VICTORIAN CURRICULUM AND ASSESSMENT AUTHORITY

2010 Environmental Science GA 1: Examination 1

GENERAL COMMENTS

It was evident that some students found the June examination slightly more demanding this year as the average score was slightly lower than in previous years. In a small number of cases, there was evidence that students may have been pressed for time to complete the paper. Students should be aware of timing as they undertake the examination and plan their work accordingly.

As in previous years, two of the questions in Section B were 'generic' questions. This year, these were Questions 1 and 3. Students were asked to nominate and answer questions on a specific case study they had undertaken during the year. As it is presumed that students will have pre-prepared some answers to these, there are two consequences. Firstly, students are expected to give more detailed responses, and secondly, there is a danger of students simply presenting pre-prepared answers rather than addressing the specific context to which they are asked to apply their knowledge. This was particularly evident in Question 1.

A number of terms are used in examination questions which demand different responses. Students should be aware of these terms; they have also been outlined in previous Assessment Reports. In particular, the following terms appear commonly in examinations:

- nominate or name: students are simply required to give a term and no elaboration is required
- describe or outline: students are required to give a longer account which demonstrates understanding of what is being discussed
- explain: students should give an underlying reason or a reason why something occurs
- evaluate: this term demands a judgment. It will usually be used in questions where there are two opposing viewpoints or approaches, and a judgment between them is required. Full marks will only be given when there is a clear element of judgment in the response; a simple description of each option will not achieve full marks.

SPECIFIC INFORMATION

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	2	97	1	0	
2	16	62	19	2	1	This question asked which of four gases contributes most to the **natural** greenhouse effect. The natural greenhouse effect maintains the equilibrium temperature on earth without the effects of human intervention. The major contributor is water vapour (option B). While water vapour is not the highest per unit absorber of infrared radiation (IR), it is the most significant as it is the most abundant IR absorber in the lower atmosphere. Common incorrect responses included carbon dioxide (the most significant contributor to the enhanced greenhouse effect) and methane (the greatest absorber per unit). Students should be aware of the difference between the natural and enhanced greenhouse effects.
3	5	2	83	9	0	

Question	% A	% B	% C	% D	% No Answer	Comments
4	13	22	12	51	1	This question asked students to rank energy sources in order of their emissions of carbon dioxide as they are used to produce energy. As a nuclear energy source emits no carbon dioxide in its operation, this is obviously the lowest. Coal is the highest as all the energy in burning coal comes from the combustion of carbon. Carbon dioxide emissions from natural gas come from both carbon and hydrogen (which burns to water vapour) in the molecules. The most common incorrect response was option B – biomass, natural gas, nuclear, coal.
5	9	24	53	13	1	This question asked for a percentage increase in atmospheric concentrations of CO_2 from 1960 to 2000. % increase = increase x 100/original value = 60 x 100/320 = 19% (option C) A common incorrect response was option B, 17%, achieved by putting increase over final value instead of original value.
6	7	5	79	8	0	Questions 6–8 related to the interaction of radiation with the atmosphere in the greenhouse effect. This is an area that was not well answered in previous years; however, this year these questions were well done.
7	7	79	7	6	0	
8	12	7	12	68	1	
9	81	7	7	4	0	
10	13	8	65	13	1	This question proved challenging for some students. tonne of coal = 1000 kg, using 1000 x 5 MJ = 5000 MJ 50 tonnes = 2.5 x 10^5 MJ (option C)
11	9	14	23	53	1	25 MJ per sec = 25 x 3600 = 9.0 x 10^4 MJ per hour % efficiency = 9.0 x 10^4 x 100/2.5 x 10^5 = 36% (option D) It appears that some students may have guessed the answer.
12	5	2	5	88	0	
13	67	8	22	3	0	Probability of extinction of two species = product of the individual probabilities = 0.70 x 0.20 = 0.14 (option A)
14	1	9	80	9	0	
15	5	9	78	9	0	
16	16	41	1	42	0	The precautionary principle requires taking action in uncertainty, that is, before the full data is known (option B). While the scientists should then undertake further studies (option D), this is not a direct consequence of the precautionary principle.

Question	% A	% B	% C	% D	% No Answer	Comments
17	45	6	2	46	0	The aim of conservation planning and action should be to avoid degradation of an ecosystem (option D). There is no good reason to maintain a system exactly in its original state, although this is often the image projected in the media and by some environmental groups. For example, if the wetland environment is currently not stressed and is underutilised, there would be no objection to an increase in, for example, migratory birds using it, so long as this new use did not cause degradation. This would still be good conservation planning, but would not be maintaining the wetland environment in its original state.
18	11	3	85	1	0	
19	7	79	8	6	0	
20	21	51	3	24	0	The most common incorrect responses – options A and D – seemed to indicate that many students misunderstood the term 'ecosystem service'.

Section B – Short answer questions

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

For each question, an outline answer (or answers) is provided. In some cases the answer given is not the only answer that could have been awarded marks.

Question 1a.

