



**2007 Environmental Science GA 3: Written Examination 2**

**GENERAL COMMENTS**

In the 2007 mid-year (June) examination there was evidence that some students were pressed for time. This was taken into consideration in setting the November examination, and consequently there seemed to be no evidence that students had a shortage of time in November.

**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	4	1	7	88	
2	16	76	5	3	
3	86	5	6	3	
4	9	21	67	3	Bioaccumulation occurs because material is stored in fatty tissue in the body; hence, solubility in fatty tissue is the key property. The most common incorrect response was option B – solubility in water. While this will obviously be a factor in the transport mechanism, it will not contribute to bioaccumulation as solubility in water would make removal from the body easy.
5	4	90	3	3	
6	3	87	4	6	
7	8	4	86	2	
8	0	4	3	93	A number of students who scored very well on the paper overall answered this question incorrectly. Recycling involves recovering reusable materials (including those mentioned in the stem) from discarded phones and reusing these as raw materials. Presumably the misunderstanding came from students thinking that the whole phone was recycled, thus avoiding the need to manufacture new phones.
9	3	6	7	84	
10	13	4	77	6	
11	8	7	70	15	
12	54	5	5	36	The sudden release of a large quantity of water is likely to cause erosion as it flows down a river. The most common incorrect response, option D (increased salinity), is unlikely as increased water is likely to lower salinity. Some students may have felt that the water would bring the water table closer to the surface; however, a once only release of water into a river is unlikely to cause this – it is a more long term effect, mainly due to removal of vegetation.
13	89	3	6	2	
14	1	27	1	71	The common incorrect response was option B, to eliminate any disruption to the environment during repair – this is not always possible. The purpose of an ERA is to balance the benefits against the disruption.
15	83	9	4	5	
16	0	68	13	19	A surprising number of students responded incorrectly to this question. Bioremediation implies some biological process that removes phosphorus – hence absorption by suitable planted vegetation. The most common incorrect response, option C (water conservation), is unlikely since the planted trees would more probably use more water.
17	8	1	16	75	



Question	% A	% B	% C	% D	Comments
18	31	61	3	5	Initially the transport mechanism would be airborne and, since the wind is predominantly from the south, the main concentration would be north of the island. Therefore, either option A or B is correct. However, sulfur dioxide is significantly heavier than air, and is very soluble in rain or moisture. Hence it is unlikely to be carried 50 km (option A); therefore the much closer location of point B was correct.
19	2	3	86	10	
20	14	67	14	4	45 kg = 45 000 g. Dissolved in 12 000 L, this gives the concentration as $\frac{45000}{12000} = 3.75 \text{ g/L}$

The multiple-choice questions contained a mix of relatively straightforward and some more challenging questions. Almost all the questions showed a high correlation co-efficient – that is to say, students who did well on the paper overall scored well on that particular question. The one exception was Question 8, as mentioned above.

## 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 tested the pollutant that students had studied in depth during the year. Most students appeared to have studied a suitable pollutant; however, it should be noted that carbon dioxide technically does not meet the definition of a pollutant. That is, i) **introduced** into the environment by human activity and ii) injurious to the health of humans or the environment. Although humans have increased the concentration, carbon dioxide occurs naturally in the environment, so technically it is not a pollutant. The small number of responses on carbon dioxide were unable to score high marks.

In questions such as this that relate to areas studied in depth, more detailed and specific responses are expected.

#### 1a.

Marks	0	1	2	3	Average
%	3	6	23	68	2.6

This question was well answered, with the vast majority of students scoring full marks. Students who did not achieve full marks generally described the pollutant but did not make any reference to its impact on humans. These students did not read the question carefully enough.

#### 1b.

Marks	0	1	2	3	4	Average
%	3	3	19	34	41	3.1

Again, this question was generally well done, with the majority of students scoring full marks. The most common errors were:

- ignoring one of the requirements of the question
- a lack of specificity in naming a specific situation; that is, students provided a very general answer.

Students are expected to have studied a specific situation; hence, full marks are not awarded for very general answers. Examples of excessively general responses included ‘where people live’ and ‘near cities’.

In this question a reference to either effect on humans or on the ecosystem was acceptable.

#### 1c.

Marks	0	1	2	3	4	Average
%	1	5	10	27	57	3.4

Appropriate responses to parts i. and ii. were fairly obvious. The most common error was not mentioning whether it was a point or diffuse source in part i. A reason for point or diffuse was not required for full marks.

