2018 VCE Environmental Science examination report

General comments

The 2018 VCE Environmental Science examination addressed knowledge and skills from all areas of Units 3 and 4 of the study design.

It is important that students read each question carefully and take note of what is specifically being asked for. There was some evidence of students trying to use ideas and answers from previous examinations to fit new questions.

If a question asks for one example it is important that students focus on their single best answer rather than listing a variety of possible ideas. Sometimes students gave multiple points, which is not an acceptable way to structure such a response, and then would occasionally contradict themselves from one point to the next.

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	1	1	97	1	0	
2	10	3	5	82	0	The introduction of a non-native species could have potentially harmful consequences on the native birds. Therefore, the argument against the proposal is based on the precautionary principle (option D).
3	8	65	25	2	0	The role of the nitrogen-fixing bacteria is as a supporting service for the plants (option B).
4	4	2	83	11	0	The key reason to explain the current high rate of species extinction relates to the various negative impacts of humans on ecosystems over a short time scale.
5	5	83	1	11	0	Because the devil exists only in Tasmania, it is endemic to Tasmania (option B).

Question	% A	% B	% C	% D	% No answer	Comments
6	1	3	95	1	0	A low genetic diversity within the Tasmanian devil population is most likely to lead to a limited ability to adapt to and therefore withstand any rapid environmental change (option C).
7	47	27	6	19	0	Students need to have an understanding of various systems that rate the conservation status of species and where these systems are applicable.
8	10	37	17	34	1	Students needed to be aware of the definition of a species. A species has members of a population that can mate and produce offspring that are fertile. Mating of two related but separate species (as indicated in the question) could potentially produce offspring, but usually they would be infertile and would not help to re-establish numbers. Therefore, the most suitable answer was option B.
9	6	15	74	4	0	The idea of valuing the entire ecosystem means that emphasis is put on the ecology rather than human needs, and would be regarded as an ecocentric view.
10	2	78	9	10	0	Intergenerational equity refers to protecting resources over a long period of time for use by generations into the future. Option B was the best response because World Heritage listing would protect forest areas into the future.
11	14	84	1	1	0	The focus of the project is to minimise the impact on the upper soil and rock layers, which is classified as the lithosphere (option B).
12	1	6	91	2	0	An environmental risk management plan involves assessing risks and planning for mitigation.
13	14	10	8	68	0	Natural gas is largely composed of methane (CH_4). In combustion (burning) it oxidises to CO_2 and H_2O (carbon dioxide and water).
14	2	80	17	0	0	The correct option listing only non-fossil energy sources was option B. The most common incorrect response selected was option C. Natural gas is a fossil energy source.
15	1	3	93	4	0	
16	66	15	14	5	0	Option C (plant and animal matter, heat, thousands of years) was the common incorrect response. High pressure underground is required to form fossil fuel and would take longer than thousands of years.
17	6	3	4	87	0	

Question	% A	% B	% C	% D	% No answer	Comments
18	10	83	4	3	0	To correctly calculate the percentage efficiency the output was divided by the input and multiplied by 100 (i.e. 160/200 × 100 = 80%, option B). The most common incorrect response was gained by incorrectly inverting the output and input (i.e. 200/160 × 1000 = 125%).
19	92	4	1	2	0	A disadvantage of solar energy compared to hydroelectricity is that it cannot generate electricity 24 hours a day (no sunlight at night).
20	0	17	11	71	0	Eccentricity (option D) was the only option that referred to Earth's orbit around the sun.
21	5	48	28	18	0	The percentage of CO_2 as a greenhouse gas in the atmosphere is less than 0.04 per cent.
22	69	7	21	2	0	Option A, acidification of the oceans, was correct. The most common incorrect response was option C, a rise in atmospheric density. This may reflect knowledge that carbon dioxide has a molecular mass of 44 compared with the mean of the atmosphere of about 29. However, this has a negligible effect on density compared to other factors (e.g. temperature and pressure).
23	3	7	6	84	0	Methane's lower effect on global warming compared to carbon dioxide is due to its much lower atmospheric concentration and lower molecular mass.
24	1	15	4	80	1	Option D, about there being less certainty about future droughts rather than average temperature rising, was correct. Many factors other than temperature can affect droughts. The most common incorrect response was option B, It is certain that average temperatures will rise in the future. While it is a true statement, it was not relevant to the question.
25	5	8	79	8	0	Option C, coastal erosion due to rising sea levels, was the only answer relevant to the lithosphere. Although some of the other options were potential impacts of climate change, they did not relate to the lithosphere.
26	20	45	20	16	0	Plankton absorbing carbon dioxide is an example of carbon sequestration, that is, removing existing carbon dioxide from the atmosphere (therefore, option B was correct). Option C, replacing coal-burning power stations with solar power stations, reduces carbon dioxide from entering the atmosphere but does not remove what has already entered the atmosphere.
27	83	2	6	10	0	
28	1	2	85	12	0	The most common incorrect response was option D, which would have decreased the accuracy of the results.

