2015 VCE Environmental Science examination report

General comments

Overall, students showed a good understanding of key concepts and major areas of the study. Most students were able to complete the examination.

Some students needed to read the information provided more carefully and use this in their answers when required. Students should note the command words in the question and 'explain', 'describe' or 'justify' when asked to do so.

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	% No Answer	Comments
1	0	6	82	11	0	
2	2	83	11	3	0	
3	8	4	81	7	0	
4	60	17	2	20	0	Since the operation of the fuel cell is exothermic (that is, gives out heat), it needs to be kept cool, so therefore option A was correct.
5	72	5	19	3	0	Sulfur and oxygen (option A) combine to form sulfur dioxide. The most common incorrect answer was sulfur and carbon dioxide (option C).
6	20	71	8	1	0	Many metal ores contain sulfur (as sulfides). When heated in the smelter, sulfur separates and combines with oxygen to form sulfur dioxide, leaving the elemental metal.
7	10	2	3	84	0	
8	3	4	90	2	0	
9	20	8	2	70	0	
10	71	15	1	13	0	
11	14	6	8	71	1	

Question	% A	% B	% C	% D	% No Answer	Comments
12	85	7	2	5	0	
13	7	3	84	5	0	
14	5	89	1	4	0	
15	11	0	8	81	0	
16	2	14	83	1	0	
17	70	19	7	5	0	The graph indicated that there were 35 species in 1950 and 24 in 2010. Change = 11. To calculate percentage change: 11/35 × 100 = 31% decrease (option A). The most common incorrect answer was 46% decrease (option B), obtained by dividing the change by the final state instead of the initial state.
18	77	15	2	5	0	
19	2	89	2	7	0	
20	1	12	80	7	0	
21	1	95	1	2	0	
22	82	2	9	6	0	
23	9	65	1	24	1	The policies and guidelines given in the ballast water example were clearly part of the government's regulatory frameworks used to help protect marine environments (option B).
24	10	21	5	62	1	The precautionary principle directs that if scientific information regarding the potential impacts of an action is not available, then this lack of information should not be used as an argument for not undertaking suitable measures to prevent environmental harm. This was suggested in option D, although some students did not seem to understand the concept.
25	2	21	76	1	0	
26	81	1	14	2	1	
27	1	2	11	86	0	
28	1	1	38	59	1	In general the role of an environmental risk assessment is to balance some of the problems of a project, including any damage against the benefits (option D). It is not the main aim of an environmental risk assessment to eliminate any disruption or damage during construction (not possible).
29	1	88	1	9	1	
30	1	1	13	84	1	

Section B

Question 1a.

Marks	0	1	2	Average
%	9	40	51	1.4

Two clear reasons were required to explain why the government would be considering moving from a fossil fuel source to nuclear energy to supply the country's electricity. Relevant points made included the points that less greenhouse gases would be produced, the fossil fuel supply is running out (finite) and the need to replace the fossil fuel power plants due to age.

Question 1b.

Marks	0	1	2	Average
%	13	33	54	1.4

This question required students to explain what the term 'energy efficiency' meant, using an energy source they had studied. The concept that 'energy efficiency' is related to the amount of total energy in the source that is converted into usable energy needed to be stated. Some students related this concept to the number of energy conversions (i.e. more conversions means less efficiency due to the energy loss in each step), although this was not necessary.

Question 1c.

Marks	0	1	2	Average
%	7	33	60	1.6

Overall this question was well answered, although some students had difficulty in using an example to explain why an energy source would be classified as renewable. The concept that renewable resources are 'naturally replenished in a human timescale' or 'constantly being renewed in a short timescale' needed to be stated and related to the particular example. A number of students incorrectly stated that a renewable resource was reusable.

Question 1d.

Marks	0	1	2	3	Average
%	10	28	42	21	1.7

A variety of relevant points were provided by students to explain why environmental groups may not be in favour of using nuclear energy. These included major concerns over potential problems with radiation leaks, the possible meltdown of nuclear reactors and issues related to safe disposal/long-term storage of radioactive waste from spent nuclear fuel. Some students were able to identify that exposure to this radiation from leaks/waste materials can create human and environmental health problems.

