GENERAL COMMENTS

In this, the second year of the Environmental Science study, it was clear that teachers were more familiar with what is expected in the course. An interesting observation was that students were more expert in one area of the course than others; with many scripts in which almost full marks were obtained in, for example, the biodiversity sections, but poorer marks in those requiring background knowledge in Chemistry or Physics and vice versa.

As in previous examinations, there was an emphasis from the teaching of the course on actual detailed studies of real situations rather than memorising large numbers of facts. Hence, for example, Question 1 in the short-answer section on fossil fuels, allowed students to use case studies they had done during the course. It would be expected that all groups would have studied in some depth one fossil and one non-fossil fuel, rather than learning a whole series of facts about a large number of energy sources. Similarly, Question 7, on the impact of a sewerage outfall on a shellfish population, should have been fairly straightforward for students who had actually undertaken a field study or data analysis of some kind in a realistic situation.

The structure of the examination will continue to encourage this emphasis in the study design, on teaching the course by in-depth studies, using either real (fieldwork) data or simulated data of real situations.

SPECIFIC INFORMATION

Multiple-choice questions

This table indicates the approximate percentage of students choosing each distractor. The correct answer is the shaded alternative.

Question	A	B	C	D	
1	4	85	2	8	This was intended as a straightforward question to begin the examination. The most common distractor was surprising given that that the question emphasised **level** road.
2	1	14	80	5	Most students correctly identified methane as the Greenhouse gas. The most common distractor chosen presumably by students confusing nitrogen with the oxides of nitrogen.
3	24	62	7	6	Burning natural gas was the exothermic (giving out heat) reaction. The most common distractor (A) melting ice – which absorbs heat in the process.
					For questions 4 to 6 students had to assimilate data from a table and then answer a series of questions based on the data
4	14	68	11	5	Required dividing the renewable energy used by the total energy used.
5	7	13	70	7	Required dividing the total available brown coal remaining by the annual usage.
6	73	13	8	5	Required realising that if the amount used exceeded the amount produced in Australia in a year, the difference must be imported; oil (A) was the only example of this in the data.
7	1	4	79	15	Most students realised that burning hydrogen produces no carbon dioxide, a greenhouse gas. While hydrogen exists in minute quantities in the atmosphere, obtaining it from this source is virtually impossible. If hydrogen existed in any significant quantities (as hydrogen) in the atmosphere, it would make lighting a match a very hazardous operation.
8	3	3	39	54	Many students correctly realised that geothermal, hydrogen, uranium and biomass are non-fossil fuels. The format of the question may make this difficult for some students, and perhaps more practice in this type of question is desirable. Other students may have considered biomass to be a ‘fossil’ fuel. A fossil fuel is one that has been formed by high pressure deep underground over a very long period of time (thousands of years). Some may identify ‘fossil’ with ‘from recently living material’.
9	6	4	83	7	A well answered question.
10	2	5	1	92	This question required students to realise that the natural greenhouse effect is a positive process – making life on earth possible – and to distinguish it from the enhanced greenhouse effect, caused by industrialisation and other human activity.
11	89	5	2	3	Planting trees was the only carbon sink, with no obvious pattern in incorrect responses.

