2012 Assessment Report

VICTORIAN CURRICULUM AND ASSESSMENT AUTHORITY

2012 Environmental Science GA 3: Examination 2

GENERAL COMMENTS

Students generally performed well on the 2012 Environmental Science examination 2, although some students had difficulty with questions that involved the use and manipulation of scientific data.

There was minor evidence of students being unable to complete the examination in the allocated time. This may need to be considered by students in the way they plan and use the time available, including reading time. Students should try to move through the questions at an appropriate pace. This may be a skill to develop in 2013, given that the examination will lengthen to 120 minutes.

Teachers and students need to carefully examine the updated study design (2013–2016), advice to teachers and the sample examination provided on the VCAA website. Changes to coursework and exam preparation will need to be planned for in accordance with the changes to the study design.

SPECIFIC INFORMATION

The statistics in this report may be subject to rounding errors resulting in a total less than 100%.

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	87	8	3	3	0	
2	4	59	20	17	1	A chemical property of a pollutant is its reactivity. The other options listed would be regarded as physical characteristics of the pollutant.
3	8	1	75	17	0	
5	72	10	4	13	1	
4	3	9	2	87	1	
6	6	40	52	1	2	Students found it difficult to calculate the average annual increase correctly. The whales had accumulated more than 1200 mg/kg of mercury over sixty years, which is 20 mg/kg per year (option B). Many students incorrectly chose 200 mg/kg (option C), possibly based on the information on the vertical axis's scale.
7	67	12	10	10	0	Based on an understanding of bioaccumulation, over time older organisms in a population would be expected to have higher concentrations of a heavy metal like mercury in certain organs.
8	2	3	1	94	2	
9	5	4	81	10	1	
10	8	24	3	65	3	Students are reminded that they need to read alternatives carefully. Exposure relates to how much of a pollutant a person is exposed to or experiences in a given time. Exposure does not include absorption into the body.
11	5	3	85	7	0	
12	7	36	25	31	3	The correct maximum that could be allowed to enter the river was 2.0 g/s. This answer was gained by multiplying the depth by the width and then the flow rate. This answer was then converted to cubic metres by multiplying by 1000.

Question	% A	% B	% C	% D	% No Answer	Comments
13	24	35	28	12	3	To obtain the correct answer of 0.2 g/s (option C) students needed to convert 20 micrograms into grams by multiplying by 10^{-6}. This answer was then multiplied by the volume flowing past of 10 000L.
14	2	2	3	93	1	
15	1	4	81	14	2	
16	3	84	6	7	4	
17	11	64	9	17	1	The increasing levels of salt concentrations found are an example of an environmental hazard (i.e. in this case, these have the potential to cause harm to native plants).
18	2	7	29	61	3	Key principles of ecologically sustainable development include the concepts of providing for current needs without compromising the needs of future generations. This was clearly suggested in option D, which was the strongest argument. A weaker argument, but a relevant point nonetheless, was that of reducing the environmental impact of waste going to landfill (balanced against the impact of combusting the plastic in a furnace).
19	15	65	6	14	2	The Environment Protection Authority provides guidelines for the levels of a variety of pollutants that may be released into the environment. The guidelines form part of the process for a monitoring program and a regulatory framework for maintaining the health of the Victorian environment.
20	10	66	12	12	2	The concept of using the hot gases from the furnace is aimed at minimising waste heat being released by the process. This waste heat energy is transferred to the water used for another process.

Section B

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

This report provides sample answers or an indication of what the answers may have included. Unless otherwise stated, these are not intended to be exemplary or complete responses.

Question 1

This question required students to answer in terms of a pollutant (other than mercury and sulfur dioxide) that they had studied in depth as a case study.

The more successful students showed good depth and range of knowledge about a specific pollutant. Common pollutants included nitrogen dioxide, particulate matter, lead and phosphates. Students included relevant examples where the pollutant had affected human or animal populations at particular locations. It was evident that students had prepared well for this question.

The less successful answers lacked clarity and confused the form in which the pollutant existed and changed from one to another throughout the parts of the question (for example, nitrogen to nitrates or phosphorus to phosphates). Students are expected to be able to write about a pollutant in the correct chemical form.

Question 1a.

Marks	0	1	2	3	Average
%	5	19	47	30	2

To be defined as a 'pollutant', it is necessary for the substance to be released or emitted by human action or activities. Once released, the pollutant can cause harm to humans or other organisms. It can have a negative impact on the environment in general. These two points (release/harm), therefore, needed to be made clear and then related to the specific substance chosen. For example, students wrote about lead being released by the mining activity and smelter at Port Pirie and causing harm to the nervous system and development of young children in the town. Most students were able to do this clearly, but a number of students neglected to include the point about the pollutant being released into the environment by human activity.

