2016 VCE Environmental Science examination report

General comments

Overall, students showed a good understanding of key concepts and major areas of the study, and were able to use examples they had studied when required. Most students were able to complete the examination within the given time.

One of the questions students found the most challenging was Section B, Question 1c. on emissions trading. Many students had little idea of the concept. It is important to remember that all points in the study design could be incorporated into the examination.

Some students had difficulty with multiple-choice questions that involved calculations, including Questions 6, 9 and 13. Students need to continue to work on questions that use numerical data and practise responding to these types of questions throughout the year.

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 resulting in a total more or 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	Comments
1	1	1	2	96	
2	3	88	8	1	
3	67	5	22	6	The source of the methane is biological, from the pig farm waste, therefore biomass was correct. Methane is a constituent part of natural gas, but the source given in the stem means it is a biomass energy source.
4	97	0	2	0	
5	6	90	4	0	

Question	% A	% B	% C	% D	Comments
6	2	60	16	22	To calculate the energy saving students needed to work out 30% of 650 kWh. Therefore giving 650 × 30/100 = 195 (option B). A number of students chose option D (455 kWh), which was the actual energy usage rather than the saving.
7	9	14	74	2	Water vapour is by far the most significant gas contributing to the natural greenhouse effect. Option C was the only option containing this gas. Carbon dioxide is the second-most important natural greenhouse gas.
8	2	66	5	28	Carbon dioxide is the most significant greenhouse gas produced by human activity, with methane (from agriculture and mining) the second-most significant. This gave the correct option as option B.
9	15	54	19	11	Reading the figures from the graph, 1940 was 300 ppm, and 1990 was 360 ppm. Therefore the increase was 60 ppm. To calculate the percentage increase = change/original = 60/300 = 20%, therefore option B was correct.
10	6	2	7	85	
11	33	4	14	50	Incoming energy from the sun is largely visible light, with most outgoing energy in the form of infrared. The correct option was option D. The most common incorrect option chosen was option A, which indicates an incorrect understanding of the electromagnetic spectrum reaching Earth.
12	10	87	2	1	
13	22	58	17	2	In 2001 the emissions of mercury were 127 kg, and in 2004 the emissions had dropped to 92 kg. Therefore the change was 35 kg less. To calculate the percentage change = change/original × 100 = 35/127 × 100 = 28% The emissions decreased, so the answer was negative: –28% (option B).
14	85	2	7	7	
15	96	2	2	1	

Question	% A	% B	% C	% D	Comments
16	7	5	5	83	
17	7	3	5	85	
18	12	71	13	4	The toxic effect of the cryolite on the rats is caused by repeated doses over a long period, which is chronic toxicity (option B).
19	4	73	15	7	A point source means a particular single point of origin can be identified from where the pollutant is being emitted. The only option that this does not apply to is a city (option B), which will be spread out or diffuse. The most common incorrect answer was option C, a ship.
20	5	83	10	1	
21	71	15	3	11	The aim of CITES is to limit and control the international trade in endangered species so they are protected from extinction, which was option A. It does not directly address monitoring as such, although option D was the most common incorrect response.
22	90	2	1	7	
23	1	9	88	2	
24	5	91	3	2	
25	6	1	93	0	
26	1	93	5	1	
27	0	38	16	45	There are many different classification systems worldwide. The Australian *Environmental Protection and Biodiversity Act 1999*, which the study design reflects, lists these definitions for non-extinct species as vulnerable, endangered or critical (or critically endangered). High risk of extinction in the medium term puts the African Dwarf Crocodile in the vulnerable category, therefore option B was correct. The most common incorrect response was option D – endangered, which would imply the short term rather than medium term.

Question	% A	% B	% C	% D	Comments
28	65	11	16	7	Creating a national park would be the best of these options (option A) in order to protect all five species in their only known habitat. The most common incorrect response, option C – a captive breeding program, would be a possibility, but a successful captive breeding program would be less likely for five different species.
29	9	7	79	4	
30	70	25	2	3	These guidelines outlined by the EPA are part of the regulatory framework (option A). Option B was the next most common answer given. The precautionary principle applies when there is some doubt, and care needs to be taken because of this doubt. There was no indication of uncertainty about pollutants in the stem of the question.