Marks	0	1	2	3	4	Average
%	4	11	19	35	31	**2.8**

A suitable response would have been: Coal – coal would be mined in an open cut as close as possible to the city. In a power station adjacent to the open cut, the coal would be burned in a boiler, producing steam which turns a turbine. The turbine in turn drives a generator to produce electricity. This electricity is then transmitted to the city via high voltage (low loss) transmission lines, and provided at appropriate voltages to houses and industries in the city.

For full marks, students needed to refer back to the situation of providing electricity to a city of 100 000 people. The answer should have included some reference to the source, some detail on the steps in conversion to electricity, and some reference to providing it to the relevant users.

Many responses consisted of an obviously pre-prepared answer which had not been adapted to the situation. For instance, solar panels on the roofs of houses are unlikely to provide for the industrial needs of a city. A list of the steps in conversion would have achieved a maximum of two or three marks.

It is expected that students should have addressed the issue of distributing energy produced by the chosen method to its end users in their case study. This is a major issue in some renewable energy sources.

Question 1b.

Marks	0	1	2	3	4	Average
%	6	11	23	39	22	**2.6**

This question asked for a similar response as in Question 1a., but for a non-fossil fuel energy source.

Question 1c.

Marks	0	1	2	3	4	Average
%	2	1	11	30	56	**3.4**

This question was generally well done, with many students scoring full marks.

Question 1d.

Marks	0	1	2	3	4	5	Average
%	7	8	23	32	21	9	**2.8**

This question required mention of an emission from the nominated source, and then a strategy for reducing the emission or reducing its impact on the environment. Some students named a strategy, for example, geosequestration, but did not give a description of it or elaborate any further as required by the question.

In this 'generic' question, it is expected that students will have pre-prepared points, but students are reminded that these points must be applied to the scenario given in the question.

Question 2

In a small number of responses, students seemed to misunderstand 'natural gas'. Natural gas is abundant in Australia, both in the southeast populated parts of the country and in the northwest. It is relatively easy to mine and transport (using pipelines). Natural gas is used to some extent in producing electricity in thermal power stations (for example, Newport) and in peak load gas turbine plants – one of which is located in eastern Victoria and one in western Victoria. Gas turbine plants have the advantage of being able to be started and stopped rapidly. This is like hydroelectricity stations, but unlike steam turbines, which must be started and stopped very slowly to avoid damage as they heat and cool. A very small number of students seem to confuse natural gas with biogas. While they are both largely methane, the term 'natural gas' applies to the fossil fuel obtained from underground.

Question 2a.

Marks	0	1	2	3	4	Average
%	6	7	18	28	42	**3**

Almost all students could name three non-renewable energy sources, and most could give some idea of their relative use. It should be noted that there is no nuclear production of energy in Australia. The only reactors are for production of medical and industrial isotopes (the vast majority of Lucas Heights' use), and for research. Although many students gave numerical estimates this was not necessary in order to gain full marks.

Question 2b.

Marks	0	1	2	3	Average
%	11	23	39	27	**1.9**

The concept of accessibility refers to both the amount available and how easy it is to extract.

Question 2c.

Marks	0	1	2	3	4	Average
%	2	6	26	46	18	**2.8**

Most students were able to name two renewable energy sources for one mark. However, many students failed to mention how these could be integrated into Australia's energy mix; for example, by supplementing another source. Some renewable energy sources cannot be relied upon totally for base load.

Most students could mention a difficulty that would have to be dealt with. It was expected that if students discussed wind and/or solar power, to achieve full marks they needed to mention the fact that these energy sources could not provide power all the time.

Some students mentioned the use of batteries to store electricity for when there is no sun or wind. While this is possible for small installations, it is not yet practical for the total provision of base load power as some students thought.

Question 3

Question 3 was a generic question on a threatened species. As with Question 1, a common failing was to present a pre-prepared answer rather than using prepared points to address the question asked.

Question 3a.

Marks	0	1	2	3	4	Average
%	2	2	8	26	62	**3.5**

This question was very well done. It required description of a specific population, mention of a very specific geographical location, some description of the habitat, and an estimated size of the population.

It should be noted that the question asked for a specific population of the species, not a general comment on the species as a whole. As this was a question relating to a case study that should have been studied in some detail, it was expected that the size (or an estimate) of the population should have been known. Full marks were not awarded if there was no numerical estimate given. Teachers and students should be careful about using a population/species about which little is known or for which there is not yet a conservation strategy as it can be difficult to give numerical estimates.

Question 3b.

Marks	0	1	2	3	4	Average
%	1	3	18	37	41	**3.1**

There was a considerable number of students who did not read the question carefully. The answer required students to state a conservation category, for example, vulnerable, endangered, critical (or critically endangered); describe a threat; and give some comment on its risk of extinction. Some students failed to mention a threat, although this was clearly asked for in the question. In some students' responses there was an inconsistency between the stated conservation category – for example, vulnerable – and the risk of extinction; for example, a high risk of extinction in the immediate future.

Question 3c.