Question 1b.

Marks	0	1	2	3	Average
%	6	11	38	44	2.2

Students were expected to have an understanding of the transport mechanisms and possible pathways the pollutant may take, which would allow (or not allow) this substance to enter the body. They were required to comment on relevant characteristics (for example, particle size, solubility, chemical state) that may affect the methods of exposure. Ingestion (for example, taking into the digestive system through eating foods covered with lead dust particles or drinking water contaminated with arsenic), inhalation (for example, breathing a gas or tiny particulate matter [PM^{10}] into the lungs) and dermal absorption (for example, inorganic lead cannot be absorbed through the skin, while inorganic forms like tetraethyl lead can be absorbed through the skin).

Question 1c.

Marks	0	1	2	Average
%	22	34	44	1.2

The more successful students clearly outlined the basic method used to collect primary data related to the chosen pollutant. It was evident that they had collected data using suitable equipment and techniques. Students were expected to have a basic understanding of the equipment being used, rather than simply writing 'the sample was put into a machine'. For example, if water-testing equipment is being used to test for nitrates, then students should be able to write about a spectrophotometer measuring the amount of light spectrum being absorbed by the solution after a reaction with a cadmium reagent. Some students did not understand the difference between primary and secondary data.

Question 1d.

Marks	0	1	2	Average
%	18	19	63	1.5

The unit of measurement given for either dosage or exposure needed to be correct and related to the chosen pollutant. For dosage (how much has been absorbed into a body), this measurement unit should have been a concentration per kilograms or grams (body weight) or per litre or decilitre (in blood). For exposure, the measurement unit did not need to be a concentration related to body mass, but a measurement that could be taken from the environment. It could have been parts per million (ppm) or grams per litre (g/L) in water or just grams.

Question 1e.

Marks	0	1	2	3	Average
%	11	11	35	43	2.1

A sink can be regarded as any location that removes the pollutant from the environment where it is causing harm, or that changes the form of the pollutant so that it is no longer harmful. The sink given should have been the major location, accurate for the given pollutant and related to removal from the environment.

Question 1f.

Marks	0	1	2	3	Average
%	6	10	29	55	2.3

This question asked students to outline a strategy that aims to reduce the levels of emission of the chosen pollutant. The more successful students provided details about steps that have been taken (or could be implemented) to stop or reduce the level of emissions being released into the environment (for example, the use of catalytic converters in cars to reduce oxides of nitrogen emissions into the atmosphere). The strategy needed to address levels of emissions, rather than try to manage the pollutant once it had been released into the environment.

Question 1g.

Marks	0	1	2	3	Average
%	11	13	27	50	2.2

In this question, students needed to evaluate the success of the strategy outlined in Question 1f. To evaluate the effectiveness, data supporting the argument that emissions had or had not been reduced was required. Data that indicated pollutant levels before the strategy was implemented and after it had been put into action was required to make such a judgment.

Question 1h.

Marks	0	1	2	Average
%	18	33	50	1.3

In this question, students were asked to suggest if improvements needed to be made to the emissions reduction strategy outlined and then to justify their answer. Students could have argued that no improvements needed to occur, but the basis of the justification should have been made using evidence. Strategies that had not been implemented were difficult to evaluate and students struggled to suggest improvements.

Question 2

Students were required to have studied both mercury and sulfur dioxide in some detail. Some students found the depth of knowledge required in the questions related to sulfur dioxide emissions from the copper smelter scenario difficult.

Question 2a.

Marks	0	1	2	Average
%	20	34	46	1.3

This question related to the generation of sulfur dioxide during the copper-smelting process. The stem of the question provided students with the information that copper ore contains some sulfur that is released during smelting (i.e. the ore needs to be heated) and, as a result of the combustion at high temperatures, the sulfur is released and then reacts with oxygen to form sulfur dioxide. Some students misunderstood the process and wrote about the sulfur dioxide being trapped in the copper ore and being let out when the smelting occurred.

Question 2b.

Marks	0	1	2	3	Average
%	8	20	33	40	2.1

Students were generally able to describe some key effects of excessive sulfur dioxide on environmental health. These key effects included damage to plant growth, reduced crop productivity and the accelerated corrosion of buildings and monuments due to the effects of acid rain. Many also discussed the adverse effects of acidic deposits from acid rain on both land and aquatic ecosystems, including acidifying soils, lakes and streams, and the harmful impact this has on the organisms in these habitats. The focus of the answer needed to be on environmental health rather than the negative impacts on human health as a result of sulfur dioxide exposure.