Question	% A	% B	% C	% D	% No answer	Comments
29	2	8	6	84	0	
30	5	6	84	5	0	

Section B

Question 1a.

Marks	0	1	2	3	Average
%	2	4	13	80	**2.7**

Students were generally able to use the data and formula provided to correctly calculate the Simpson's Index (D) for site Y of 0.810. A few students made small mathematical errors in completing the table, which resulted in an incorrect final calculation.

Question 1b.

Marks	0	1	2	Average
%	9	74	17	**1.1**

Site X has a Simpson's Index of 0.808, therefore, Site Y is only very slightly higher, with an index of 0.810. Based on this data, the species diversity is almost identical – the index figures are so close and are not significantly different. High-scoring answers correctly noted that the slight difference of 0.002 between the two figures meant that species diversity of the two sites was very similar.

Question 1c.

Marks	0	1	2	Average
%	49	19	32	**0.9**

Overall, the term 'species richness' was not very well understood. Many students gave ideas about the number of individuals and the number of different species, but then incorrectly compared the number of organisms at each site (i.e. 136 at Site X compared to 129 at Site Y). Species richness is the number of different species identified in a specific region. In this case the reptile species richness is identical because they found seven different species at each of the two sites.

Question 1d.

Marks	0	1	Average
%	26	74	**0.8**

The purpose of carrying out a mark-recapture sampling method is to gather data that allows the scientists to estimate the size of the bardick snake population. The majority of students were able to correctly identify this purpose.

Question 1e.

Marks	0	1	2	Average
%	34	13	53	**1.2**

This question asked for one appropriate health and safety guideline that would need to be used by the scientists in capturing reptiles in the national park. The term 'health and safety guideline' refers to actions that would need to be followed by the scientists to protect themselves from harm when working in the field. For example, actions could include making sure they had adequate sun protection (such as hats, sunscreen, long sleeves and sunglasses) to protect from sunburn or taking care when handling reptiles by using gloves and appropriate equipment so they are not scratched or bitten. Some students incorrectly referred to guidelines based on protecting the reptiles from harm, which, although an important consideration when working with animals, was not the focus of this question.

Question 2a.

Marks	0	1	2	Average
%	28	50	22	**1**

Based on the information provided about the native frog population, the correct conservation category was 'critically endangered'. This is because population numbers are very low in the wild and the recent decline has been so rapid that the species is facing an extremely high risk of extinction in the wild in the near future. The explanation of the critically endangered classification needed to include these ideas to gain full marks.

Question 2b.

Marks	0	1	Average
%	73	27	**0.3**

Given the already very low population of fewer than 50 individuals in the wild and the rapid decline of 99% since 1988, further combined with a decrease in fertility, it is likely the frog species will continue to decrease in numbers and become extinct. Students did not often make the likelihood of species extinction clear in answering this question.

Question 2c.

Marks	0	1	2	Average
%	6	15	78	**1.7**

A variety of human and non-human threats to biodiversity are indicated in the study design. The most common answers focused on describing the loss of wetland and woodland habitats (habitat modification) and the impacts of reducing habitats on a small population. Other primary threats discussed included the impact of exotic species that compete for habitat, shelter or food, or introduced feral species that may prey on the frog. Only one primary threat needed to be included, with a number of low-scoring answers describing multiple threats.

Question 2d.

Marks	0	1	2	Average
%	10	25	65	**1.6**

The threat described in part c. needed to be addressed in answering this question. Higher-scoring answers were able to describe how to maintain and potentially enable the frog population to grow by addressing habitat modification (i.e. by protecting current habitats in conservation reserves, as well as expanding and restoring suitable habitats to provide larger areas for the frog population to expand into). Other clear answers discussed relinking fragmented wild populations by restoring wildlife corridors and protecting these populations from further negative human impacts. If students had discussed the threat of exotic species in part c. then strategies focused on the elimination of threatening feral species (either predator or competitor) from the frog habitat by trapping or other methods were explained. The focus of the question was maintaining the frog population in the wild, therefore answers needed to indicate how to protect and support them in the wetlands and woodlands of New South Wales. A number of incorrect answers focused on capturing frogs, putting them into captivity and carrying out a captive breeding program.

Question 3a.

