VICTORIAN CURRICULUM AND ASSESSMENT AUTHORITY

2009 Environmental Science GA 1: Examination 1

GENERAL COMMENTS

The VCE Environmental Science study involves in-depth exploration and investigation of case studies, with emphasis on local issues, and the use of field and practical work. Short answer Questions 1 and 3 on the 2009 June examination tested this. It was noteworthy that these questions were done significantly better than other questions on the exam. In many cases students' responses which related to a particular fossil and non-fossil energy source, and a threatened animal species, were very specific and had considerable depth, reflecting the way these areas have been taught.

Students did not perform well on Questions 2a. and b. in Section B, about the pathways of visible, infrared and ultraviolet radiation and the mechanism of the greenhouse effect. Given that the major emphasis of Area Study 1 of Unit 3 is on global warming, and the comments related to this that have appeared in past Assessment Reports, it is disappointing that students have not focused on improving their understanding of this area.

It was pleasing to see some improvement in the interpretation of graphs and the use of calculations to manipulate data, which have been noted as areas of weakness in the past. Again this year there were very few instances of students being unable to complete the paper.

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	% No Answer	Comments
1	97	0	1	2	0	
2	6	7	78	9	0	Natural gas is a fossil, non-renewable energy source. Students should be aware of these terms and have an understanding of how they apply to major energy sources.
3	2	9	2	87	0	
4	81	8	9	2	0	
5	7	76	12	4	0	The overall efficiency equals 0.60 x 0.80 x 0.85 = 0.408 = 40.8 % therefore the best answer was option B.
6	3	20	66	11	0	The law of conservation of energy states that energy cannot be created or destroyed, only changed from one form to another – option C referred to this transformation. Not all of the energy in natural gas will be converted into electricity, with much being lost in the form of heat.
7	5	14	21	58	1	Energy is lost in the transmission of electricity through power lines (as waste heat), and little energy is lost by the flow of gas in pipelines. Therefore the gas-fired power station should be close to Melbourne to improve energy efficiency.
8	8	90	2	1	0	
9	6	17	7	70	0	
10	3	7	80	10	0	
11	96	3	1	1	0	
12	68	9	0	22	0	

Question	% A	% B	% C	% D	% No Answer	Comments
13	13	17	67	3	1	According to the graph the number of individuals per square kilometre in 1940 was 20, and by 1990 the number was 5. Therefore the number of individuals has decreased by 15. $\frac{15}{20} \times \frac{100}{1}$ = 75 % (option C)
14	7	6	86	1	0	The formula for the calculation was given in the stem of the question and students were required to use the figures provided. Therefore the total population size = $\frac{25 \times 42}{3}$ = 350 (option C).
15	1	86	12	1	0	
16	11	35	19	36	0	Demographic variation refers to chance variations in death rate, birth rate and age/sex composition over time. The effect of variations in sex ratios in small populations can have a marked impact.
17	18	29	11	42	0	The most likely reason for considering the removal of a number of Northern Hairy-nosed Wombats from southern Queensland and relocating them in a similar habitat in northern New South Wales is to avoid a major population loss if their specific habitat was destroyed. Genetic swamping can occur when two previously isolated populations come into contact with each other (which is not happening in this case).
18	1	2	15	81	0	
19	89	1	5	5	0	
20	63	6	24	7	0	To calculate the probability of extinction students were required to multiply the estimated risk of the two populations to gain an answer of 0.005. Some students made the mistake of adding the two figures together.

The multiple-choice section of the paper proved to be relatively straightforward, with an average score of about 75 per cent. Questions 1–9 focused on basic energy terms and concepts such as renewability, exothermic/endothermic and efficiency. Questions 13–20 related to two different biodiversity issues and required an understanding of Area of Study 2.

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 required students to write about a fossil and non-fossil energy source they had studied as part of Outcome 1. Students who had clearly investigated a specific fossil and non-fossil energy source, including a location where the energy sources were being used, were able to answer the question well.

1a.

Marks	0	1	2	3	4	Average
%	3	4	19	41	33	**3**

Students needed to correctly name a fossil fuel energy source and describe how it is being used at a specific geographic location to provide for the energy needs of that particular location. Students were required to discuss whether the fossil fuel will be able to supply the location's energy requirements.

Most students discussed coal and related it to electricity use in Melbourne. Some poorer answers focused on energy generation rather than use, and there was some confusion over the provision of base and peak loads. There was also a wide estimation in the length of time coal might remain available in the Latrobe Valley and some inaccurate understanding of the non-renewability of coal.

1b.

Marks	0	1	2	3	4	Average
%	4	6	24	39	27	**2.8**

Students needed to correctly name a non-fossil fuel energy source and describe how it is being used at a specific geographic location to provide for the energy needs of that particular location. Students were required to discuss whether the non-fossil fuel will be able to supply the location's energy requirements.