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The most common error in part iii. was giving a human strategy for removing the pollutant rather than its natural sink. For example, an acceptable natural sink for mercury is 'sediment in the bottom of rivers or seas'; however, 'precipitators in the chimneys of factories' is not a natural sink. Students needed to describe how the pollutant leaves the environment without human intervention.

## 1d.

Marks	0	1	2	3	4	Average
%	6	5	19	42	27	2.8

To receive full marks for this question students needed to refer to both 'exposure' and 'dosage' in one or other of the parts. The response also needed to show some understanding of the distinction between the two concepts.

Exposure refers to the amount of pollutant a person or population is exposed to in a given time. Dosage refers to how much of the pollutant is actually absorbed by a person or animal, usually in terms of body mass. No reference to units was required for full marks.

## 1e.

Marks	0	1	2	3	4	5	Average
%	11	5	13	26	31	15	3.0

For this question students were required to provide a coherent, longer response. For full marks, responses needed to:

- describe (rather than just mention) a management plan
- evaluate its effectiveness – evaluation implies an actual judgment of some kind
- provide evidence for its effectiveness.

In general, for full marks in a question that refers to a pollutant studied in depth, some quantitative or semi-quantitative data should be referred to.

The alternative part of Question 1e. – 'or describe criteria that could be used to evaluate the effectiveness of this plan' – was included in case some students had addressed a management plan that had not yet had any results. However, students and teachers are cautioned against using an in depth study which has not yet had any outcomes, or at least interim results. Undertaking such a study makes it very difficult to achieve full marks in questions relating to the effectiveness of management strategies.

## Question 2

This question gave a scenario involving mercury, one of the two pollutants to be studied.

### 2a.

Marks	0	1	2	3	Average
%	6	15	39	40	2.2

This question required students to:

- mention at least two properties of mercury. Some possible answers included:
  - elemental mercury is a solid
  - mercury can exist in vapour form
  - elemental mercury oxidises to mercury oxide
  - bacteria can transform mercury into methyl mercury
  - mercury oxide and methyl mercury are very soluble in water
  - mercury is subject to bioaccumulation in tissue
  - mercury interferes with the brain, kidney, liver and central nervous system
- make some reference to human health.

The most common error was to make no reference whatsoever to human health.

### 2b.

Marks	0	1	2	3	Average
%	2	18	73	8	1.9

The most likely transport mechanisms from the figure shown were:

- a soluble form of mercury carried by river
- attached to particles and carried by river.

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Simply answering 'airborne' was did not provide enough information; however, 'attached to particles that were airborne' was acceptable.

In order to gain the full three marks, students were expected to refer to the form of mercury (elemental, oxide, salt or methyl) in which it was transported. Students should know the different forms in which mercury exists.

2c.

Marks	0	1	2	3	Average
%	24	28	34	14	1.4

Responses to this question required reference to bioaccumulations and, and least implicitly, the food chain.

As has been pointed out before, students should know the different forms in which mercury exists. Methyl mercury, being fat soluble, is the form that will cause bioaccumulation,

2d.

Marks	0	1	2	3	4	Average
%	9	11	20	26	34	2.7

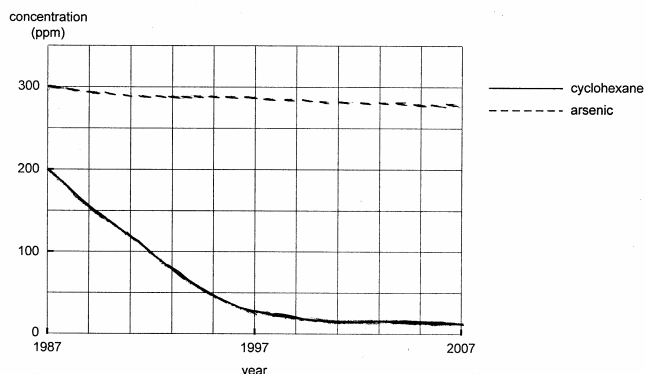
Responses to this question were generally well done. The vast majority of students scored three or four marks, with a wide variety of responses given. In general, answers needed to:

- refer to the nominated pollutant, and some property of it
- refer in some way to the scenario.

## Question 3

3a.