Section B – Short-answer questions

Question 1a.

Marks	0	1	2	Average
%	11	39	50	**1.4**

The focus of this question should have been two environmental impacts that result from the extraction of the nominated fossil fuel. Most students chose to describe impacts that result from the mining of coal, such as habitat disturbance or vegetation removal, effects on the water table, ground subsidence and issues related to dust or noise pollution. Other impacts that result from oil leaks into the ocean were given by students.

Question 1b.

Marks	0	1	2	3	Average
%	8	24	37	32	**1.9**

Students were required to identify the key energy conversion steps from the source of their nominated fossil fuel through to the supply of electricity to the region. Some students left out the first step of mining or processing the fossil fuel and began with a focus on the combustion stage. The burning of the fossil fuel releases heat, which is used to produce steam, which is used to turn a turbine and in turn a generator. The generator creates an electrical current that is sent through transformers and the transmission lines into the region. Some students added extra detail by including energy forms in each step (i.e. from chemical to thermal to kinetic) but this was not required by the question.

Question 1c.

Marks	0	1	2	3	4	Average
%	45	15	14	15	11	**1.4**

Students found this question difficult because few had a clear idea about how the concept of emissions trading could be applied. The highest-scoring answers clearly explained how the government could set a cap (or target) on total greenhouse gas emissions and set a price per unit of emissions. Companies can then buy a permit to produce a certain amount of greenhouse gas. They then have the incentive to reduce their emissions and can sell or trade their permits. This system encourages polluters to reduce their greenhouse gas emissions for an economic benefit.

Question 1d.

Marks	0	1	2	3	Average
%	4	17	41	38	**2.1**

In general this question was well answered. Two benefits of increasing the supply of non-fossil energy from 15% to 75% needed to be explained. The main point given discussed the reduction of greenhouse gas emissions because less fossil fuel would have to be burnt if this plan went ahead. Other ideas that were clearly explained included decreased environmental impacts from the extraction and mining of fossil fuels, as well as the fact that using renewable energy forms means that they will not be depleted.

Question 1ei.

Marks	0	1	2	Average
%	13	36	51	**1.4**

Students were not always clear about the difference between peak and off-peak electricity, and therefore could not link the challenges of using a non-fossil fuel energy source to the different requirements of varying demands for electricity. Challenges related to solar and wind not being able to consistently supply electricity when conditions changed (i.e. no sun at night or lack of wind) were discussed but this was not linked to the peak/off-peak demands. Students who chose nuclear or geothermal non-fossil energy were able to describe that supply challenges could be managed by these energy sources.

Question 1eii.

Marks	0	1	2	Average
%	17	63	20	**1.1**

Having indicated challenges in Question 1ei., students then needed to explain how one of these could be overcome to allow for electricity to be consistently generated. Most discussed the need for a back-up system to supply energy when solar or wind was not available. Higher-scoring answers suggested building a dam and hydro-electric power plant to supply this backup. Many students suggested the use of batteries to store energy when it was being generated and then be used when solar or wind was not available. However, very few students acknowledged the major limitations of battery storage systems currently in use.

Question 2a.

Marks	0	1	2	3	4	Average
%	6	11	18	10	55	**3**

Line	Radiation type
P	visible
Q	ultraviolet
R	infra-red
S	infra-red

Students with a clear understanding of the incoming/outgoing radiation types added ‘reradiated’ to their answer for line **S**, although this was not required.

Question 2b.

Marks	0	1	2	3	4	Average
%	4	9	20	36	31	**2.8**

The basic differences between the cause and consequences for humans of the natural and enhanced greenhouse effects needed to be outlined. Most students were able to explain that the cause of the enhanced greenhouse effect was due to additional gases, like carbon dioxide, being

added to the atmosphere by a variety of human activities (mainly burning fossil fuels). Some students struggled to make the cause of the natural greenhouse effect clear – they needed to indicate that naturally occurring levels of greenhouse gases were generated by natural phenomenon like volcanic activity and forest fires caused by lightning. The consequence for humans of the natural greenhouse effect is that Earth is kept at a temperature suitable for life to exist. A variety of consequences of the enhanced greenhouse effect were given, such as increasing average global temperature, sea level rising, ice caps melting, etc.