Marks	0	1	2	3	4	5	6	Average
%	9	6	14	25	25	17	4	**3.2**

This question required a well-structured response focused on explaining how the plan to treat and recycle effluent as drinking water should be regarded as an ecologically sustainable development. Higher-scoring answers used information provided in the introduction (not just restating points) to explain how the plans to use resources (both water and energy) to try to conserve current resources and minimise negative impacts on the environment for future generations. Using the sustainability principles correctly in the explanation was also important. Intragenerational equity is concerned with equity between people of the same generation with consideration of evenly sharing resources (such as between the farmers and city population). Some low-scoring answers confused intragenerational equity with intergenerational equity. ‘Efficiency of resource use’ means using Earth’s limited resources in the most efficient (least wasteful) manner (such as reusing wastewater rather than letting it evaporate). Understanding of the term ‘hydrosphere’ and relating this term to the project and the water going into the river/dam/wetland habitats needed to be included to fully answer the question.

Question 3b.

Marks	0	1	2	Average
%	8	76	17	**1.1**

Most students understood that it would be necessary to maintain a very high level of water quality and make sure it was safe for human consumption (due to health and safety concerns). This would need ongoing, regular measurement and checking through regular monitoring and assessment of data. This ongoing assessment of water quality was not always made clear by students in their answers.

Question 3c.

Marks	0	1	2	Average
%	6	49	44	1.4

This question asked students to describe a role the media could play in influencing the decision-making process regarding the plan to treat effluent and recycle it as drinking water. In this situation the media should be presenting a balanced overview of the plan itself and the public debate on the plan. They could then ask questions of the government and developers to inform the community on both the positive and negative aspects of drinking treated wastewater. However, most students provided answers based on the idea that the media would present information and arguments with bias (either positive or negative) regarding the plan. The media would then have some influence on the public viewpoint (either for or against the plan) and this could impact the government decision regarding possible approval of the proposal. Low-scoring answers did not include ideas related to how the government's decision-making process could be influenced by the role taken by the media.

Question 4a.

Marks	0	1	2	3	4	5	6	Average
%	2	2	5	19	34	28	9	4

This question required students to describe one advantage and one disadvantage of each of the energy supply systems listed. Some students listed multiple points when only one of each was asked for. Higher-scoring answers included a point for a gas-fired thermal power station, such as a ready supply of gas or constant availability as an advantage, and the production of CO_2 emissions or non-renewability of the energy form as a disadvantage. The possible advantages of wind turbines include that it is a renewable energy form or that the island location was very windy, thereby providing a ready energy supply. The main disadvantage of wind turbines most students described was the intermittent nature of wind and therefore the lack of energy supply at times. Students described a possible advantage for diesel generators based on the idea that it is a known technology that can be set up in different locations. Disadvantages given either focused on the expense of bringing in fuel to the island or the release of CO_2 emissions and other pollutants, such as sulfur dioxide and carbon dioxide. Students should be able to correctly name emissions rather than just stating 'pollution'.

Question 4b.

Marks	0	1	2	Average
%	19	32	48	1.3

Most students were able to state the four main energy conversions involved in the process of producing electricity from offshore gas, which were chemical potential to heat/thermal to kinetic to electrical.

Question 4c.

Marks	0	1	2	3	Average
%	5	27	36	32	2

Students outlined various energy plans in order to provide sufficient energy for the new town of 70 000 people, often using combinations of the energy supply systems listed. For example, many answers discussed the suitability of using wind turbines to provide renewable energy for the town with the support of a diesel system that could provide the constant electricity needs if the wind was

not blowing. Other students discussed the benefits of using the substantial gas reserves in a gas-fired thermal power station for a town of this size.

Question 4d.

Marks	0	1	2	Average
%	21	45	34	1.2

Higher-scoring answers understood the principle of conservation of biodiversity and ecological integrity and related it to the plan provided in the previous answer. High-scoring answers were able to explain that whatever energy plan is developed, the aim should be to protect the variety of living organisms, reduce the ecological impact to a minimum and maintain or protect all the natural ecosystems on the island. These ideas were then directly related to the energy plan, such as not putting wind turbines in the known flight paths of birds or not siting the gas power station in or near an environmentally sensitive area like the turtle habitat on the southern side of the island.

Question 5a.

Marks	0	1	2	Average
%	31	34	36	1.1

Some students were not clear on the correct scientific explanation of the term ‘energy efficiency’. The term refers to the ratio of output energy to the initial input energy (i.e. how much usable electrical energy is obtained from the original amount of energy in the coal energy source).

Question 5b.