12	1	1	8	91	A straightforward question with C (increased Ultraviolet radiation) being a common incorrect choice. This probably reflects the confusion some students have between enhanced greenhouse effect and ozone depletion. Teachers should emphasise clearly the difference between these two phenomena.
13	7	77	9	6	In such questions, students need to be sure of the differences between the terms species, population and ecosystem and this may need further emphasis in teaching.
14	45	17	7	30	
15	14	17	15	54	Salinisation of groundwater is not an ecosystem service. While ‘ecosystem service’ may not be a very common term in general use, it is specifically mentioned in the study design, and one of the textbooks in common use defines ecosystem services as ‘processes that contribute to human survival’. Salinisation of groundwater is the only ecosystem function mentioned that does not contribute to human (and other) species’ survival and benefit, within the ecosystem as a whole.
16	12	3	70	14	‘Endemism’ refers to the restriction of a species to a particular location. As ‘threats to biodiversity’ is a primary focus of the unit in the study design, the lack of knowledge of these threats is a little surprising. The extinction of a species to specific areas should, it would seem, arise as a threat in the study of the biodiversity of any species chosen for particular study. While encouraging the detailed study of particular cases as the teaching approach, teachers should ensure that the basic terms are covered; and if they do not arise in the particular study, supplement this by a brief additional study to make sure threats are covered.
17	4	22	69	4	Most students correctly chose that the status improves when it changes from critical to endangered. Teachers need to ensure that, in detailed studies of threats to a species, the terms ‘vulnerable’, ‘endangered’, ‘critical’ and ‘extinct’ arise.
18	5	43	13	38	This proved to be by far the most difficult of the multiple-choice questions. Less successful students could not think through the probable impact on genetic diversity of a wild life corridor – it would decrease rather than increase genetic diversity. This may indicate a weakness in the understanding of terms involved in threats to biodiversity, such as genetic diversity or swamping, as mentioned in Question 13, and as was also obvious in short-answer Questions 5 a) and d). The distinctions between genetic diversity, species diversity, ecosystem diversity and their relationship to threats to biodiversity need to be more clearly understood, and demonstrated in examples.
19	5	7	17	70	Most students answered correctly – B is a host of A. The simple inverse (response C) – B is a parasite of A was a case of not being able to see exactly what the question is stating, and perhaps students could be encouraged in such cases to draw themselves a simple diagram to aid them visually.
20	4	5	2	90	The concept of inbreeding is well understood.

Short-answer questions

Question	Marks	%	Comments
1	This question, like Question 6 on last year’s paper, tested a major section of the study design – fossil and non-fossil energy sources – in a way that would allow students who had made an in-depth study of one fossil and one non-fossil source, as required, to show their knowledge. This approach, as stated in last year’s report enables students to answer a generic question in terms of the case studies they have undertaken rather than a litany of learned facts and encourages teaching through in-depth case studies, as envisaged in the study design.		
	a 0/2 1/2 2/2	 34 38 27	It was anticipated that a specific geographic location, that had been studied, would be mentioned (perhaps this was not clear enough in the question). A fair degree of latitude in marking was rewarded, although extremely general responses were not looked upon favorably, such as ‘where the sun shines’ for solar energy, or ‘where the wind blows’ for wind power. The ideal answer would be, for example, Brown Coal, the Latrobe Valley, supplying Melbourne; or Hydro-electricity, Snowy Mountains, supplying Melbourne and Sydney; or Solar power, Central Australia, supplying a small isolated town or cattle station.

