



2008 Environmental Science GA 3: Written examination 2

GENERAL COMMENTS

The 2008 Environmental Science examination seemed to be of appropriate difficulty and length and there was little evidence of students being unable to complete the examination in the allocated time. Students performed well on the multiple-choice section, although Questions 12, 13 and 17 proved challenging.

The trend towards teaching the study using in-depth case studies regarding local issues continued this year. Generic questions relating to a specific case study (Questions 1 and 4) were well done. Teachers are encouraged to use this approach and focus on learning through field, laboratory and data analysis work related to specific case studies.

Teachers should consider their choice of pollutant carefully, environmental project and parallel selections in Unit 3, as the selection can have an impact on how easy or difficult students find answering the generic questions. In general, a small, local choice, focused in time and location, with a clear conclusion and outcomes, is most suitable.

Teachers and students should draw their attention to the use of the term ‘evaluate’ on the examination. When students are asked to evaluate a situation or argument, a judgment is required, usually between two possible approaches or lines of argument. For example, short answer Question 3, where students were asked to evaluate the arguments for and against the desalination plant. A significant part of the marks was given for the judgment of which argument seemed to be the stronger case.

When a question asks for a specific number of examples, only the number asked for will be assessed. Students should not give a long list of examples or instances when a specific number is asked for; for example, Question 4bii., where two key performance indicators were asked for, students should have only provided two answers.

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	8	7	70	14	Although there was a spread of incorrect responses, the most common incorrect response was option D – volcano. A volcano is a fairly obvious point source. Perhaps some students determine whether something is point or diffuse by considering how far the pollutant spreads rather than considering the exact entry point into the environment.
2	6	2	84	8	
3	14	76	3	7	The concept of ‘sink’ continues to cause difficulty for students. A sink is the mechanism by which the pollutant leaves the environment or is the long-term resting or storage mechanism for the pollutant. In this case, the sulfur dioxide dissolves in water (to form sulfuric acid) and ends up as acid in the lake. High winds (the common incorrect response) merely move the sulfur dioxide around the environment. It remains in the environment as sulfur dioxide.
4	82	9	4	5	
5	3	88	3	6	
6	3	79	4	13	
7	7	3	87	3	
8	6	91	1	2	
9	5	2	80	14	
10	7	2	13	78	
11	18	10	67	5	Tank A contains 100 g of the chemical in 10 L of water, or 100 g / 10 L = 10 g/L, C.



Question	% A	% B	% C	% D	Comments
12	23	49	18	9	In 20 s, 100 g of chemical enters stream. During the 20 s, 20 L/s x 20 s = 400 L of water flows past (could add the 10 L in the tank). Hence concentration = 100 g / 400 L (or 410 L) approx = 0.25 g / L, B.
13	0	0	36	64	
14	3	74	6	17	
15	5	85	3	7	
16	10	71	11	7	
17	5	24	59	12	The normal annual variation of species W and Z is approximately + / - 2000. Hence the change in these species over the three years is within normal variation and the variation is more likely to be random or sampling variation (option C).
18	53	2	44	1	The information indicates is a relationship, not a causal link, so the correct answer was option C. Further evidence is needed to establish a casual link.
19	3	2	4	92	
20	1	11	3	84	

Questions 5–7 tested students' understanding of and differentiation between three related concepts – toxicity, exposure and dosage.

- Toxicity refers in general to the harm that a pollutant can cause.
- Exposure is the amount of the pollutant in the environment, usually expressed as parts per volume or mass of environment – for example, mg (milligrams) per litre (of water), or sometimes ppm (parts per million).
- Dosage refers to the amount of pollutant actually absorbed by a person or animal – often expressed as an amount per kg of body weight. For example, µg per kg or, in the case of blood, µg per dL (micrograms per decilitre).

Short answer Question 1c. also required an understanding of this distinction between exposure and dosage. It would be possible to have a very high exposure but, with adequate precautions, no absorbed dosage.

Questions 11–12 tested students' ability to perform simple concentration calculations. This skill has been tested regularly on previous examinations, but is one of the more demanding and challenging calculations required in the study.

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

This question was one of two 'generic' questions on the paper (the other was Question 4) and required students to answer in terms of a pollutant (other than mercury and sulfur dioxide) which they had studied in depth as a case study. Students were expected to have considerable depth of knowledge on this pollutant.

Question 1a.

Marks	0	1	2	3	4	Average
%	4	11	13	27	46	3

Students needed to mention at least two physical or chemical properties of the pollutant, with relevance given to its effect as a pollutant and its effect on human health or the environment.

