2005 Assessment Report

VICTORIAN CURRICULUM AND ASSESSMENT AUTHORITY

2005 Environmental Science GA 3: Written examination

GENERAL COMMENTS

Teachers of Environmental Science should be congratulated for the obviously sound preparation that students are receiving in this subject and the enthusiasm being engendered. In particular, the standard of examination responses in terms of specificity and analysis seems to be steadily improving, and this is certainly in large measure due to the mode of teaching and learning being employed by teachers. This trend shows that teachers are obviously teaching to the spirit of the course (that is, in-depth studies of a specific pollutant and an environmental project), and using these to teach the key concepts rather than asking students to rote learn definitions and ideas.

Both Outcomes 1 and 2 in Unit 4 include an in-depth study, and these are examined by what are termed 'generic' questions: questions that students respond to in terms of the in-depth studies they have undertaken during the year (Questions 1 and 4 of Section B on the 2005 paper). The other questions require students to respond to specific scenarios and/or questions as given on the paper. The Environmental Science examination requires some analytical and evaluative type responses. Students may be required to provide evidence in support of their responses.

Below is a list of some of the 'action' words used on the paper. Students should be aware of the different requirements of various instructions in questions.

- name/nominate: simply state; for example, 'name a pollutant – *chlorofluorocarbon*'
- define: requires a description that identifies and differentiates the term or concept
- describe: requires some properties of the subject; for example, 'describe the pollutant – *a pink liquid, volatile, lower density than water, toxic to humans*'
- outline: briefly give an overview of the main features or issues; for example, 'outline a management plan – *list measures to safeguard the environment, set up equipment to monitor emissions, establish acceptable limits, determine whether limits are met, if necessary modify procedure*'
- evaluate: requires a judgment based on evidence or data
- compare: list similarities and differences

In particular, if the question asks for an evaluation, a description will not achieve full marks. Some element of judgement must be present, preferably supported by some evidence; for example, Question 6c. on this paper.

Unlike previous years, there was some evidence that some students found the paper a little long. Although the number of questions and parts were consistent with previous years, there was probably more reading, assimilation and evaluation required this year.

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
1	80	7	2	12	0
2	2	78	11	9	0
3	49	35	13	3	0
4	3	14	76	7	0
5	2	85	7	5	0
6	1	2	10	87	0
7	3	89	2	5	0
8	0	63	3	33	0
9	3	4	5	88	0
10	1	13	1	85	0
11	11	5	83	1	0
12	54	23	17	5	1
13	28	0	2	70	0
14	12	33	30	23	1

Question	% A	% B	% C	% D	% No Answer
15	48	13	24	15	0
16	2	90	3	4	0
17	90	2	1	6	0
18	3	93	2	3	0
19	0	2	5	92	0
20	42	2	46	11	0

In this area of the paper, multiple-choice questions are placed in scenario-type situations where possible. The *Environmental Science VCE Study Design* requires students to be able to manipulate data, hence students should be able to interpret graphs and do simple calculations, such as determine averages and concentrations. They should also be familiar with simple units, such as of volume, mass and concentration.

Question 3
Sulfur dioxide is a gas more dense than air. It has a molecular mass of 64, compared with air, which has a molecular mass of about 29.

Almost half of the students thought that sulfur dioxide is less dense than air (this was also evident in Short-answer Question 3c.). It is possible that some students may be confused because very hot SO_2, for example in the plume from a power station exhaust, will rise through cooler air to a considerable height before cooling.

Question 14
Questions 13–15 related to a scenario about a proposed mining operation, and the risk assessment and planning relating to it. Question 14 asked students to calculate the concentration of arsenic in a river. Students are expected to be able to perform this type of calculation.

$$\text{concentration} = \frac{\text{amount of solute}}{\text{amount of solvent}}$$
$$= \frac{2.0\times10^{3}\,\text{g}}{10^{10}\,\text{L}}$$
$$= 2.0 \times 10^{-7}\ \text{g/L (option B)}$$

Question 15
They have ignored Life Cycle Analysis (option A), as there is no allowance for decommissioning and restoring the site.

Question 20
Life Cycle Analysis (option A) identifies all the environmental impacts over the lifetime of a project or program, not just at the beginning. A surprisingly small number of students answered this correctly. The majority of incorrect responses gave the precautionary principle (option C) as the answer.