Marks	0	1	2	3	Average
%	17	15	34	33	**1.9**

It was evident that many students did not read this question carefully as many students failed to make any reference to the gathering of data and merely mentioned a planned strategy.

Question 3d.

Marks	0	1	2	3	4	Average
%	7	7	26	34	26	**2.7**

This question was generally well done. Most students were able to mention an appropriate strategy to protect their nominated species. The most common error was to mention a string of strategies but fail to describe them as required by the question.

Question 3e.

Marks	0	1	2	3	Average
%	35	27	25	13	**1.2**

A good answer to this question would have been: To protect the Eastern Banded Bandicoot (EBB) a fence has been put around their enclosure at Mount Rothwell. The number present is counted at regular intervals by spotlighting them at night and using a sampling technique to estimate the total population. As the numbers have increased from about 20 five years ago to approximately 50 now, the data indicates that the management plan has been successful.

This question was poorly done. Students were required to make reference to scientific data in their response, and to evaluate the strategy they described in Question 3d. Again, teachers and students are warned against using a population/species for which there has been no conservation or protection plan implemented.

Question 4a.

Marks	0	1	2	Average
%	6	8	87	**1.8**

Almost all students were able to calculate the averages 4.4 and 4.25 (4.3 was accepted).

Question 4b.

Marks	0	1	2	3	Average
%	8	13	42	37	**2.1**

Students were expected to refer to both the total number of groups and the average size of each group, both of which had increased. Many students made reference to one or the other but not both, despite this being asked for in the question.

Question 4c.

Marks	0	1	2	3	Average
%	21	17	42	20	**1.6**

This question required students to outline evidence and arguments that Chris, the conservation manager, could use in discussion with her colleague. This evidence included that the comparison between the management area and the control area clearly showed that both the number of groups and size of groups have increased in the management area compared with the control area. For full marks, some reference to the argument put by Chris's colleague that the effect was climate related was required. The obvious response from Chris was that climate should have equally affected the two areas.

Question 4d.

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

While suggesting an increase in the areas or frequency of measurement achieved some marks, for full marks students were expected to suggest more than one management and one control area, as particular circumstances in one management area may have affected one control area. Students' responses should have suggested the use of both more management and more control areas, ideally somewhat separated so that extraneous factors could not affect both (or all) control areas.

Question 4e.

Marks	0	1	2	3	Average
%	20	32	32	16	**1.5**

The following points could have been included:

- description of the current distribution/status of the species
- identification of threats to the species
- management actions that can be taken.

The requirement of legally binding action was allowed as one point.

Question 5a.

Marks	0	1	2	Average
%	15	6	80	**1.7**

Highest: X
Middle: Y
Lowest: Z

Question 5b.

Marks	0	1	2	3	Average
%	14	10	19	57	**2.2**

Region Y

Species	No. of individuals	p = No. individuals of this species / Total no.	p^2
Southern Brown Tree Frog	10	0.25	0.0625
Leaf Green Tree Frog	3	0.075	0.00563
Lesueur's Tree Frog	0		
Green and Golden Bell Frog	2	0.05	0.0025
Common Froglet	11	0.275	0.07563
Eastern Banjo Frog	9	0.225	0.05063
Spotted Marsh Frog	0		
Striped Marsh Frog	0		
Southern Barred Frog	5	0.125	0.01563
Giant Burrowing Frog	0		
	Total no. = 40		Sum of p^2 = 0.02125

Simpson's Index (D) = 1 – Sum of p^2 = 0.787

Students missed out on one mark where they made one mathematical slip but used the correct method. Excessive rounding that led to a wrong answer was not penalised.

Question 5c.

Marks	0	1	2	3	4	5	6	Average
%	20	7	16	20	17	12	8	**2.8**

While it was not necessary to give all of these points for full marks, a complete answer would have been: Region X has the greatest species richness, with eight species present. It has only one threatened species, the Giant Burrowing Frog, which is classified as vulnerable. It contains the second highest abundance (34 individuals). Region Y has the next greatest species richness, with six species, and the second greatest abundance. However, it contains two threatened species, including the only population of the critically threatened Southern Barred Frog. Region Z has the greatest abundance (150 individuals), the lowest species richness (5 species), and no threatened species. Because of difficulties with the survey in Region Z, the data may not be as reliable, but with the high number counted this is probably not important unless a small species was missed altogether. Species diversity takes into account both species richness and relative abundance. Region X has the highest species diversity (0.838), Region Y is close (0.787) and Region Z has the lowest (0.67). Taking this data together, Region Y is in most need of protection. It has relatively high species diversity but, most importantly, it contains the only population of the critically endangered species. Region Z is in least need, despite its high numbers, as its species diversity is low and it contains no threatened species.

Students were expected to make reference to species richness, species diversity, and abundance in each region. Reference should also have been made to the presence or absence of threatened species. As the question asked for an evaluation, it was expected that students would state a judgment as to which area was most in need of protection. For full marks reference had to be made to data, including Simpson's Index.