Question 1e.

Marks	0	1	2	3	Average
%	13	16	29	43	2

Students generally had an understanding that some renewable forms are inconsistent – that is, they are not available all day, every day. High-scoring responses explained that having a variety of

renewable energy forms could provide the necessary amounts of energy when some sources are not available. Often they supported this well, using renewable energy examples.

Question 2a.

Marks	0	1	2	3	4	5	Average
%	7	10	15	28	28	12	3

Most students followed the suggestion of using a diagram to explain the mechanism of the natural greenhouse effect, although the clarity and correctness of labelling varied greatly. Most were able to identify the three types of radiation (visible, ultraviolet and infrared) entering Earth's atmosphere, but many had difficulty with making clear what happens to each type. The point that visible light is absorbed by the surface of Earth and re-emitted/reradiated as infrared was very important but often missing. It is this reradiated infrared radiation that is absorbed by the various natural greenhouse gases that leads to Earth's average temperature of around 15 ^{o}C. In general the depth of understanding of the entire process varied.

Question 2b.

Marks	0	1	2	3	4	Average
%	4	5	14	30	47	3.1

The question was usually well answered, with most students able to explain the key differences between the causes and impacts of the enhanced and natural greenhouse effects. The cause of the natural greenhouse effect is the natural levels of gases in the atmosphere, and the main cause of the enhanced greenhouse effect is the addition of greenhouse gases due to human activities such as burning of fossil fuels. The impact of the natural greenhouse effect is to maintain global temperatures at a level that allows for life on Earth to exist. The enhanced greenhouse effect impact is the raising of global temperatures. A variety of problems result from this, including sea level rising, icecaps melting, climate changes, etc. It was not necessary to identify the key gases involved in each, although many students did so.

Question 2c.

Marks	0	1	2	3	Average
%	16	16	31	37	1.9

Most students correctly explained that land use change due to large-scale clearing of vegetation has reduced the intake of carbon dioxide (due to the removal of carbon sinks), thereby leading to greater warming. Another change to land use impacting on the enhanced greenhouse effect was required for full marks. Higher-scoring responses included the conversion of forest/woodland to pasture for grazing animals and the consequent production of large amounts of methane or the construction of cities and factories and the production of an increased amount of carbon dioxide.

Question 2di.

Marks	0	1	2	3	Average
%	6	30	39	25	1.8

Using their nominated fossil fuel energy source, students were able to describe how burning the fossil fuel creates extra amounts of the greenhouse gases in the atmosphere, which then absorbs more of the reradiated energy and this contributes to global warming. Various impacts of the enhanced greenhouse effect such as the melting of icecaps, sea levels rising and climate changes were given. Some students had difficulty outlining a suitable reduction mechanism. Higher-scoring

answers outlined geosequestration or planting carbon sinks. Many students incorrectly suggested the use of filters or scrubbers on fossil fuel power stations to remove any carbon dioxide.

Question 2dii.

Marks	0	1	2	Average
%	16	40	45	1.8

Students were required to outline an environmental advantage and a disadvantage of using their nominated non-fossil fuel energy source. Most students were able to suggest as an advantage that using a non-fossil source of fuel produces less greenhouse gases than a fossil source of fuel. Disadvantages often related to creation of carbon dioxide during the transporting of materials or the loss of carbon sinks through the construction of the non-fossil fuel source system. Some students did not read the question carefully and did not relate their disadvantage to the enhanced greenhouse effect.

Question 3a.

Marks	0	1	2	Average
%	7	66	27	1.2

This question required an understanding of the definition of a pollutant. Most students were able to indicate that mercury and its compounds caused harm to the environment, but many did not cover the other key point that a pollutant is generated by human activities.

Question 3b.

