2013 Examination Report

VICTORIAN CURRICULUM AND ASSESSMENT AUTHORITY

2013 Environmental Science GA 3: Examination

GENERAL COMMENTS

In accordance with changes to the assessment structure and the *VCE Environmental Science Study Design* (updated for 2013–2016), the 2013 Environmental Science examination was two hours long and included material from both Units 3 and 4. The examination included 30 multiple-choice questions (worth one mark each) and six multiple-part questions (worth a total of 90 marks). Most students completed the examination in the time available and were able to satisfactorily address questions from both units.

Students are reminded to read each question and the information provided in the exam paper carefully, and use their knowledge to tailor a clear and relevant answer to the specific question.

Students struggled with some questions requiring specific knowledge about mercury as a pollutant. In particular, the questions related to forms of mercury, characteristics and effects on human health were less well answered.

In Section B, Questions 4 and 5, some students confused the terms 'species', 'individuals' and 'populations'. Students need to be aware of the variety of relevant biodiversity terms and should use them correctly.

SPECIFIC INFORMATION

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

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

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	6	71	5	18	0	
2	6	15	19	60	0	Students needed to note that the question asked for the percentage increase from 1985 to 1995. The total number of the marsupial had increased from 400 to 1600 over this ten-year period (an increase of 1200 individuals). Therefore, 1200/400 × 100 = 300% (option D).
3	9	8	3	80	0	
4	3	78	13	7	0	
5	4	14	18	64	0	The probability of extinction of both populations can be calculated by multiplying the figures for the two populations together. Therefore, 0.20 × 0.60 = 0.12 (option D).
6	1	7	88	4	0	
7	4	15	69	11	0	
8	81	15	3	1	0	
9	3	1	2	94	0	
10	1	3	87	9	0	
11	89	4	2	5	0	
12	55	38	6	0	0	These tunnels prevent the impacts of fragmentation and allow aquatic species to move more safely between parts of their habitat. Because organisms can move between the halves of the wetland, they can continue to interbreed within a larger population. This reduces the chance of inbreeding within separated, smaller populations. Many students selected 'avoid demographic variation' (option B), which can occur within smaller populations but is not as much of a serious concern compared to inbreeding.

Question	% A	% B	% C	% D	No answer	Comments
13	82	5	3	9	0	
14	1	20	2	77	0	
15	72	11	10	7	0	
16	2	71	16	10	0	
17	7	12	80	0	1	
18	2	10	81	7	0	
19	81	10	8	1	0	
20	19	16	11	54	0	
21	14	42	29	14	0	
22	37	6	52	4	0	
23	3	4	90	3	0	
24	8	4	78	10	0	
25	74	17	2	6	0	
26	71	25	2	2	0	
27	75	11	9	5	0	
28	25	15	57	2	0	Although the platypus is not currently listed as threatened, the precautionary principle would suggest that if population estimates are uncertain then it should still be protected, rather than take no action to conserve the species. It would not be sufficient to simply conduct more monitoring and research (option A).
29	89	1	3	7	0	
30	3	91	3	3	0	

Section B

Question 1a.

Marks	0	1	2	Average
%	2	32	66	**1.7**

The graph illustrated the change in electricity consumption for a large city over a typical 24-hour period. This information provided students with an understanding of the variation in electricity usage on a winter's day. Students described how electricity use increased from a low of around 5500 megawatts at 6 am to a peak of 7500 megawatts at 9 am. There was a decline in usage during the early afternoon until another peak at 7 pm of 7500 megawatts. Overnight, electricity use decreases as a result of the reduced use of domestic appliances as people sleep, and rises to peak usage as people make use of lighting, heating and cooking appliances in the home, as well as transport on the electric rail system. Better answers indicated the high and low consumption times and clearly linked these to reasons for electricity use changing over the course of the day.

Question 1bi.