Section B – Short-answer questions

Question 1
This question was on the pollutant that students studied in depth during the year. Students should know the physical (for example, solid/liquid/gas, density and volatility) and chemical (for example, solubility and reactivity) properties of the pollutant they have studied, and its effects on the health of humans and the environment. Students should be able to relate these to the characteristics of the pollutant: origin; source (how it enters the environment); transport mechanism; health effects (exposure, toxicity); and sink (both how it would naturally dissipate from the environment and how it is removed or reduced by management). They should be able to describe management strategies that have been used to reduce the introduction of the pollutant, to minimise its impact, or to remove it.

Where a very general pollutant (for example, 'air pollution') was discussed, it was difficult for students to attain the required specificity. A more defined situation, such as 'Emission from cars and efforts to reduce it in the Melbourne metropolitan area in the period 1990–2000' better enabled students to produce high-scoring responses.

Question 1a.

Marks	0	1	2	3	4	Average
%	4	7	18	32	39	**3.0**

Students were required to state some properties of their nominated pollutant. These needed to be reasonably fundamental to the material as a pollutant. There needed to be some reference to effects that are harmful either to humans or the environment.

The question was generally well done. Responses that were not as satisfactory generally quoted very peripheral or false properties. A few responses made no reference at all to harmful effects.

Question 1b.

Marks	0	1	2	3	Average
%	4	11	15	70	**2.5**

The source described had to relate to how the stated pollutant was introduced into its environment. Students had to state explicitly whether it was a point or diffuse source, and give a reason. A few students failed to mention point or diffuse at all.

Question 1c.

Marks	0	1	2	Average
%	7	21	72	**1.7**

Students were required to describe the transport mechanism of the pollutant. A small number of students gave a totally inappropriate transport mechanism for the pollutant; for example, 'by air' for phosphates.

Question 1d.

Marks	0	1	2	Average
%	14	28	58	**1.5**

The sink is the mechanism by which the pollutant naturally degrades or is removed from the environment. A small number of students clearly did not understand the concept of 'sink', and often described the source instead. A very small number described a management strategy instead of a natural sink.

Question 1e.

Marks	0	1	2	3	4	5	Average
%	5	5	17	30	32	11	**3.1**

This question required an evaluation of the effectiveness of a strategy to reduce the risk of the pollutant. Students had to provide some evidence in their responses. In order to receive full marks, some quantitative reference had to be made; for example, to a time line, the amount by which the pollutant had been reduced, or similar.

As this question related to something students would have studied in depth, a reasonably detailed response was needed in order to achieve the full five marks.

Question 2

This was a scenario question relating to a mining site in Black Butte, Oregon.

Question 2a.

Marks	0	1	2	Average
%	42	21	36	**1.0**

Multiple measurements are taken to average out random variations.

Question 2b.

Marks	0	1	2	3	4	Average
%	4	12	28	26	30	**2.7**

Good responses listed some of the impacts on human health. Answers generally referred to the effect on the nervous system, and to mercury's bio-accumulation and persistence. This question was generally well answered.

Question 2c.

Marks	0	1	2	3	4	5	Average
%	9	12	23	26	23	7	**2.7**

Students were required to explicitly refer to each of the sites C, D, E and F.

Locations C and D are above the level of the mine, therefore the transport mechanism is airborne. The levels are significantly lower at D than at C, as mercury and its compounds are heavy and not easily carried far by wind.

Locations E and F have much higher concentrations, and the mechanism is waterborne. The level at F is lower than E as mercury would settle in sediment.

Although not common, one incorrect response was to give 'carried by animals' as a common transport mechanism. This was presumably related to bio-accumulation.

Question 3

Question 3a.

Marks	0	1	2	Average
%	22	61	17	**1.0**

Coal contains considerable amounts of sulfur, which burns to SO_2 in the power station.

Question 3b.

Marks	0	1	2	3	Average
%	47	27	20	6	**0.9**

The SO_2 will be spread around the chimney, but will generally be reasonably close to it as SO_2 is significantly denser than air.

A significant number of students believed that SO_2 is less dense than air, and stated this in their answer.

Question 3c.

Marks	0	1	2	Average
%	24	23	54	**1.3**

SO_2 is soluble in water and forms sulfuric acid, which gathers in the pond and therefore affects the plants.

Question 3d.

Marks	0	1	Average
%	45	55	**0.6**

pH or acidity

Question 4

This question was on the environmental science project that students had studied in depth during the year. There was a variety of projects discussed, some of which made it easier to respond to the question than others.

