Eastern Pygmy-possum	12	0.10	0.0100
	Total no. = 120		Total p^2 = 0.2900

Simpson's Index (D) = 1 – 0.29 = 0.71

area 2

Species	No. of individuals	$p = \frac{\text{No. of individuals}}{\text{Total no.}}$	p^2
Common Brushtail Possum	30	0.25	0.0625
Leadbeater's Possum	0	0	0
Common Ringtail Possum	18	0.15	0.0225
Yellow-bellied Glider	12	0.10	0.0100
Sugar Glider	30	0.25	0.0625
Feathertail Glider	18	0.15	0.0225
Eastern Pygmy-possum	12	0.10	0.0100
	Total no. = 120		Total p^2 = 0.1900

Simpson's Index (D) = 1 – 0.19 = 0.81

Students are not expected to know or memorise any particular indices, but should have encountered some and carried out some calculations as part of their practical and field work. All information required about Simpson's index was included in the question.

As in previous years, this question was well done. Mathematical errors, no matter how many, were penalised only once; that is, one mark out of the four. Most of the mathematical errors related to adding the column to find p^2, generally by mistaking where the decimal point was in each value.

5d.

Marks	0	1	2	3	Average
%	16	17	38	29	**1.8**

This question asked students to comment on the species diversity of the two areas used in the previous part, with particular reference to the meaning of the Simpson's Indices they had calculated.

Despite being clearly requested, the most common error was simply to restate the meaning of species diversity without making any reference to Simpson's Index, or often to any data.

5e.

Marks	0	1	2	3	4	Average
%	9	13	27	27	24	2.5

The final question on the paper asked students to discuss reasons for maintaining biodiversity in terms of human health and wellbeing. Marks were awarded for any examples of biodiversity that serve human needs; for example, food, medicine, genetic health, cultural and recreational needs, etc.