VICTORIAN CURRICULUM AND ASSESSMENT AUTHORITY

2006 Environmental Science GA 3: Written examination 2

GENERAL COMMENTS

Once again, teachers are to be commended for the enthusiastic way that students are being educated in the Environmental Studies course. In particular, it is pleasing to see the obvious way that most teachers are entering into the spirit of the course; namely through in-depth case studies with, where possible and practical, emphasis on local issues. As the choice of in-depth studies can impact on the ease with which students can respond to examination questions, some comment is made on this below. There is a general trend towards an improved standard of responses.

Again this year, the examination was designed to reflect the course's focus on in-depth case study work, with an emphasis on local environmental issues (short-answer Questions 1 and 4). In previous Assessment Reports emphasis has been placed on the need for students to be specific in their responses, and this seemed to have improved this year; students' answers often showed specific examples, geographic locations, etc. Assessors look for specificity rather than generality in questions relating to in-depth studies, due to the time that should have been devoted to them in class.

The length of the examination seemed appropriate, as there was little evidence of students being unable to complete the paper.

Action words

Certain key terms are used in the examination questions in an attempt to be very specific about the type of responses sought. These terms have been mentioned in previous reports; however, students appear to have difficulty with the following two terms in particular:

- evaluate: requires a judgment based on evidence or data – a description alone is not sufficient. Generally, evidence for the evaluation will also be asked for
- compare: list similarities and differences.

In-depth studies

Although the choice of in-depth study depends on the local educational and student needs, the ease with which students can respond to questions that relate to in-depth studies does depend to some extent on the example chosen and the detail and specificity of the study.

Students are required to undertake two in-depth studies in Unit 4, one on a pollutant (other than sulfur dioxide or mercury) and the other on an environmental project. Generally, the more specific the focus of the study, the easier it will be to respond to examination questions.

The pollutant study should be of a pollutant (or an instance of a pollutant) that is introduced at a particular time and location, where there is a management plan or strategy to deal with it and some evaluation, supported by evidence, of the success of the plan. Therefore, a study 'To reduce NO_2 levels in the CBD of Melbourne over the period 1990 to 2005' would be better than a the broader 'To reduce NO_2 emissions'. The success or failure of the former study could be easily be evaluated in terms of information on EPA websites, etc. Even where actual measurements are taken, and this is to be encouraged, comparisons with other data can be made.

Similarly, in the study of an environmental project, the project (or the section of a project) should have a clear location, beginning and ending. This could be either a project to improve something (for example, reduce lead exposure in a town around a mining/processing facility), or a project to reduce environmental damage in a construction project (for example, reduce the environmental damage of building a particular piece of freeway). The examination questions are developed to allow for either type of study. If the environmental project focuses particularly on measurement, which some do, the aim of the measurements should be clear. For example, if the study is to monitor the CO levels outside the school for a two-week period, it should be placed in the context of reducing CO levels and compared with EPA or other data to check the effectiveness of reduction strategies.

In recent examination papers there have been some questions worth five marks (refer to Questions 1b. and d., 3e., 4e. and 5d. in 2006). In these questions, students should be encouraged to provide a cohesive and logical response to the question, rather than simply writing a number of facts relating to the question asked.

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SPECIFIC INFORMATION

Section A – Multiple-choice questions

Question	% A	% B	% C	% D	% No Answer	Comments
1	94	2	1	2	0	
2	83	9	5	3	0	
3	6	7	5	82	0	
4	19	3	4	73	0	
5	9	8	82	1	0	
6	6	54	37	2	1	Allergies are caused by (over)activation of the immune system; that is, an unnecessary reaction occurs in some part of the immune system. Although almost all (92%) of students realised that allergies are related to the immune system, many thought that they are caused by a failure of the immune system to react (which led them to select alternative B).
7	11	2	86	2	0	
8	91	5	4	1	0	
9	8	2	88	2	0	
10	1	1	94	4	0	
11	3	8	84	5	0	
12	9	8	13	68	1	
13	5	5	89	1	0	
14	8	63	4	25	0	
15	3	12	80	6	0	
16	1	1	98	1	0	
17	5	82	11	1	0	
18	1	10	10	79	0	
19	0	31	2	66	0	
20	30	6	8	56	0	Taking *E.coli* measurements at different sites would enable identification of sites where the readings were relatively higher (that is, close to where the pollution is entering the river). Hence, it enables the identification of the sources of pollution – alternative D. Alternative A gives a good reason for taking samples at different **times**, but would not be a reason for using different sites.