Question 2c.

Marks	0	1	2	Average
%	10	52	38	**1.3**

Most students were able to explain that the burning of a fossil fuel releases carbon dioxide. However, not all were able to then clearly make the link to this carbon dioxide absorbing reradiated infra-red radiation and therefore retaining heat in the lower atmosphere.

Question 2d.

Marks	0	1	2	Average
%	31	20	50	**1.2**

One strategy for continuing to use the fossil fuel but reducing the environmental impact needed to be described. Many students discussed the process of carbon sequestration or planting more carbon sinks to store the carbon dioxide. Other reasonable answers outlined methods to increase the efficiency of the fossil fuel use, and therefore decrease the amount of carbon dioxide being produced. Simple answers like putting a filter or a scrubber on the chimney of a coal-fired power station to trap the carbon dioxide were not accepted.

Question 3a.

Marks	0	1	2	Average
%	13	17	69	**1.6**

The harmful effects of exposure to sulfur dioxide described mainly related to the impact on the respiratory system of breathing in the gas; for example, irritation, coughing, wheezing and shortness of breath. Sulfur dioxide can also irritate the mucous membranes, including the eyes and nasal passages. Some students incorrectly wrote about the effects of sulfur dioxide on the nervous system and brain (which relate to mercury poisoning) and also causing cancers.

Question 3b.

Marks	0	1	2	Average
%	9	21	70	**1.6**

The large chimney from the smelter is a point source of the pollutant. It was important for students to make clear that the single, identifiable location of the chimney referred to a point source.

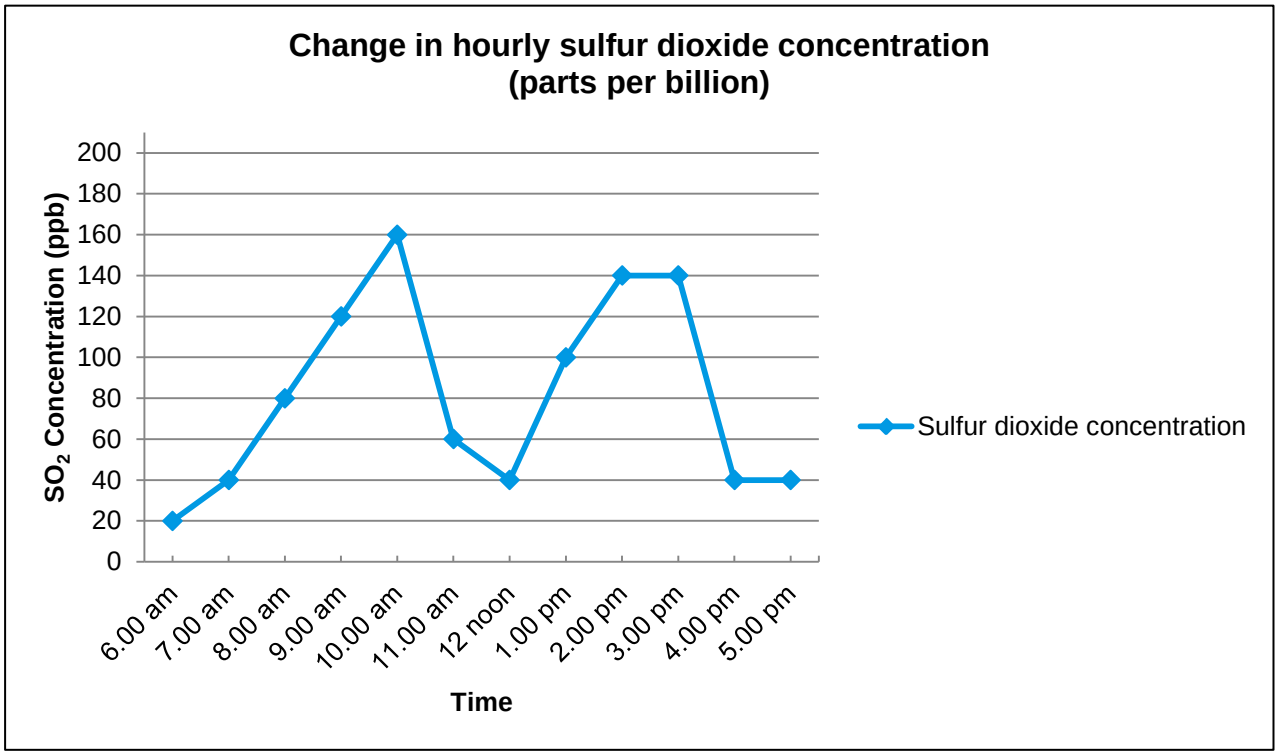
Question 3c.