Marks	0	1	2	Average
%	21	45	34	1.2

In answering this question, students needed to clearly explain the meaning of the first law of thermodynamics (i.e. energy is neither created nor destroyed). Therefore, in considering energy efficiency, the difference between the input energy and the usable output energy must go into some other form, such as heat or sound. When an energy transformation takes place, the energy cannot just disappear.

Question 5ci.

Marks	0	1	2	Average
%	8	56	35	1.3

Most students understood that the term ‘sustainability’ refers to more than just the environment. High-scoring answers were able to include the other key aspects, that is, social and economic, related to sustainability in their discussion.

Question 5cii.

Marks	0	1	2	3	Average
%	22	45	22	11	1.2

Many students found it difficult to fully explain how the three areas of sustainability (environmental, social and economic) related to the idea of increasing the efficiency of a coal-fired electricity power station. Therefore, high-scoring answers were able to suggest that if the coal-powered station was made more energy efficient there would be economic benefits, such as lower costs in the future

due to less coal needed and social sustainability benefits due to the reserves of coal being prolonged for future generations. The major sustainability benefits would relate to the reduced greenhouse gas emissions or the reduced environmental impact from mining.

Question 6a.

Marks	0	1	2	Average
%	48	11	41	**1**

The total energy use has grown between 1995 and 2015 from 10×10^9 J to 12×10^9 J. The percentage increase is equal to the energy increase over the original amount multiplied by 100. Therefore, $(2 \times 10^9) / (10 \times 10^9) \times 100 = 20\%$. Some students found the calculation difficult.

Question 6b.

Marks	0	1	2	Average
%	51	4	45	**1**

To calculate the percentage of energy provided by renewable resources in 2015, students needed to add the amounts from hydroelectric, wind and solar together (i.e. 7×10^9 J), divide by the total amount (12×10^9 J) and multiply by 100. This is equal to approximately 60 per cent.

Question 6c.

Marks	0	1	2	Average
%	53	17	30	**0.8**

Overall, this question was not well answered. Few students took note of the direction in the question to base their answer on information from the graph. A variety of unsupported and therefore incorrect ideas were often suggested. These included ideas around there being a population increase on the island or that a new fossil energy source had been found and used. However, when the graph was carefully reviewed, students who scored highly were able to notice the decline in hydroelectric energy use (from around 3×10^9 J to just over 2×10^9 J), possibly due to drought or the need for repairs to the hydroelectric power station, and then suggested that more fossil fuels were used to provide enough electricity.

Question 7a.

Marks	0	1	2	Average
%	15	34	50	**1.4**

The diagram indicated the three basic forms of radiation emitted by the sun. Most students correctly named the sun as the source of the radiation but not all could correctly name visible light as the form of radiation Q.

Question 7b.

Marks	0	1	2	3	Average
%	24	25	17	33	**1.6**

Most students could describe some of the major interactions visible light has as it travels from the sun through the atmosphere to Earth's surface. Some students commented on some visible light being reflected from clouds and particles back into space. Most of the visible light, however, reaches Earth's surface. From the surface, some is reflected back into space and some heats the

land and oceans and is re-emitted as infrared radiation. Not all students made clear the point about the visible light being re-emitted as infrared radiation, using inaccurate terms such as ‘reflected’ or ‘bounced’.

Question 7c.

Marks	0	1	Average
%	45	55	**0.6**

The form of radiation being indicated by line P was infrared radiation. This question was not correctly answered by a large number of students, and this suggests a need for improved understanding of the pathways of different radiation forms through the atmosphere.

Question 7d.

Marks	0	1	2	Average
%	27	41	32	**1.1**

The form of radiation marked X on the diagram was infrared radiation. It results from the interaction of visible light (source) with Earth’s surface creating and releasing heat. As with answers to previous parts of Question 7, not all students had a complete understanding of radiation forms and their pathways in the atmosphere.

Question 7e.

Marks	0	1	2	Average
%	23	25	51	**1.3**

This question required students to explain one piece of scientific evidence that contradicted Leon’s claim that humans have had no effect on climate because the temperature rise experienced at Earth’s surface over the past 100 years is natural. Various pieces of evidence were explained, with high-scoring answers acknowledging that the large, consistent temperature increase (compared with past changes) coincided with the rise in greenhouse gas concentrations caused by humans. Scientific modelling cannot explain this temperature rise unless this rise in greenhouse gas concentrations is taken into account.

Question 7f.

Marks	0	1	2	3	Average
%	17	8	18	58	**2.2**

This question was well answered overall, with most students describing two clear methods that scientists use to collect evidence of past atmospheric and climatic conditions. Many answers described how ice cores are collected by drilling down into older ice layers, removing and dating a core and analysing air samples trapped in the tiny gas bubbles to understand atmospheric conditions in the past. Other answers described methods related to studying tree ring growth widths and paleobotany.