Section B – Short-answer questions

Note: Student responses reproduced herein have not been corrected for grammar, spelling or factual information.

Question 1

VCE Environmental Science requires the in-depth study of one pollutant source **other** than sulfur dioxide or mercury. In 2006, this was tested in Question 1.

As mentioned in the General Comments, the choice of a specific, defined study made it easer for students to respond well to this question. For example, studying 'oxides of nitrogen' without any specific location or time frame, made the question difficult to answer because different oxides have very different persistence, effects and sinks.

If a material is used that can either be a pollutant or can be clearly contained and not a pollutant, then it must be clear that the aspect that is a pollutant is being referred to. For instance, a chemical which in itself is injurious to human health, that is used in an intermediate stage in an industrial process and always contained within a factory and never escapes, can hardly be described as a pollutant. Similarly, sewerage and fertiliser only become pollutants if they escape from where they are intended to be; if sewerage is in a pipeline on the way to a sewerage treatment plant or fertiliser is in the ground in a crop, it is hard to describe a strategy for removing it – that is where it is intended to be.

1a.

Marks	0	1	2	3	Average
%	4	14	59	23	**2.0**

The generally accepted defining characteristics of a pollutant are that it must:

- be introduced into the environment by human action
- have a detrimental effect on the environment.

To gain the third mark, students were required to relate at least one of these characteristics to their nominated pollutant. The most common error was not to comment on the non-natural introduction.

1b.

Marks	0	1	2	3	4	5	Average
%	4	1	5	16	34	40	**4.0**

Most students achieved high marks for this question. Common reasons for not achieving full marks were providing very general responses or failing to address one of the items mentioned in the question.

1c.

Marks	0	1	2	3	Average
%	13	14	33	40	**2.0**

Common errors included mentioning a specific **human** strategy to remove the pollutant, or not mentioning persistence at all; although the term persistence did not have to be explicitly used, students were required to make some reference to the time the pollutant remains in the environment.

1d.

Marks	0	1	2	3	4	5	Average
%	6	3	12	23	31	25	**3.4**

As mentioned in the General Comments, the term 'evaluate' demands some form of judgement, in this case to be backed up by some evidence. Since this question related to a pollutant studied in-depth, it was expected that students would have some evidence of the outcome of the strategy. Good responses quoted some numerical evidence; for example, 'the levels of lead measured in the atmosphere in a particular area of Melbourne from the time of introduction of unleaded petrol to 2005 reduced by 60%'.

Question 2

Students are required to know the general characteristics of sulfur dioxide, as this is one of the two specified pollutants to be studied. This question asked students to use that knowledge and apply it to a particular scenario.

2a.

Marks	0	1	2	Average
%	15	32	53	**1.4**

The common effect of sulfur dioxide exposure is irritation of the throat and eyes; in larger dosages, it can also affect the lungs. Most students were able to answer this question well. Some seemed to consider sulfur dioxide to be more dangerous than perhaps it is – it is unlikely that 'any exposure is inevitably fatal', as one response suggested.

2b.

Marks	0	1	2	Average
%	2	47	52	**1.5**

Most students realised that sulfur dioxide is airborne or windborne. This response was awarded one mark. To gain two marks it was expected that students would refer to the fact that the highest levels were found when the wind was blowing from the east and there was no rain.

2c.