Marks	0	1	2	3	Average
%	20	23	39	18	1.6

The question required students to think through the factors that would influence the location of a monitoring station. Two factors needed to be explained, with high-scoring responses making it clear that the monitoring station should be located near the population centre (to provide relevant data for the people living near the smelter) and that the scientists should consider environmental conditions, including the prevailing winds.

Question 3di.

Marks	0	1	2	3	4	Average
%	2	0	3	5	90	3.8



Most students were able to correctly graph the data points and join them with a line. Axes were usually labelled with figures and the units, and the title given clearly explained what the graph was showing.

Question 3dii.

Marks	0	1	Average
%	45	55	0.6

Many students did not include the line at 200 ppm on the graph or label it.

Question 3e.

Marks	0	1	2	3	Average
%	27	26	27	20	1.4

Students found this question difficult, with many suggesting that the drop in sulfur dioxide emissions resulted from the smelter stopping while the workers went to lunch. This is not how smelters, power stations or most factories operate, with the main reasons for the reduction in monitored levels occurring because the wind was blowing in a different direct away from the station and/or a rainstorm washed sulfur dioxide out of the atmosphere.

Question 3f.

Marks	0	1	2	Average
%	66	16	18	0.5

Students with a good knowledge of the pollutant's characteristics understood that sulfur dioxide is not persistent and would be unlikely to remain in the environment for a long time after emission. Therefore, it is likely that there are background levels of sulfur dioxide in the atmosphere being recorded and that there may be other sources of the pollutant in the region. This question was not answered well by many students.

Question 4a.

Marks	0	1	2	Average
%	24	29	48	1.3

The algae are regarded as a 'symbiont' of the giant clam because there is a close and long-term interaction between the two different species. They both benefit from this relationship because the algae use the clam as a place to live and the clam gains nutrients from the algae.

Question 4b.

Marks	0	1	2	3	4	Average
%	3	4	18	35	39	3

Based on the information provided most students were able to describe two human activities that are threatening the giant clam, and how these activities would impact on the clam. Overharvesting as a food source or taking individuals for display in aquariums were two activities discussed. A negative impact of global warming (increased ocean temperature) and coral bleaching decreasing habitat for the giant clam was described by many students.

Question 4c.

Marks	0	1	2	Average
%	19	21	60	1.4

If there were a reduction in diversity and/or abundance of other species then a number of negative impacts on the giant clam would be possible. Most students correctly suggested that a decrease in species that become food for the clam would decrease clam numbers. Another common idea that was explained was that a reduction in coral species would have a negative impact on habitat availability for the clam.

Question 4d.

Marks	0	1	2	Average
%	35	29	36	1

This question required students to outline why the giant clam should be included on the threatened species list under the *Flora and Fauna Guarantee Act 1988* if it were found in waters near the Wilsons Promontory Marine Park. The clam is already listed as vulnerable by the IUCN and believed to be extinct in some countries, and therefore deserves the legal protection from any threats in Victoria that this action would provide.

Question 4e.

Marks	0	1	2	3	4	Average
%	21	12	24	26	17	2.1

Students needed to clearly describe two management actions that might be detailed in the Action Statement for the giant clam. High-scoring ideas described by students included the protection of the reef habitat by adding the area to the existing marine park, banning any fishing and shellfish harvesting in the region. Some students explained how a captive breeding program that then involved the release of mature clams onto the reef could be a positive management action. An effective monitoring program that evaluated the health of the reef and clams habitat could be part of the action statement if the data was used to help maintain the health of the aquatic system.