Question 1b.

Marks	0	1	2	3	4	Average
%	2	2	10	31	55	3.4

This question asked students to identify standard facts about their nominated pollutant. This question was generally well done, with the exception of the natural sink (Question 1biv.). The sink is the mechanism by which the pollutant is either

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destroyed (for example, by chemical change into another material) or its final resting place outside the environment into which it is sourced. A small number of students confused the transport mechanism with sink.

Question 1c.

Marks	0	1	2	3	Average
%	7	10	36	47	2.3

To receive full marks students needed to give:

- an indication that they understood the difference between exposure and dosage
- some quantitative or numerical reference. This is the pollutant students should have studied in depth so some numerical indication of the exposure or dosage was required.

Students did not need to have the exact units correct to receive full marks.

The following is an example of a good answer.

Levels of airborne lead particles have been measured in the residential areas surrounding the Port Pirie lead smelters. Prior to the implementation of the Lead reduction plan, the population was exposed on some days of unfavourable winds of levels in the air of up to 2 µg per m³. This level of exposure has caused dosages to be measured in children of up to 50 µg per dL (decilitre) to be measured in the blood. Levels above 10 µg / dL have been observed to cause brain damage in children.

Question 1d.

Marks	0	1	2	Average
%	39	28	33	1

This question asked for specific actions relating to **measuring** pollutant levels – not actions to be taken to reduce general population exposure.

The following is an example of a good answer.

Since the major method of absorption of airborne lead is by breathing particles in through the mouth, the use of a suitable mouth and nose mask when measuring suspected high lead levels would be a health and safety precaution.

Question 1e.

Marks	0	1	2	3	Average
%	5	11	27	56	2.4

This question was generally well done. Most students were able to outline a strategy.

Question 1f.

Marks	0	1	2	3	4	Average
%	7	8	22	31	32	2.7

The main reason students did not score highly for this question was that they did not give an ‘evaluation’ – that is, they failed to give a judgment about how successful the strategy was, together with some supporting evidence. Teachers and students are advised to select a pollutant and a region of exposure to it that enables a clear implemented strategy to be identified, together with some outcome indicating success or otherwise. Selection of a pollutant that is too general, or that does not specify an area and timeline, can make answering this type of question difficult.

Question 2a.

Marks	0	1	2	3	4	Average
%	8	5	26	54	7	2.5

General characteristic	Elemental mercury (Hg)	Sulfur dioxide (SO ₂)
Physical state at room temperature	liquid	gas
Solubility in water	low	high
Solubility in fat	low	low
Persistence in environment	long-term	short-term

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Many students were not aware of the difference between elemental (metal) mercury and some of its compounds. Elemental mercury is an insoluble liquid at room temperature. Some of its compounds are soluble in water (mercury salts) or fat (methyl mercury).

Question 2b.

Marks	0	1	2	3	4	Average
%	17	21	17	24	21	2.1

All of:

- source – copper pipes in landfill
- NO₂ from chimneys dissolves in water to form nitric acid
- nitric acid converts copper into soluble copper salts
- soluble copper salts are carried by water run-off into the lake.

Question 2c.

Marks	0	1	2	3	Average
%	10	20	28	42	2

To receive full marks students needed to mention the following points:

- bioaccumulation is the relative increase in concentration of a chemical within an organism compared to the immediate environment or increase in concentration up the food chain
- levels of copper salts observed are above toxic levels
- reference needed to be given to at least one numerical value from the data provided.

The following is an example of a good answer.

Bioaccumulation is the increase concentration found in species higher up the food chain due to eating lower species.

As the concentration of copper salts in the water (3.2 at C, 2.8 at D) are above the level causing harmful effects (1.9) negative effects on aquatic species could be expected.

Question 3a.

Marks	0	1	2	3	4	5	6	Average
%	4	2	22	28	27	12	4	3.3

Students needed to describe three clear and relevant steps relating to the material provided (that is, specific project).

For example:

- consultation with key stakeholders such as community, State Government
- impact assessment of development, could include reference to offsite new renewable energy sources
- cost-benefit analysis of two proposals considering a balance between financial, social and economic factors.

Some reference to community consultation was required for full marks.

Some students simply listed three very similar steps, for example, environmental impact statement, environmental risk assessment and life cycle analysis, but this did not receive full marks.

Question 3b.