Marks	0	1	2	3	Average
%	3	15	46	36	**2.2**

Most students correctly named a fossil fuel energy source (coal and natural gas were mainly used). They described a form of extraction (mining or drilling) to obtain the fuel and how it could then be transported to Seaview. Better answers acknowledged sourcing the fossil fuel from a suitable location. Poor answers assumed the fossil fuel could be found by just digging a hole anywhere near Seaview and expecting to find a deposit under the surface of the ground. Clear answers explained how the fuel would be burnt in an electricity generation plant, with some including a basic description of a furnace producing steam, turning the turbine and then the generator to produce electricity. As well as the infrastructure required in the power plant, some discussion of the electrical transmission lines and transformers was included. The electricity generated would be used to contribute to the domestic, transport and industrial peak and off-peak requirements for the residents of Seaview.

Question 1bii.

Marks	0	1	2	3	4	Average
%	3	8	26	42	21	**2.7**

A variety of non-fossil fuel energy resources were discussed for the population of Seaview, including solar, wind, biomass and nuclear energy resources. Most answers focused on using the particular energy form to contribute electricity, which would mainly be used to supplement base loads due to the inconsistent and unpredictable nature of some non-fossil fuel forms. Better answers explained how the energy could be obtained, how the source produces electricity, in which period of the day the energy could be used and the infrastructure required. For example, students who chose solar energy as their non-fossil fuel described how solar panel systems could be set up in suitable locations and used to convert solar energy into an electrical current during the day, and how this could be used or stored in battery systems for use at other times.

Question 1c.

Marks	0	1	2	3	Average
%	12	17	23	49	**2.1**

This question asked students to describe two environmental impacts related to the non-fossil fuel energy resource they had nominated. For example, in discussing the environmental impacts of sourcing wind energy, students described the effects of habitat loss and destruction due to the construction of turbine towers, the disruption to scenic coastal views when wind farms are built and the deaths of birds flying into the turbine blades. Most chose to focus on negative environmental impacts, although some included relevant positive impacts. Weaker answers described the environmental impacts of their nominated fossil fuel energy resource. Students need to make sure they read each question carefully and give examples related to the correct energy source type.

Question 1d.

Marks	0	1	2	Average
%	28	38	35	**1.1**

Some students struggled with this question. They needed to explain a clear way of increasing the energy efficiency of one of their energy resources. Some students discussed the need to reduce the number of energy conversions to reduce energy loss in a general way; however, the more successful students gave specific points about improving technology or reducing the distance the energy is required to travel, which reduces heat loss in the transmission process.

Question 2a.

Marks	0	1	2	3	Average
%	20	22	33	25	**1.6**

This question required students to explain the mechanism of the natural greenhouse effect, supported by a diagram (or diagrams). Most students produced a diagram that included the sun and Earth with the three key types of solar radiation being emitted from the sun. Labelling should have shown the sun emitting mostly visible light as well as ultraviolet and infrared wavelengths. The visible light is absorbed by Earth and is re-emitted as infrared radiation from the surface. This infrared radiation is absorbed by greenhouse gases and leads to the heating of the lower atmosphere. Better answers explained how the greenhouse gas molecules absorb the infrared radiation rather than just 'trapping heat'. A number of less successful students confused the different types of radiation, did not label diagrams clearly or accurately, did not correctly explain the absorption of visible light and the re-emission of infrared radiation, or discussed the role of the ozone layer, which was not relevant to the natural greenhouse effect.

Question 2b.

Marks	0	1	2	Average
%	10	47	42	**1.3**

Students were generally able to describe the basic difference between the natural and enhanced greenhouse effects. Clearer answers explained that the natural greenhouse effect is due to the naturally occurring levels of greenhouse gases (especially water vapour) that keep Earth's surface at a relatively constant average temperature of 15 °C. The enhanced greenhouse effect is due to the increased level of particular gases that are being added to the atmosphere by various human activities (anthropogenic sources).

Question 2c.

Marks	0	1	2	Average
%	7	47	47	**1.4**

Most students were able to provide at least one reason for the levels of carbon dioxide significantly increasing in the atmosphere over the last 50 years. Better answers gave two clear reasons that were usually related to an increased burning of fossil fuels, such as a greater numbers of cars or increased production of electricity from coal-fired power stations. Other points given related to the global human population increase and an increased use of fossil fuels, or the level of global deforestation leading to less carbon dioxide being removed from the atmosphere.