Question 5a.

Marks	0	1	2	3	Average
%	21	7	10	62	2.1

Most students understood that the term ‘species richness’ refers to the number of different species in an area, and were able to answer that area Y had the lowest species richness with only three species compared to four in area Z and five in area X.

Question 5b.

Marks	0	1	2	3	Average
%	24	25	17	34	1.6

Students needed to clearly state that Thanh’s view of biodiversity (that area Z had the least biodiversity) was incorrect because the concept of biodiversity includes more than just the number of individuals in an area. It is also important to consider the number of different species as well as the evenness of species (i.e. the relative abundance) to give a full understanding of the biodiversity of an area.

Question 5c.

Marks	0	1	2	Average
%	18	51	32	1.2

The reason why the scientist, Sophie, chose to sample three random areas of equal size was to increase the scientific accuracy of the data collected. Students needed to explain that random areas should be sampled to reduce bias and equally sized areas were chosen to allow for comparisons to be made between three sites.

Question 5d.

Marks	0	1	2	3	Average
%	4	4	6	86	**2.8**

Most students were able to use the data and formula presented in the table to correctly calculate the Simpson's index of 0.56.

Question 5e.

Marks	0	1	2	3	Average
%	11	21	34	35	**2**

Based on the three figures, area X had the highest species diversity with an index of 0.78, compared to area Z with 0.72 and area Y with 0.56. The highest index value indicates the highest species diversity. This is because species diversity refers to both the relative abundance of each species and the number of different species present at each location.

Question 5f.

Marks	0	1	Average
%	52	48	**0.5**

The correct conservation categories in order of highest to lowest risk were critically endangered, endangered and vulnerable.

Question 6a.

Marks	0	1	2	3	4	Average
%	22	14	29	22	14	**2**

This question required students to evaluate the claim regarding the ecological sustainability of the proposal. Students needed to apply two principles of ecologically sustainable development to this evaluation. The main principle used by many students was intergenerational equity, that is, that the development should take into consideration the needs of the current generation, as well as those of future generations. Another principle commonly used in answering this question was the conservation of biodiversity and protection of ecological processes. Most students suggested that the claim the proposal should be regarded as an ecologically sustainable development was not accurate, based on the negative impacts the development could have the islands ecology, even though the use of renewable energy sources and energy-efficient housing design does meet some sustainability principles. Not all students were able to correctly explain two principles and fully evaluate the claim using these sustainability principles.

Question 6b.

Marks	0	1	2	Average
%	13	19	68	**1.6**

Most students understood that the Ramsar Convention relates to protecting significant wetlands that provide habitats for migratory bird species. The southern end of the island included a large salt marsh and tidal flats that provided habitat for 25 different seabird species, including some migratory species.

Question 6c.

Marks	0	1	2	3	Average
%	17	15	30	38	**1.9**

The proposed development requires an environmental impact assessment to be completed. The question required students to describe two steps in the process of preparing the environmental impact assessment. Most students were able to describe the need to collect data related to the potential environmental impacts of the development, as well as other costs and benefits of the proposal. A report should be prepared based on this information, which could include possible alternative options for the proposal. Public comment should be included on this draft report, with the final report submitted to the Minister.

Question 6d.

Marks	0	1	2	Average
%	28	44	28	**1**

Most students understood the basic role that local environmental groups and existing residents could play in the environmental impact assessment process, in making public comment on the draft report during the consultation process. High-scoring responses added the idea of these groups being able to contribute to the data collection process during the preparation of the report.

Question 6e.

Marks	0	1	2	3	4	5	Average
%	14	4	14	30	28	10	**2.9**

This question required students to use the key pieces of information provided to discuss the development proposal. High-scoring responses presented both the arguments for and against the development of the island, and argued clearly for one side. The justification for proceeding or not proceeding was based on a balanced analysis of the information provided. The cohesion of the overall answer was important, as was some discussion and development of the points given regarding the positive and negative aspects of the island's development (rather than just relisting them).