The project could be either one which improves the environment in some way, or a major project which needs to have the environment protected during its construction phase. The main consideration when choosing a project should be that it is well defined in terms of location, time and aims. Since the examination will often ask for an evaluation of the success of the project, it is obviously easier if the project is completed (or some phase of it is completed), or there are clear criteria and means of assessing them if it is not yet completed.

Question 4a.

Marks	0	1	2	3	Average
%	2	5	31	62	**2.5**

For the environmental science project named, students needed to specifically refer to:

- an aim (for example, reduce the impact on native species during the construction of a freeway)
- a location (for example, the CityLink project in Melbourne, Victoria)
- a timeline (for example, to assess environmental impact at completion, or perhaps after one year, or end of some phase).

Responses needed to provide a clear idea of the project in order to achieve high marks. Answers varied somewhat but were generally good; there was a clear improvement in the level of detail provided over previous years.

Question 4b.

Marks	0	1	2	3	Average
%	9	15	30	46	**2.2**

Students needed to list the environmental impacts and/or risks. These needed to relate to the environment in some way and had to explicitly relate to the nominated project.

Question 4c.

Marks	0	1	2	3	Average
%	11	22	38	29	**1.9**

Students had to describe one or more strategies for meeting environmental aims or guarding against environmental damage. These needed to explicitly relate to the nominated project and had to be plans for some action, not simply, for example, 'conform to EPA requirements'.

Question 4d.

Marks	0	1	2	3	4	Average
%	13	13	28	30	17	**2.3**

This was an 'evaluate' question. It therefore required some sort of judgment as to effectiveness of the strategies described in Question 4c., and some element of evidence. Answers had to refer explicitly to the nominated project.

Responses were much more specific than in the past. One common error was to not have any element of judgment in the answer.

Question 5

Ecotourism was a new requirement in the Study Design and was therefore examined for the first time this year.

Question 5a.

Marks	0	1	Average
%	64	36	**0.4**

There are two elements seen to be essential to ecotourism:

- a respect for the environment, hence minimal damage is done to the environment
- an element of environmental education specifically built into the program.

Question 5b.

Marks	0	1	2	3	4	Average
%	9	9	24	32	26	**2.6**

Students were required to name an ecotourism activity or business. Specificity was rewarded here; for example, 'observing dolphins in Port Philip Bay', rather than 'whale watching'. A reasonably detailed description of the activity was needed for full marks, including a reference to educational or environmental awareness.

Question 5c.

Marks	0	1	2	Average
%	18	32	50	**1.3**

Students had to comment on why the operators of the business had labelled it 'ecotourism'. Students generally responded well.

Question 5d.

Marks	0	1	2	3	4	Average
%	13	12	28	29	18	**2.3**

For full marks, students needed to:

- indicate what is meant by 'ecologically sustainable'. Definitions could include an activity that can be continued indefinitely without permanent damage to the environment, or an activity that allows for the use of

the environment by this generation while preserving it for future generations. Most students provided an adequate explanation

- refer explicitly to the ecotourism activity described in part b. A number of students failed to do this, instead giving just a general description of ecologically sustainable
- make a judgement as to whether the description of the activity as ecologically sustainable was justifiable and give some reason for this, as related to their definition of ecologically sustainable.

Question 6

This question provided a scenario on dredging, including some of the arguments for and against, and asked for comments based on this information. The question involved a considerable amount of reading and assimilation and some students appeared to have run out of time to complete their answers.

Question 6a.

Marks	0	1	2	3	Average
%	15	35	36	15	**1.5**

This question asked about the Environmental Impact Assessment process and the Environmental Effects Statement (EES). Things that could be incorporated into this include arguments for and against, and appropriate consultation with stakeholders and community groups.

Question 6b.

Marks	0	1	2	3	Average
%	19	32	31	19	**1.5**

Answers could have included:

- the role of the media in giving a balanced account of both sides of the question
- the need for community groups to assess the arguments carefully
- the need to provide representation to the Impact Assessment process and to the government.

Question 6c.

Marks	0	1	2	3	4	5	Average
%	12	5	26	35	19	4	**2.6**

This question required students to summarise, comment on and assess the arguments given in the stem of the question. An evaluation was asked for, so some judgement about the relative merits of the arguments was expected.

Some students made comments that did not relate to the information given in stem. Other responses lacked any element of evaluation and simply repeated the arguments in the stem. Although this achieved some marks, full marks were not available.