Chosen non-fossil energy sources included solar, wind and hydroelectric at various locations, especially at sites in Victoria. Better answers were able to clearly describe the use of the energy source at the particular location. Some poorer answers tended to focus on the generation of the energy rather than the use.

1c.

Marks	0	1	2	3	4	5	Average
%	3	3	11	29	38	16	**3.5**

Some discussion of the relative costs and benefits of the two energy sources was required with an evaluation of which one was more effective. This comparative judgment could have been based on a variety of factors including environmental, economic and/or social, and should have clearly indicated an understanding of the concept of sustainability.

Question 2

Question 2 focused on the students' understanding of both the natural and enhanced greenhouse effect. There was some improvement in the understanding of the mechanism that allows heat energy to become trapped by the various greenhouse gases, and the ability to correctly identify naturally occurring greenhouse gases and those that have been introduced or substantially increased by human activity. Students at this level should be able to correctly spell 'carbon dioxide' and 'chlorofluorocarbons', and use correct phase (state) subscript notations on CO_2, SO_2 and CH_4.

2a.

Marks	0	1	2	3	4	5	Average
%	9	14	25	14	17	20	**2.8**

Line	Radiation type (UV, visible, IR)
A	visible
B	ultraviolet
C	infrared
D	visible
E	infrared

This question tested students' understanding of how visible, ultraviolet and infrared radiation travel through the atmosphere and interact with Earth's surface. Many students clearly understood the pathways and differences between the types of radiation and were able to complete the table correctly.

2b.

Marks	0	1	2	3	4	Average
%	6	14	34	33	13	**2.4**

Students needed to explain how the use of the fossil fuel energy source indicated in Question 1 produces greenhouse gases (that is, through combustion), and how these gases affect the enhanced greenhouse effect (that is, by the absorption of re-radiated infrared radiation). After explaining the mechanism students needed to indicate some actions which would reduce the enhanced greenhouse effect. Students focused on the reduction of fossil fuel usage and replaced use with energy forms such as solar, wind, etc. Other answers discussed the use of scrubbers in fossil fuel energy stations, capturing CO_2 using forest plantations and CO_2 sequestration underground. The question was generally well answered.

2c.

Marks	0	1	2	Average
%	3	14	83	**1.8**

Most students correctly gave carbon dioxide and water vapour as their answers. Other correct answers included sulfur dioxide (from volcanoes) and methane (from decomposing vegetation in swamps). Some students incorrectly gave nitrogen as an answer.

2d.

Marks	0	1	Average
%	33	67	**0.7**

Most students were able to identify chlorofluorocarbons as the main greenhouse gas introduced by human activity. A few students correctly gave sulfur hexafluoride as their answer.

2e.

Marks	0	1	Average
%	9	91	**0.9**

The most common answer was carbon dioxide. Sulfur dioxide and methane were also accepted.

Question 3

Question 3 was generally very well done. It was again noticeable this year that far fewer general responses were seen, and that most students had investigated examples of a threatened animal species at a specific location. A few students had problems with the spelling of locations and locating specific sites (for example, the Flinders Ranges in New South Wales), as well as using inaccurate figures to indicate population size or changes in population numbers over time.

3a.

Marks	0	1	2	3	4	Average
%	3	3	10	27	57	**3.3**

Students were asked to describe one population of the threatened animal species they had studied during the year. Answers needed to be specific to that population, describing its location and size and giving an indication of the likelihood of its long-term survival.

Most students performed very well on this question.

3bi.

Marks	0	1	2	Average
%	8	40	52	**1.5**

Students were required to state the degree of threat under which their species is classified under using a standard conservation category (for example, vulnerable, endangered, critical), and correctly indicate the criteria for inclusion in this category. Most students were able to indicate the correct category and criteria for their particular animal species.

Poor answers did not link the conservation category with the correct criteria. Some students changed the conservation category they were referring to throughout Question 3.

3bii.

Marks	0	1	2	3	Average
%	1	9	49	42	**2.3**

Students had to outline the main threats to the specific population of animal at the identified location. Better answers gave a variety of key threats and made it clear how they impacted on the individual population. This was then linked to a judgment about the likelihood of extinction of this specific population (not the species overall).

3c.

Marks	0	1	2	3	4	Average
%	14	13	30	27	15	**2.2**

This question required students to give an outline of a monitoring process or processes undertaken to investigate the threatened species. The monitoring should have generated some specific numerical data related to the species'

conservation category. Better answers clearly showed that students had studied actual case studies of a threatened species and had investigated the collection and analysis of relevant scientific data.

3d.

Marks	0	1	2	3	Average
%	4	12	34	49	**2.3**

For Question 3d. students needed to describe a realistic management strategy that has been used to protect the population at the particular location. Reponses needed to go into some specific detail regarding the implementation of a suitable strategy and relate it to the particular population rather than the species in general.

3e.