Question 2c.

Marks	0	1	2	3	Average
%	14	41	34	11	1.4

Most students were able to outline a basic monitoring procedure that involved taking a number of measurements (using accurate equipment) over time and at a variety of locations around the smelter site. The more successful answers included points related to taking surface air measurements with a focus on prevailing wind patterns. Monitoring is required both before the smelter is operational to establish baseline data (i.e. what background concentrations of sulfur dioxide occur in the region) in order to determine how much extra sulfur dioxide is being added during operation. This would then be used to set suitable emission guidelines. The less successful responses only explained monitoring at one location and on one occasion.

Question 2d.

Marks	0	1	2	Average
%	40	43	17	0.8

Many students were able to state that a scrubber could be used to reduce emissions from the smelter. Few were able to give an explanation related to how a scrubber works. The more successful answers gave additional information related to the sulfur dioxide in the exhaust gases reacting with an alkaline (lime) mixture in the scrubber system and forming

other products, which can be then be removed and not be released into the atmosphere. Continuing to monitor emissions would not be regarded as an effective method for reducing emissions. Some students discussed the idea that electricity for the smelter was being generated by a coal-fired power station and that coal that has a lower sulfur content should be used instead.

Question 3

A wide variety of projects was used by students to respond to Question 3. Most students were well prepared and had clear knowledge of their project. Sometimes the focus of the project was distorted in the discussion. For example, the Werribee Treatment Plant has been operational since 1897 and clearly has been managing a large proportion of Melbourne's sewage since then. The more successful responses on the topic focused on the program of upgrades (begun in the 1990s) that has resulted in reduced nitrogen levels being released into the Bay, a reduction in odour levels, an increasing use of recycled water and the use of methane gases to generate electricity requirements at the plant.

Students need to take care when using acronyms; they should write them in full at least once in the question.

Question 3a.

Marks	0	1	2	3	Average
%	2	3	23	72	**2.7**

Students were generally able to describe the key aspects of their project clearly. The more successful students provided a clear indication of the project's location and the specific timeframe involved. The timeframe usually included a beginning date and a completion date, although some students acknowledged that their project was ongoing. The main objectives of the project were clearly listed and could include the non-environmental aims of the project.

Question 3b.

Marks	0	1	2	3	Average
%	4	5	22	68	**2.6**

This question required students to describe the environmental aims of the project. Students were usually able to outline the key positive environmental outcomes of the project, or how potential environmental impacts/damage would be addressed during the project's operation. For example, while students described the Port Phillip Channel Deepening Project's main objective as allowing greater access for container ships into the Port of Melbourne in Question 3a., in Question 3b. they described key environmental aims such as meeting acceptable turbidity levels and minimising disturbance on marine animals and plants during dredging.

Question 3ci–ii.

Marks	0	1	2	3	4	Average
%	10	7	17	31	36	**2.8**

Students needed to have clear knowledge of the particular environmental assessment document that was prepared prior to the project being undertaken. This may have been an Environmental Risk Assessment, an environmental impact statement or an equivalent document.

After describing the environmental assessment document in part i., in part ii. students needed to indicate who prepared the document (usually the project's proponent or their agency) and discuss who may have been consulted during the preparation of the document. Students usually had an awareness of the consultation process involved in their project and discussed the adequacy of various aspects such as public submissions and community consultation meetings.

Question 3d.

Marks	0	1	2	3	Average
%	13	14	29	43	**2**

Students needed to use the environmental aims or objectives described in Question 3b. and describe how actions taken as part of the management plan were put in place to achieve them. The more successful answers described clear actions that had been undertaken and related these actions to particular environmental aims. For example, the environmental aim of reducing greenhouse gas and odour emissions (as well as generating renewable energy) from the Werribee Treatment Plant has been achieved by using covers over the sewage ponds to capture the methane gas, which is then used in a biogas-fuelled power plant on-site.

Question 3e.

Marks	0	1	2	3	Average
%	14	14	35	38	2

Based on evidence, students needed to evaluate the success of the management actions described in part d. Many students discussed clear examples of the success (or otherwise) of their management actions and supported these with data. For example, 90% of odour emissions are now trapped by the pond covers and the power plant generates around 95% of the treatment plants energy needs, indicating successful management actions at the Werribee Treatment Plant.

Question 4

When sections of information are provided in the introduction to a question, it is important that students use, interpret and refer to this information (in this case, both the written outline and map) in their answers. They should not merely copy information from the introduction.

Question 4a.