Question 8a.

Marks	0	1	2	Average
%	14	35	51	**1.4**

Students needed to consider the data in the graph showing little overall change in global sea level between 1700 and 1800. Correct explanations for this were based on discussing how atmospheric conditions were unchanged because human-induced greenhouse emissions had yet to rise significantly (due to lower use of fossil fuels over this period), so global temperatures had not increased and hence global sea level showed little change.

Question 8b.

Marks	0	1	Average
%	47	53	**1.4**

This question required students to accurately read from the graph the sea level in 1800 (around 0.05 metres) and 2000 (around 0.2 metres), and therefore calculate the approximate change as an increase of around 0.25 metres.

Question 8c.

Marks	0	1	2	Average
%	42	41	17	**0.8**

Students needed to give two reasons to explain the increase in sea level from 1900 to the present. The two direct reasons that relate to the sea level increasing are land-based ice melting adding water to the oceans and the thermal expansion of water in the oceans as it warms; both are due to warmer global temperatures.

Question 8d.

Marks	0	1	2	3	Average
%	21	28	39	12	**1.4**

The standard of answers to this question varied. Firstly, students needed to respond to the projected data by acknowledging a possible sea level rise between 0.5 and 1 metre by 2100 from 1900 levels. Therefore, future planning should include actions to deal with such a rise, such as trying to move human settlements to higher land, limiting any future development on low-lying coastal land and building coastal structures (such as sea walls and earth banks) to protect coastal regions. Other planning suggestions made included trying to use energy forms more efficiently and converting from fossil to non-fossil energy sources in an effort to decrease global warming (and therefore sea level rise). Two actions needed to be described.

Question 9a.

Marks	0	1	2	Average
%	25	42	33	**1.1**

The independent variable in this experiment was the use or absence of a wildlife corridor. The dependent variable was the number of individuals in the population. Some students were unable to differentiate between independent and dependent variables when conducting experiments and incorrectly referred to the graph in stating the independent variable was the month.

Question 9b.

Marks	0	1	2	Average
%	16	43	41	**1.3**

Not all students were able to write a clear hypothesis that correctly linked the variables given in the answer to the previous question. However, higher-scoring responses stated a prediction that the butterfly populations linked by a wildlife corridor (the experimental group) will have a greater rate of population growth when compared to the separated populations (the control group).

Question 9c.

Marks	0	1	2	3	Average
%	27	23	39	11	**1.3**

Many students were not able to clearly explain the idea of 'validity'. They mentioned various points about bias or reliability and the experiment not being accurate but did not focus on what scientific validity refers to. The idea that the suitability of the experimental method will accurately test/measure the aim being investigated was important in this answer. Therefore, students needed one example of an important controlled variable that would make the experimental results valid (i.e. measuring the effect of the wildlife corridor, rather than any other possible variable, on population numbers). For example, correct responses included discussion of one controlled variable such as starting the experiment with similar initial population sizes in each of the areas or the need to have the same habitat type and availability of food in all areas (because if food was more available in one area compared to the others, then the population numbers increasing could be due to this instead of the effect of connecting the populations with a wildlife corridor).

Question 9d.

Marks	0	1	2	Average
%	12	28	60	**1.5**

Based on the data a suitable conclusion was that the population increased in the experimental group at a faster rate than the control group, which most students were able to explain in their response.

Question 9e.

Marks	0	1	2	3	Average
%	25	21	32	21	**1.5**

The standard of answers to this question varied. Two reasons that explained the population data in the graph that related to biodiversity concepts were required. Higher-scoring answers focused on the presence of the wildlife corridor, which improved population numbers because butterflies in the experimental group were able to reproduce and interbreed more successfully. This was expanded on by explaining that the wildlife corridor allowed improved genetic diversity and reduced inbreeding or that increased genetic variability increased resistance within the population to changes in the environment.

Question 9f.

Marks	0	1	2	Average
%	36	29	35	1

Students needed to have a clear understanding of genetic swamping to answer this question, and overall had difficulty in expressing a clear answer. Genetic swamping refers to the potential for the genetic material of one population (usually smaller) to be overtaken by the genetic material of another, usually larger, population when they are linked together. Some students understood that because the populations were a similar size then neither the experimental nor control group could have potentially experienced genetic swamping. Other students explained that the experimental group could have experienced genetic swamping, as the corridor allows one population to be joined to another, and so could introduce dominant genes to other the population and ‘swamp' existing genes in one of these populations.