Marks	0	1	2	3	4	Average
%	7	10	27	33	23	**2.6**

Students were asked to evaluate the effectiveness of the management strategy described in Question 3d. The term 'evaluate' requires that some element of judgment 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.

As a description and evaluation of an actual management plan/strategy is often asked for in the examination, teachers and students should be warned against studying a species for which no actual management plan exists and therefore no element of evaluation is possible.

Question 4

4a.

Marks	0	1	2	3	Average
%	8	17	32	43	**2.1**

Vegetation class	Working	Number of individuals per hectare
A	$\frac{3+5+2+2}{4} = \frac{12}{4}$ = 3 per 10 hectares	$\frac{3}{10} = 0.3$
B	$\frac{4}{9} = \frac{6}{4}$ = 1.5 per 10 hectares	$\frac{1.5}{10} = 0.15$
C	$\frac{0+0+0+0}{4} = 0$ = 0 per 10 hectares	0

Students were required to calculate the average occurrence of the Mallee Emu-wren in each class of vegetation. They needed to show their working to gain full marks.

4b.

Marks	0	1	2	3	Average
%	28	8	14	49	**1.9**

Vegetation Class A – 0.3 birds per hectare x 400 hectares = 120
Vegetation Class B – 0.15 birds per hectare x 500 hectares = 75
Vegetation Class C – 0 birds per hectare x 1000 hectares = 0
Total = 195 birds

Students used the calculation from Question 4a. to determine the average population size of the Mallee Emu-wren for the entire reserve. Students needed to show working to gain full marks.

4c.

Marks	0	1	2	3	Average
%	21	30	32	18	**1.5**

Most students had a basic understanding of the requirements of the *Flora and Fauna Guarantee Act 1988* and were able to discuss what should happen **after** a species is listed under the Act in Victoria. The description should have included the establishment of an action plan/statement which gives the species further legal protection and focuses on strategies to address threatening processes.

Some students did not read the question carefully and wrote incorrect answers about what steps should be followed in order to list a species under the Act. Other misdirected answers focused on the establishment of a captive breeding program, which is not necessarily a legal requirement of listing under the Act. Students found this question to be one of the more difficult questions on the paper.

4d.

Marks	0	1	2	3	Average
%	22	24	40	13	**1.5**

Consequences of an action plan being developed means that strategies to address the conservation needs of the Mallee Emu-wren should be incorporated into the management of the reserve. If these management strategies are successfully undertaken, then a benefit to the species would be expected. This benefit could be an improvement in population numbers and therefore an improvement in conservation status.

Some students found it difficult to answer this question if they had misread Question 4c. but were able to discuss some consequences related to the conservation status. Some students attempted to explain how listing under the Act would not benefit the species but found it difficult to justify their position.

Question 5

This question presented a scenario with a substantial amount of data relating to the species of butterflies recorded in three different habitat types.

5a.

Marks	0	1	2	Average
%	16	23	61	**1.5**

Communities	Working	Answer
Remnant and revegetation	$S_1 = \frac{6}{10}$	0.6
Remnant and plantation	$S_1 = \frac{4}{9}$	0.44

Students were required to use the Jaccard's Index provided to calculate a measure of similarity between two communities. Given that the formula and a worked example were provided in the question, most students were able to calculate the correct answers. To gain full marks students were required to show working.

5b.

Marks	0	1	2	Average
%	14	2	84	**1.7**

Based on the calculations in Question 5a. the highest value is 0.6, therefore the remnant vegetation and revegetation butterfly communities are the most similar.

5c.

Marks	0	1	2	3	4	Average
%	10	17	38	25	9	**2.1**

Students were required to discuss one benefit and one limitation for the conservation of butterflies as a result of establishing a large area of plantation on farmland which would then be harvested for timber. Students' discussion of a benefit needed to focus on the likelihood that the four species found to exist in plantations would gain habitat. A mark

was also awarded to responses which noted that this may be difficult to assess given that no survey data was provided about the number of butterfly species that exist in farmland. Limitations focused on the disruption the harvesting of timber would cause on the four species, and that in terms of biodiversity it would be better to establish the revegetation community which would provide habitat for seven species.

5d.

Marks	0	1	2	3	4	Average
%	17	16	24	25	18	2.1

The question required students to describe a suitable scientific investigation process that the environmental scientist described in the question would use to test her observations. They needed to explain that in setting up the investigation she should have included fenced remnants of native vegetation (which excluded cattle) and unfenced areas which cattle could graze on. A control is required to measure results against. Both areas needed to be of a sufficient size to gain statistically significant data, and a sufficient amount of time had to be given to allow for any changes to be evaluated. Once undergrowth has recovered, an assessment of the status of the butterfly populations should be undertaken and compared against the unfenced areas. The number must be significantly different for any clear judgment to be made on the success of the fencing.

A number of students discussed the use of a population viability analysis or conducting an environmental impact assessment, which was not the focus of the question.