Question 2d.

Marks	0	1	2	Average
%	14	34	52	**1.4**

Students named a variety of different gases that contribute to the greenhouse effect. Many students identified the particular gas, such as methane, and linked it to a human activity that increases its level in the atmosphere (for example, coal mining or agricultural production). Other greenhouse gases discussed included ozone, chlorofluorocarbons, nitrous oxide and sulfur dioxide. For full marks each gas needed to be correctly matched to the relevant source. Weaker answers discussed carbon dioxide, but this was excluded by the question.

Question 2e.

Marks	0	1	2	Average
%	10	21	69	**1.6**

Most students were able to outline two different impacts of the enhanced greenhouse effect. Answers related to increased surface temperatures, rising sea levels, changing rainfall patterns or rising snowlines in alpine areas. Better answers clearly described the impact of these changes on humans and/or the environment.

Question 3a.

Marks	0	1	2	3	Average
%	23	24	21	32	**1.6**

Sulfur dioxide is formed during the combustion of coal when sulfur in the coal reacts with oxygen in the atmosphere. Most students were able to explain this process, although weaker responses described natural sources of sulfur dioxide or tried to explain that sulfur dioxide exists in coal and was ‘let out’ when burnt.

Question 3b.

Marks	0	1	2	Average
%	12	20	68	**1.6**

This question required students to identify whether the power station was a point source or diffuse source of sulfur dioxide, and to give a reason this classification. Most students correctly identified the power station as a point source of pollution, explaining that the pollutant usually emerges from a single, identifiable location (i.e. the chimney stack).

Question 3c.

Marks	0	1	2	3	Average
%	13	28	46	13	**1.6**

Students needed to understand and use the definition of a pollutant to describe why sulfur dioxide from the power station would be regarded as a form of pollution. Key factors relate to the sulfur dioxide being produced by human activity (i.e. the coal burnt in the power station) and causing harmful impacts on the environment (e.g. damage to vegetation growth due to acid rain). The more successful answers clearly described and linked these points, although a number of students did not include the idea that a pollutant results from human activity contributing additional amounts of the substance to the environment.

Question 3d.

Marks	0	1	2	3	Average
%	9	14	32	45	**2.2**

Sulfur dioxide is initially released as a gas and therefore is airborne, transported on wind currents. It then dissolves in atmospheric moisture to form sulfuric acid and becomes waterborne (e.g. acid rain that precipitates to the ground and can move through water bodies and into the soil).

Question 3e.

Marks	0	1	2	3	Average
%	7	20	44	29	2

To answer this question, students needed an understanding of the difference between 'exposure' and 'dosage'. Exposure relates to how much sulfur dioxide is in the air that staff in the power station are exposed to in a given amount of time, whereas dosage refers to how much sulphur dioxide is absorbed by the individual staff member (per unit of body weight). Inhalation by the staff members can lead to absorption; however, exposure is likely to be at low levels and as a result measured dosages are low. Some students struggled to explain each term clearly and relate them to inhalation by power station staff.

Question 3f.

Marks	0	1	2	Average
%	13	24	63	1.5

Most students were able to indicate two key stakeholders that should have been consulted during the development of the power station's Environmental Impact Assessment. Examples given included local residents and landowners, the power station company, community users of the electricity, community environmental groups and relevant government departments. The more successful students gave specific stakeholders such as the Environment Protection Authority rather than general answers; for example, some students wrote 'the government'.

Question 3g.

Marks	0	1	2	3	4	Average
%	20	18	25	19	18	2

Students needed to describe two management strategies to reduce the environmental risks that exist at the power station and clearly explain how each strategy could work to reduce the potential environmental problems associated with developing the power station. The risks did not need to relate to sulfur dioxide but most students referred to it in their responses. For example, many students discussed that scrubbers which remove the sulfur dioxide by reacting it with water could be installed in the exhaust system. Others described the use of very high chimneys to dissipate the waste gases over a much wider area in order to decrease the impact on vegetation around the power station. Some answers focused solely on monitoring programs that check various pollutant levels, but without the data being analysed and the results being used to develop particular strategies these do not necessarily reduce environmental risks.