Marks	0	1	2	3	4	5	6	Average
%	4	2	12	20	23	27	13	3.9

Students were required to give an evaluation that linked to desalination, specific arguments presented by Alan and Bridget, and must have shown a logical and consistent line of argument when reaching their decision.

The following is an example of a good answer.

Alan has argued largely on the needs and economic aspects of the proposal. He says that as Melbourne's population is increasing – and planning assumes increasing further – adequate supply of water is essential and the most economic and ecological sustainable way to address this is the desalination plant.

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No amount of water savings can address the problem, and a new dam would infringe on a National Park. He argues that in other parts of the world, and indeed Australia (Perth), desalination plants operate satisfactorily with little environmental impact.

Bridget argues on more environmental grounds – impact on marine life, effect on beauty of the area and hence tourism, and that it is interfering with nature.

She argues that the amount of power involved will produce large Greenhouse emissions. However Alan has answered some of Bridget's points, in that since it can operate at any time of the day, renewable energy sources such as wind power can be used, thus answering Bridget's concerns about Greenhouse emissions. Similarly he says the low impact to other desalination plants answers her concerns about effect on marine life.

Overall, Alan has argued on needs economic grounds, Bridget on environmental and emotive issues. Alan has answered Bridget's criticisms, while Bridget has not really resounded to Alan's points. Hence overall I think Alan has out the stronger case, as he has addressed a wider range of issues and has answered many of Bridget's concerns.

Question 4

This was considered to be a 'generic' question, so it was expected that students would be well prepared.

Question 4a.

Marks	0	1	2	3	4	Average
%	3	2	7	20	68	3.5

To receive full marks for this question students needed to:

- refer explicitly to the nominated project
- name and describe a geographic location
- give a time line – that is, for the beginning and end of the project.

Students needed to give a clear picture of the specific project that allowed assessors to visualise key features, the time frame, and the location.

The question was well done. As with the selection of a pollutant, teachers and students are advised to select a project which is manageable, constrained reasonably in location and time, and where the outcomes are clear, so that a judgment or evaluation can be made about its success.

Question 4bi-ii.

Marks	0	1	2	3	4	Average
%	3	4	19	36	38	3

Question 4bi.

Students were required to list aims related to the environmental project and needed to relate these aims directly to the project.

Question 4bii.

This question required a description of two specific intended outcomes of the project, linked to criteria that could be used for evaluating success.

The second part of this question was not well answered. Some students repeated aims rather than describing outcomes that could be used to judge success (key performance indicators).

Question 4c.

Marks	0	1	2	3	4	Average
%	14	9	18	23	35	2.6

This question required students to describe a specific environmental management plan which was relevant to the project and which was linked to either ensuring the success of the project or avoiding environmental damage. Ideally, there should have been reference to the lifetime of project.

This question was not well done by students who simply repeated the aims, rather than describing a management plan. As this is a common question that it is central to studying an environmental project, students should have a clear idea of the management plan relating to the project.

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Question 4d.

Marks	0	1	2	3	4	5	Average
%	10	5	11	23	28	23	3.2

As this question asked for an 'evaluation', good responses needed to have an element of judgment as to the success of the project.

Answers should have explicitly made reference to the aims described in Question 4b. and to the strategies described in Question 4c. Students should have also quoted some data or information as evidence of the judgment made.

The most common error involved responses that did not contain any element of judgment.

Question 5a.

Marks	0	1	2	Average
%	11	15	74	1.6

This question required students to name and give a description of an ecotourism activity or business. The most common error was simply naming the activity or business without giving a description. Reference to a specific business, rather than a general activity, facilitated answering the whole question.

The following is an example of a good answer.

Penguin watching at Phillip Island, Victoria. Tourists come to Phillip Island, South East of Melbourne, in the evening to stand in controlled areas to watch the fairy penguins return from feeding to their nests in the dunes.

Question 5bi-ii.

Marks	0	1	2	3	4	5	6	Average
%	12	2	5	10	12	21	38	4.2

For both Question 5bi. and 5bii. criteria needed to be stated and applied explicitly to the activity described in Question 5a.

Appropriate criteria included:

- specific environmental focus
- conducted with little damage to the environment
- an educative focus.

For full marks, some reference to educative focus was required.

Question 5c.

Marks	0	1	2	Average
%	19	21	60	1.4

At least one negative impact, related directly to the nominated activity, needed to be stated.

Some students stated that there were no negative impacts. Any activity must have some potential negative impact, even if it is minor and considered acceptable in view of the positive benefits.