Marks	0	1	2	3	Average
%	3	13	32	52	2.3

A variety of harmful effects of mercury and its compounds on people were given, including negative impacts on the nervous, digestive and immune systems. Students were required to describe two effects. Higher levels of mercury produce permanent damage to the brain, kidneys and developing foetus, and may be fatal. Lower exposure to mercury can lead to tremors, insomnia, memory loss and/or headaches.

Question 3c.

Marks	0	1	2	3	Average
%	37	9	22	32	1.5

This question required an understanding of the mercury conversion process and was difficult for many students. Students needed to describe that the gases emitted from the electricity generation plant are washed out of the atmosphere into water bodies. The action of anaerobic organisms (bacteria) that live in these aquatic systems was required, specifically that the methylation process by these organisms converts inorganic mercury into methyl mercury.

Question 3d.

Marks	0	1	2	3	Average
%	5	6	18	72	2.6

Most students were able to explain the difference between a point and a diffuse source of pollution. In this case the coal-fired power plant was a point source because it had a clear, single source point – the chimney.

Question 3e.

Marks	0	1	2	3	Average
%	13	27	43	17	1.7

Based on the information provided, students needed to indicate that Sarah was incorrect in suggesting that there should be no concerns with the emissions of mercury into the air. Students' explanations should have made clear that the emissions to the air would be transported by winds and would settle onto the land and in lakes and oceans. Land deposits can be washed into waterways and oceans and converted to methyl mercury. Therefore, methyl mercury enters the food chain and bioaccumulates in the fish and shellfish. Some students had difficulty in explaining logically how this problem occurs, and others discussed problems related to sulfur dioxide rather than mercury.

Question 3f.

Marks	0	1	2	3	4	Average
%	9	5	14	47	25	2.8

The standard of answer to this question varied depending on the student's knowledge of various forms of mercury, and their understanding of the terms 'persistence' and 'mobility'. 'Persistent' is a term applied to chemicals that do not break down easily in the environment. Most students understood that mercury and its compounds last for a long time in the environment and therefore have a high persistence. 'Mobility' is the ability of chemicals to move from one natural reservoir to another. Some students confused this with transport mechanisms. Mercury is generally mobile in water but has low mobility in air.

Question 4a.

Marks	0	1	2	Average
%	32	28	40	1.1

CITES is an acronym for the Convention on International Trade of Endangered Species of Wild Fauna and Flora. There was a variety of incorrect and unusual names given. Under CITES the bear species will gain protection through the restriction/limitation and control of trade of live animals and animal parts. CITES would not directly stop the captive breeding of the bears, limit habitat logging or control killings, as suggested by some students.

Question 4b.

Marks	0	1	2	Average
%	7	25	68	1.6

Most students correctly identified the main threat to the Sun Bear as being deforestation or habitat fragmentation through logging activities. This would clearly reduce the bear's range due to removal of suitable sleeping areas, shelter and food supplies.

Question 4c.

Marks	0	1	2	Average
%	16	48	36	1.2

A variety of strategies were suggested to monitor the Sun Bear population. These included surveying areas, using cameras to identify animals and habitats or the capture/tag/release method. Some description of the particular method was required to score highly.

Question 4di.

Marks	0	1	Average
%	9	91	0.9

The correct IUCN classification given by most students was either endangered or critically endangered.

Question 4dii.

Marks	0	1	2	3	Average
%	10	17	47	27	1.9

A definition of genetic diversity needed to refer to the variation of genetic material (in DNA) within species or population. The most common negative consequences referred to by students was inbreeding (because mating between related individuals increases the frequency of genetic problems and disease).

Question 4e.

Marks	0	1	2	3	4	Average
%	4	4	27	45	20	2.7

Students discussed a variety of advantages and disadvantages related to the strategy of keeping four Sun Bears in a zoo in North America. The suggestion that this strategy would ensure the long-term survival of the species was supported by points that this could prevent total extinction of all members of the species by protecting some in the zoo, and could allow for possible reintroduction of individuals bred in captivity to boost the wild population. Disadvantages discussed included the removal of breeding partners/genetic diversity from the wild population when taking animals for the zoo. Inbreeding of such a limited number of individuals in the zoo and the possible difficulties of reintroduction were also given as disadvantages. An overall evaluation of the strategy was required to complete the response.