Marks	0	1	2	Average
%	8	73	19	1.1



This question tested students' ability to plot data on a graph, a skill which should be developed through the year.

The most common error (for which one mark was deducted) was to simply draw a straight line from 1987 to 1997, and then another straight line from 1997 to 2007, with a major discontinuity at 1997. Students should realise that concentration is unlikely to change abruptly at 1997; it is more likely that some sort of smooth variation would occur.

3b.

Marks	0	1	2	3	4	5	6	7	8	Average
%	3	1	13	18	22	20	12	7	3	4.2

For this question, students were asked to **explain**; a mere description of the changes (spatial and over time) did not receive full marks. Such a description needed to be related to some properties of the pollutants in order to fulfil the requirement to 'explain'. Many students merely provided a description of how the concentrations varied over either space or time.

Some examples of relevant comments are given below. Note that not all these comments would have been required for full marks; however, some comment on each of spatial and time variation for each pollutant, relating these to some characteristic, was required for full marks.

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### 3bi.

Cyclohexane is insoluble in water, hence water run off and the river will not be a significant transport mechanism. Therefore it will not be carried far on the surface or into the river.

Cyclohexane is volatile, hence it will evaporate relatively quickly, explaining the fairly rapid reduction in concentrations at all points measured.

### 3bii.

Arsenic is a heavy metal. It will not be carried by water; hence concentrations decrease rapidly as measurements are taken away from the original source point, with very small concentrations in the river. The main transport mechanism would be by attachment to soil, which would not be a significant factor in removing it. Therefore, arsenic remains in high concentrations over the time period close to the original source.

### Question 4

This question related to an environmental science project studied in depth during the year. Hence, as in Question 1, greater specificity, rather than a very general response, was expected.

#### 4a.

Marks	0	1	2	3	4	Average
%	3	1	4	23	69	3.5

The majority of students scored full marks for this question. The most common reason for receiving fewer than full marks was not referring to all three of the specific references required; many students neglected to give any time frame.

Students needed to provide a good description of the project. Students should be warned against assuming the reader has some background, or has even heard of the project. The response should give a good idea of the project and what it hopes to achieve.

Selection of a suitable project can have an impact in this question. From observing examination responses over a number of years, in general a project should:

- be fairly specific and restricted, both in location and time
- be either completed or at least at a stage where some evaluation of the achievement of the aims is possible
- provide students with some very specific data to support an evaluation – if possible quantitative or semi-quantitative.

#### 4b.

Marks	0	1	2	3	4	Average
%	6	7	22	35	31	2.8

Ecological sustainability refers to meeting current needs without jeopardising the needs of the future (for humans or the environment). For full marks, some reference had to be made to these notions, and applied to the nominated project.

#### 4c.

Marks	0	1	2	3	Average
%	19	14	36	31	1.8

Students were able to answer this question with reference to **either** regulatory frameworks **or** interest groups. Those who answered on both options were only rewarded for one.

Again, students were penalised for a lack of specificity; ‘the local population’ was generally not considered specific enough, as it could apply to any project. However, ‘people affected by noise’ or ‘local farmers affected by run-off’ would have been acceptable.

#### 4d.

Marks	0	1	2	3	4	5	6	Average
%	10	2	9	13	25	27	14	3.8

In this question students were asked to evaluate, which implies some actual judgment backed up by evidence.

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In most cases, quantitative evidence of some sort was expected. For example, if the aim was to reduce nitrogen oxide concentrations in a particular location, some percentage or concentration reduction should have been noted and included.

## Question 5

### 5a.

Marks	0	1	2	3	4	Average
%	10	5	25	23	38	2.8

The two criteria given should:

- minimise the impact on the environment
- have some educative element.

For full marks, both of the criteria mentioned needed to be specifically related to the situation on Macquarie Island as outlined in the stem.

### 5b.

Marks	0	1	2	3	4	5	6	Average
%	11	2	8	21	27	23	9	3.5

For the last question on the examination, students needed to make a clear, logical presentation of arguments for and against the proposal. More marks were awarded to responses that had been carefully planned, rather than those that simply present a long, disorganised listing.

In general, responses needed to:

- show an understanding of what is meant by ecologically sustainable development
- provide a clear judgment (evaluation)
- present evidence (data, etc.) to support the evaluation
- draw from the information in the stem.