Marks	0	1	2	Average
%	22	45	32	**1.1**

One mark was awarded for giving water as the sink for sulfur dioxide. For two marks, it was necessary to indicate that the difference between 18 and 19 March (when the wind was from the east) was due to the fact that it was raining on 19 March – indicating that water/rain is the sink. The data in Table 1 provides no evidence that the ocean is a sink.

2d.

Marks	0	1	2	3	Average
%	10	30	45	16	**1.7**

Exposure relates to the levels and time the sulfur dioxide is in the environment in which the residents exist. Dosage refers to the amount absorbed into the body.

The following is an example of a three-mark response.

The exposure to the sulphur dioxide is the amount that the city residents are exposed to (or come into contact with) over a given amount of time. The dosage would be the amount of SO_2 absorbed by the city residents per kg of body weight over the given amount of time.

Question 3

This scenario question contained all the required information, and students were expected to apply this information to the scenario given.

3a.

Marks	0	1	2	3	Average
%	15	26	41	18	**1.6**

Benzene is more volatile than water and so will evaporate into the atmosphere more rapidly over time, decreasing the concentration as shown in Figure 3.

3b.

Marks	0	1	2	Average
%	40	9	51	**1.1**

$$\text{Concentration} = \frac{80}{50} = 1.6\text{g/L}$$

Full marks were given for the correct answer with no working, or for a correct answer in different units, if the answer was correct in those units.

3c.

Marks	0	1	2	Average
%	8	34	58	**1.5**

The untreated sample acts as a control, which provides a basis for comparison with the treatments.

3d.

Marks	0	1	2	3	4	Average
%	26	16	19	19	20	**1.9**

The untreated sample shows a 50 per cent reduction in the amount of benzene after four hours, and a further 50 per cent reduction after eight hours. This is the same as data collected from the real-life scenario and so this laboratory experiment successfully models real-life.

Students needed to refer to both the real data and the experiment for full marks. A common mistake was to compare the treatments; however, the question referred to comparison between the data in Figure 3 (theoretical persistence) and the untreated sample in Figure 4.

3e.

Marks	0	1	2	3	4	5	Average
%	15	5	13	21	27	19	**3.0**

This question sought a comprehensive comparison on the relative merits of the different treatments.

The point overlooked by most students was why the detergent treatment may have been worthwhile; the benzene would only seriously affect people in the city if it were airborne, hence decreasing its evaporation may reduce exposure.

Most students were able to find some obvious advantages and disadvantages of the two treatment methods. Some discarded the detergent treatment because it decreased rather than increased the evaporation, without seeing the possible advantage of this in the situation discussed. There were relatively few students who provided their answer as a simple tabulation of an advantage and disadvantage for each method. This was the easiest way to address the 'comparison' required in the question.

Question 4

This question related to the environmental science project studied in depth. As in previous years, a wide variety of projects emerged in students' responses. Students were required to discuss either a project with an explicitly environmental aim (for example, reducing pollution in a particular ecosystem) or avoiding environmental damage in a construction project.

4a.

Marks	**0**	**1**	**2**	**Average**
%	4	17	79	**1.8**

4b.

Marks	**0**	**1**	**2**	**Average**
%	5	11	84	**1.8**

4c.

Marks	**0**	**1**	**2**	**Average**
%	32	40	28	**1.0**

4d.

Marks	**0**	**1**	**2**	**3**	**Average**
%	12	15	33	40	**2.0**

Parts a–d. were generally well answered. The differences in marks generally lay in more or less specificity or generality.

4e.

Marks	**0**	**1**	**2**	**3**	**4**	**5**	**Average**
%	15	6	14	27	21	16	**2.8**

In part e. an evaluation was asked for, therefore some element of judgement, backed up by evidence, was required. Teachers should ensure that students are prepared to make judgments on effectiveness and that they have included some evidence to support the judgement. In particular, care should be taken where a project has commenced but has not been completed (or a particular stage of it has not been completed). In this case, it is very important to outline what would be considered a success, ways of monitoring this and criteria for success.