Students should not list more strategies than the number asked for in the question.

Question 3h.

Marks	0	1	2	3	4	Average
%	17	12	28	27	16	2.2

Students needed to provide two arguments as to whether or not the power station could be an example of an ecologically sustainable development (ESD). Students needed to provide their own arguments on the issue and show clearly that they understood the principles of ESD. Many students discussed the idea that ESD focuses on providing for the needs of the current generation (by providing electrical energy now) but also considers the possible requirements of future generations (coal resources are not totally depleted). Most students understood that coal was non-renewable and that sources will be depleted in a relatively short period of time, and therefore clearly argued that the power station was not an example of an ecologically sustainable development. A number of students omitted the ESD principle related to minimising the environmental impacts when developing and using the particular resource. The more successful students included some discussion of the use of carbon sequestration to remove the greenhouse gases from the power station exhausts and store them underground, thereby potentially reducing environmental impacts in line with ESD principles.

Question 4a.

Marks	0	1	2	3	4	Average
%	5	15	37	35	8	2.3

Students needed to carefully read the information provided about the wallaby populations and use their knowledge of biodiversity principles to discuss the two management proposals. Better answers indicated reasons for and against the suggested plans for establishing a population at each particular habitat. Students acknowledged that Maria's proposal would re-establish a population in a region that had previously supported these wallabies and would remove them from their current location (and therefore away from the impacts of predators and exotic grasses), although concern was expressed about the distance to transport the animals and the stress this could cause. Alan's proposal was supported because the habitat was closer to the current location and was more likely to provide suitable conditions for the

wallabies. The possibility of a large-scale catastrophic bushfire event in this region leading to all of the populations being wiped out was often highlighted as a problem with this plan.

Question 4b.

Marks	0	1	2	3	4	Average
%	9	14	21	36	20	**2.4**

Students needed to give a recommendation for either Alan or Maria's plan and support this with valid reasons. Most students supported Maria's plan to take wallabies from all three populations because this would help to increase the genetic diversity of the relocated population by mixing the genes from all three populations. Some students argued for Alan's plan, on the basis that removing individuals from very small populations could reduce the viability of these populations and impact on demographic variation.

Question 4c.

Marks	0	1	2	3	4	Average
%	8	4	15	21	51	**3**

Most students were able to identify and describe two strategies that could be incorporated into a management plan for the bridled nail-tail wallaby based on information in the question stem. Ideas discussed included a weed-eradication program to remove the buffel grass and replace it with native grasses, fencing off the current habitat and removing predators, captive breeding and re-introduction programs, and creating wildlife corridors to link isolated populations.

Question 4d.

Marks	0	1	2	3	Average
%	14	38	45	4	**1.4**

Many students found this question difficult. They needed to outline a strategy for accurately determining the number of bridled nail-tail wallabies in the park. Some suitable strategies related to random sampling methods over a period of time and in a variety of locations within the park. The more successful students described capture/tag/recapture methods, the use of sensor cameras, spotlighting or scat analysis to gain data related to population numbers. Using quadrats to measure and count numbers is most often used with plants rather than large, mobile animal species.

Question 4ei.

Marks	0	1	2	Average
%	12	77	10	**1**

The term 'endemic' refers to a species being naturally restricted to a limited geographic location. In this example the species is endemic to a small region in northern Queensland. Therefore, the species is only found naturally in this part of Queensland. For example, some individuals could be in a zoo in Victoria, or have been introduced somewhere else, but they are still endemic to northern Queensland. Students needed to clearly make this distinction.

Question 4eii.

Marks	0	1	2	Average
%	25	21	53	**1.3**

The majority of students were able to explain that the unusually resilient immune system of the wallaby may give the species a better chance of survival when compared to other, more numerous marsupial species. Other reasons given discussed the broader possible range of the species giving it a larger potential habitat if degradation or catastrophe occurs.

Question 5a.