Marks	0	1	2	Average
%	3	14	84	1.8

This question required students to review the information provided and to identify key points related to social and economic arguments used both for and against the waste treatment and recycling facility proposal. Most students were able to summarise the relevant factors in the correct sections in the table provided. In some cases, the distinction between social (which relates to people and communities) and economic (which relates to money and employment) factors needed to be written more clearly.

Question 4bi–ii.

Marks	0	1	2	3	4	5	Average
%	3	8	22	29	28	10	3

An Environmental Impact Assessment (EIA) should be conducted to outline the costs and benefits of the proposal. It is required by the state government to provide information for the decision to be made regarding approval. The EIA is regarded as a legal requirement and is a part of the planning process.

In order to conduct the EIA, research and data collection is required to present relevant information related to both the positive and negative aspects of the proposal. Information that should be included in the final report could be

- an outline of the proposal (and possible alternatives)
- possible environmental issues
- possible social and economic issues
- actions required to reduce environmental impacts
- possible monitoring procedures required if the proposal goes ahead
- input from the consultation process
- a recommendation to the Minister.

Not all of these points were required for full marks; however, a suitable combination of points such as those suggested should have been included.

Question 4c.

Marks	0	1	2	3	4	5	Average
%	10	8	23	31	20	8	2.7

Based on the information provided, students needed to present a well-constructed argument focused on the environmental advantages and disadvantages of the waste treatment and recycling facility. The more successful answers clearly outlined advantages such as the recycling of waste materials being more ecologically sustainable, and that the closure of the old landfill site and incinerator would reduce pollutant emissions. Environmental disadvantages discussed included

- the loss of 67% of the heathland ecosystem
- the possible impact on the threatened Heath Mouse habitat
- the negative impact on species due to the draining of the wetland
- possible environmental health issues due to dust, noise and odour.

Students should then have evaluated the proposal. This should have been followed by a recommendation regarding whether or not the proposal should be allowed to proceed. The focus of this evaluation should have been the environmental arguments (not the social and economic points). The more successful students focused on the idea of recycling being ecologically sustainable compared to the option of landfill/incineration, and discussed environmental management actions being taken to reduce risks such as odour and vermin. They clearly argued that the advantages outweighed the disadvantages. The most successful students understood that the Heath Mouse was a threatened species, and therefore it would not become extinct if the facility were built, and that further research may be required to investigate its possible habitat. Some applied the precautionary principle and stated that approval for the facility should not be given until this research has been conducted.

Question 4d.

Marks	0	1	2	Average
%	28	45	27	**1**

In this question, most students were aware of the need to consider all aspects of the waste treatment and recycling facility, including social and economic issues. Some of the more successful students used the ideas of the 'triple bottom line' and ecologically sustainable development in their discussion of the need to balance all aspects of the proposal in the decision-making process. Good answers included the point that good decision-making weighs up the costs and benefits to people, society and the environment compared with the economic returns.

Question 5a.

Marks	0	1	2	Average
%	11	30	59	**1.5**

Students needed to use their knowledge of the ecotourism concepts to identify two important criteria that any group (including Greenyhands) should consider when developing an ecotourism activity. These criteria could have included a focus on direct contact with the natural environment of the site, having minimal impact on the environment when undertaking the experience and having a component of environmental education/understanding as part of the ecotourism experience. It should be noted that the concept of 'not-for-profit' or using proceeds from the activity to fund the proposal is not regarded as key criteria for an ecotourism project.

Question 5b.

Marks	0	1	2	3	Average
%	18	15	29	38	**1.9**

Students were required to describe how the criteria identified in part a. could be incorporated into the development of an ecotourism wildlife reserve by Greenyhands. The more successful answers described the building of facilities (such as a visitors' centre) on the cleared land by using recycled materials and renewable energy sources, and related this to the criterion of having a minimal environmental impact on the site. Many discussed the development of an environmental education program that focused on the threatened species and the importance of wildlife corridors.

Question 5c.

Marks	0	1	2	3	4	Average
%	21	18	25	28	8	**1.9**

An understanding of the principles of ecologically sustainable development is an important part of the study. In this question, students needed to explain that ecologically sustainable development includes the idea that development should meet the needs of current generations without compromising the ability of future generations to meet their own needs. Humans should be using, conserving and enhancing resources while maintaining ecological processes. These principles then needed to be applied to the development of the wildlife reserve. Therefore, the wildlife reserve can be used and enjoyed by the current generation but also managed and maintained so that threatened species do not become extinct at the site and are therefore not available for future generations to observe. Ecological processes such as the wildlife corridor needed to be protected and maintained.