Question 5a.

Marks	0	1	2	3	Average
%	5	28	39	28	1.9

Students provided a variety of reasons to explain why an environmental impact assessment would be required before a project to clear a large woodland area could gain approval. Three correct ideas were required and suitable points made included the gathering of scientific data to support the decision-making process, to give a balanced view of both positive and negative aspects of the proposal, to develop alternative options and to allow for public input into the process.

Question 5b.

Marks	0	1	Average
%	35	65	**0.7**

Acceptable answers given included ‘remnant’ or ‘vegetation fragment’. Because the woodland patches were isolated, ‘wildlife corridor’ was an incorrect response.

Question 5c.

Marks	0	1	2	Average
%	14	33	54	**1.4**

The question asked for one reason for and one reason against the strategy of studying a similar area in a different part of the country that was cleared 10 years ago. Students needed to think about how this study could provide data for the scientists to use in helping make the decisions about the woodland project. The key idea that this strategy could indicate the possible impacts of clearing and how well the isolated patches of woodland habitat may cope over 10 years was required. The main reason given against the strategy related to the fact that the study area was in a different part of the country, and therefore may have different species and conditions that would make the data irrelevant.

Question 5d.

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

Species richness refers to the total number of different species, therefore area C had the lowest species richness with only four species compared to five in the other two areas.

Question 5e.

Marks	0	1	2	Average
%	27	9	64	**1.4**

Most students were able to use the data provided in the two tables to correctly identify area C as having the greatest biodiversity. Area C had a lower index of 0.050 compared to area B with 0.112, indicating a higher biodiversity (because a lower figure means a greater biodiversity).

Question 5f.

Marks	0	1	2	3	Average
%	18	15	43	25	**1.8**

The key factors taken into account when considering the index and calculations were both the total number of different species (species richness) and the evenness of distribution of numbers of individuals across species (relative abundance). Higher-scoring responses used some of the data, discussed what it showed and explained that in measuring the species diversity both of these factors should be taken into account.

Question 5g.

Marks	0	1	2	3	Average
%	14	8	23	55	2.2

Most students were able to use the index and correctly calculate the species diversity for Area A. Having correctly calculated the figure of 0.040, they compared this with the figures for Area B (0.112) and Area C (0.050), and explained that this figure indicated a greater biodiversity (lower index figure means a higher species diversity). A number of students missed this point, which was given to them in the information provided in the question.

Question 6a.

Marks	0	1	2	3	Average
%	8	11	35	47	2.2

This question required students to choose one of the two proposals and justify this choice as the most ecologically sustainable. Most students chose Proposal 1 and were able to use ecologically sustainable development principles to explain this. Many students explained the idea that selective logging is more sustainable because the method uses available resources to provide for the needs of the current population while considering the needs of future generations by causing less impact on the ecosystem. Selective logging provides high value timbers to use now and allows forest to regenerate naturally and trees to regrow for future use.

Question 6b.

Marks	0	1	2	Average
%	26	31	42	1.2

Students usually named an environmental impact assessment or environmental effects statement. They described that these management tools outline the costs and benefits of different options. Collection of relevant scientific information is then used to make final recommendations to the Minister who would make a decision on whether the proposal would be allowed to proceed or not.

Question 6c.

Marks	0	1	2	3	Average
%	11	5	21	62	2.4

A variety of stakeholders were named (such as local residents, environmental groups, council, and timber workers) but not all students indicated the role of the stakeholder in the environmental management process.

Question 6d.

Marks	0	1	2	3	4	5	Average
%	14	5	17	28	25	11	2.8

This question required students to use the information provided to discuss the environmental, economic and social aspects of the two proposals and make a clear recommendation about which should be allowed to proceed. Higher-scoring answers used a variety of the information (including the graph), analysed the positive and negative aspects of both proposals and clearly justified their recommendation. In these responses the discussion of aspects of both proposals was well rounded, rather than just restating/listing basic points, which a number of students did.