Marks	0	1	2	3	4	Average
%	11	26	22	16	25	**2.2**

Students needed to have a clear understanding of each of the three terms 'species richness', 'relative abundance' and 'species diversity'. Students who were able to explain species richness (the total number of different species), relative abundance (the relative number of each species) and species diversity (which combines both of these concepts) and therefore which was most significant for assessing biodiversity produced the better answers. These students were able to clearly explain that species diversity is the most significant way of assessing biodiversity in the wetlands because it considers both the specific number of species present as well as whether there is an even or uneven distribution of numbers between species.

Question 5b.

Marks	0	1	2	3	4	Average
%	9	4	7	14	66	3.2

Lagoon A had an index of 2 and lagoon B had an index of 20.8. Most students were able to use the data and formula provided to successfully calculate the indexes for lagoon A and lagoon B.

Question 5c.

Marks	0	1	2	Average
%	23	10	68	1.5

By comparing the three index figures, most students were able to correctly suggest that lagoon A had the greater biodiversity. They explained that the indexes were lagoon A: 2, lagoon B: 20.8 and lagoon C: 22.4, therefore the lowest figure indicates the highest biodiversity – all three lagoons had the same species richness but relative abundance was different.

Question 5d.

Marks	0	1	2	3	Average
%	34	14	40	13	1.3

This question asked students to name the most relevant international treaty for the management of the waterbird species at the lagoon habitats. Given that the waterbirds were both permanent and migratory, the Ramsar Convention was the most relevant. The Ramsar Convention is an international treaty whose signatories must aim to protect the habitats of waterbirds that migrate from country to country. The correct name, Ramsar Convention, was required for full marks. Some students gave JAMBA or CAMBA as answers. Although these protect the habitats of migratory birds between Australia and Japan or China, they are not the most relevant international treaties in this case.

Question 6

A large amount of information was provided for students to read and analyse for use throughout this question. It was important that students used and interpreted the information in their answers; they should not have just copied out points from the introduction as some students did.

Question 6a.

Marks	0	1	2	3	Average
%	7	3	16	74	2.6

Students were required to use the table provided to organise and summarise points that could be used as arguments related to the two proposals for the quarry. Relevant social, economic and environmental factors needed to be correctly placed into the table relating to the quarry and parkland proposals. Social factors related to the parkland development included an increase in recreational opportunities, with local residents being able to use the walking trails and playgrounds. Economic factors identified included the profit generated from being able to continue to sell crushed rock from the quarry. Environmental factors were more easily identified by students and included points related to the potential impact on frog and fish species in the wetland if the quarry is extended to the west, as well as less noise and toxic dust problems if the parkland is developed. Some students tried to organise the three factors into arguments for and against each proposal, but this was not the major focus of the question.

Question 6b.

Marks	0	1	2	Average
%	24	37	39	1.2

In making decisions related to the proposed developments at the quarry, relevant data needs to be collected and prepared. This data could then be used as part of an Environmental Impact Assessment and help to support and inform the decision-making process. Students need to be clear that an Environmental Impact Assessment or a Risk Management Assessment contain the data. Therefore, two different data forms needed to be given. Examples included data on flora and fauna numbers and species, noise pollution levels, dust emissions and toxicity levels, economic cost/benefit data or surveys of residents.

Question 6c.

Marks	0	1	2	3	4	Average
%	13	12	36	29	12	2.2

Students needed to evaluate both proposals and make a recommendation about which should be allowed to proceed. Students needed to present information that clearly justified their recommendation and give points for and against expanding the existing quarry or moving the quarry and developing the parkland/lake/community housing. Clearly explained points, balanced arguments and a cohesive justification were required. The majority of students presented points in favour of closing the quarry based on removing the current impacts of noise, dust and waste, and replacing it with a revegetated parkland and lake environment that would benefit the local community. They argued that rock material could be better provided by the new quarry site to the south, which would mean fewer disturbances of residents and a longer potential period of production of rock material from the new quarry. A number of students argued that neither proposal should go ahead and that the quarry should be allowed to continue working as it does currently. Better answers included discussion of continuing to provide employment, improvements that could be made with noise and dust reduction, as well considering what could happen when the rock supply from the existing pit is exhausted.