An example of an excellent answer is shown below. The project studied was the Lynbrook Housing Estate, a new housing development where Melbourne Water attempted to reduce the runoff of pollutants into Port Phillip Bay by a variety of means, including settling ponds:

This project has been very successful. In the project, Melbourne Water aimed to reduce phosphorus in the discharged stormwater by 45% compared with an equivalent estate of similar size. However in 3 years phosphorus was observed to have reduced to 80%. The aim for nitrogen levels was to be reduced to 60%, and 75% was achieved. Suspended solids: aim 80%, with 90% achieved.

The aim of the project was to improve storm water quality at Lynbrook Estate before discharge into Port Phillip Bay, and the quality of water has improved, thus achieving the aim for improved stormwater quality.

Our test we did have also shown improvement. The 2005 Y 12 class had measured less than 0.020 phosphorus; this year we recorded less than 0.010 of total phosphorus in the wetlands area, before it runs off into nearby waterways that end up in Port Phillip Bay.

Question 5

5a.

Marks	0	1	2	3	Average
%	16	18	44	23	**1.8**

'Ecologically sustainable' means that it is used to meet the needs of this generation, while still providing for future generations, particularly in their environmental and ecological needs. For full marks, students were required to make some reference to electricity generation.

The following answer both explains the term 'ecologically sustainable' and relates it to the generation of electricity – the two criteria used in marking.

Ecologically sustainable electricity generation would be that which allows sufficient energy to be generated for today's population without compromising the ability of future generations to meet their own electricity needs.

Ecologically sustainable means it can continue indefinitely without doing permanent harm to the environment. For power generation this relates to renewable resources such as wind energy. Producing electricity from coal is not ecologically sustainable.

Ecologically sustainability means the use of the environment to meet the current generations needs without degrading it for future generations. Renewable sources (such as wind) are ecologically sustainable, where as non-renewable sources (such as coal) are not.

5b.

Marks	0	1	2	3	4	Average
%	17	6	13	23	41	**2.7**

A wide range of key stakeholders was accepted, including:

- people who need the electricity
- landowners and residents close to the proposed power stations or other facilities (for example, power lines) whose health or quality of life may be affected
- local/regional government which has responsibility for maintaining the quality of the area (for example, the EPA or a similar government regulatory body).

Only one mark was awarded if the two responses simply repeated each other; for example, 'Government bodies' and 'EPA'. Students should be aware that if two responses are asked for, only two should be given. If more than the required number of clearly separate responses were given, only the first two were marked.

5c.

Marks	0	1	2	3	Average
%	18	19	32	32	**1.8**

Life cycle analysis means taking into account **all** the costs throughout the whole life of project. In addition to the setting up costs, these include fuel, maintenance, and, in particular, the cost of decommissioning, dismantling and restoring the area. A wide variety of factors were mentioned and received marks.

5d.

Marks	0	1	2	3	4	5	Average
%	16	6	19	27	28	5	**2.6**

The cogency of students' arguments was taken into account when marking this question. High-scoring responses referred to both Brad and Claire's arguments, gave some judgement about each, and provided an overall judgement or evaluation.

Many students correctly pointed out that Brad tended to favour economic arguments, while Claire considered more environmental concerns to be dominant.

The following is an example of an answer that received four marks.

The focus of Brad's argument is on the economic benefits of the coal-fired power station. The statement that initial and life-cycle costs are lower is accurate – as well as the advantage of continuous production. However, the solution of geosequestration to store the CO_2 is not a viable or well developed technique. It degrades land, is costly and the effect of the CO_2 is unknown. He is clearly ignoring the environmental impacts of the coal-fired station.

The focus of Claire's arguments is on environmental sustainability. Wind power is a renewable source and hence does not directly emit CO_2 or other greenhouse gases. The establishment of wind-power as the most environmentally considerate is appropriate. However she fails to recognise the environmental impact of wind-power farms on bird life and hence does not offer a solution. She gives little consideration to the economic factors. Her argument is not as substantial as Brad's as it lacks consideration of all effects environmental and economic.