Question	Marks	%	Comments
	b 0/2 1/2 2/2	 35 40 25	Many answers were of a very general nature. Full marks required reference to actual conversions. Often the best answers simply had a diagram: **Chemical (coal) → Heat (steam) → Kinetic (rotation of turbine) → Electrical**
	c 0/2 1/2 2/2	 21 48 31	For full marks, at least some passing reference needed to be made to both efficiency and economy.
	d 0/2 1/2 2/2	 9 39 52	Was better done. The most obvious answers included greenhouse gas emissions for fossil energy sources, and, for example, the ecological impact of dams for hydro-electricity.
2	There was a reasonable number of students who did not attempt part or all of this question, especially part c).		
	a 0/3 1/3 2/3 3/3	 38 16 2 45	Efficiency = $\frac{\text{power out}}{\text{power in}} = \frac{2500}{6750} \times 100 = 37\%$ One mark for formula, 1 mark for correct substitution, 1 mark for answer. It was necessary to have a percentage (0.37 was accepted for full marks).
	b 0/4 1/4 2/4 3/4 4/4	 18 17 25 19 21	As in Question 1b), some transformation was sought – that is, a transition from one energy type to another. Simple line diagrams were the most satisfactory answers. Examples: • Chemical (coal) to Heat: some heat lost up exhaust stacks • Heat to Kinetic (rotation of turbines): some lost as friction or lost (heat) in exhaust steam • Kinetic to electrical: some lost as friction in turbines, or as heat in resistance in generator.
	c 0/4 1/4 2/4 3/4 4/4	 43 32 11 3 11	This question required two steps for each of the two gases. Part marks were given for one step for one or other gas. Many students correctly performed the first step, but few carried right through both steps. i) Carbon dioxide: Step 1: Determine amount of carbon in 500 tonnes of brown coal: $\frac{500}{100} \times 26 = 130 \text{ tonne of carbon}$ Step 2: Determine amount of carbon dioxide produced by burning 130 tonnes of carbon: $\frac{44}{12} \times 130 = 477 \text{ tonne of Carbon dioxide}$ ii) Sulfur dioxide: $\frac{500}{100} \times 0.16 = 0.80 \text{ tonne of sulfur}$ $\frac{48}{16} \times 0.80 = 2.4 \text{ tonne of sulfur dioxide}$
3	This question tested knowledge of the processes involved in the Greenhouse effect.		
	a 0/2 1/2 2/2	 19 37 45	The range 0.4–0.6 μm received full marks; a wider range outside this received 1 mark.
	b 0/2 1/2 2/2	 42 31 26	This question sought a response in terms of wavelengths (from the graph). Part or full marks were given for appropriate descriptive responses.
	c 0/1 1/1	 58 42	This question sought one or both of the following responses. Most of the energy reaching the surface is in the visible part of the spectrum because this is the predominant radiation from the Sun, or because the visible light is less absorbed by the atmosphere.
	d 0/1 1/1	 38 62	A wide range of gases was accepted, such as carbon dioxide (an obvious one, but not widely chosen), water and methane. Surprisingly, most students were only able to mention one – presumably not being able to identify ability to absorb infrared light as the characteristic of a greenhouse gas.

	e		Despite a wide range of responses being acceptable, many students struggled with this question. The ideal response involved mentioning that the incoming radiation is in the visible and ultraviolet, the outgoing at a longer wavelength, in the infrared. Full marks could be obtained by only mentioning part of this, e.g. 'longer wavelength'.
	0/2	66	
	1/2	16	
	2/2	18	
	f		This question was poorly done. It was expected that most students would have studied a diagram of the greenhouse effect, considering its centrality to the area of study. Full marks were obtainable by a very good diagram without explanation. An explanation without a diagram could obtain full marks, but with difficulty. For an ideal answer, it was expected that reference would be made (perhaps by indication on a diagram) to the following: • energy reaches Earth from the Sun as visible and ultraviolet radiation, which are not appreciably absorbed by atmosphere, hence reach surface of Earth • Earth re-radiates in the infrared (since its surface temperature is much less that of the Sun) • the infrared is absorbed in atmospheric gases (trapped), hence warming the surface and atmosphere.
	0/3	38	
	1/3	34	
	2/3	21	
	3/3	6	
4			This question tested the large area of the study design on threats to biodiversity. As with other questions, it was expected that students would answer in terms of an in-depth study of threats, which they had undertaken in the course; hence the fairly open-ended nature of the question.
	a		The response expected was for two threats. Some of the common ones mentioned included predators, loss of habitat, loss of genetic diversity.
	0/2	18	
	1/2	22	
	2/2	60	
	b		Students were asked for a definition of each of the terms in a). A reasonable description rather than a strict definition was accepted.
	0/2	23	
	1/2	33	
	2/2	44	
	c		This question sought an example of the threats mentioned above to a particular population, and seeking a response in terms of some threatened population studied. The most successful responses clearly were in terms of a species studied – often Leadbeater's possum. Less successful responses tended to be very general, that is to repeat the definition or description given in b) rather than giving an example.
	0/2	41	
	1/2	33	
	2/2	26	
5			This question tested knowledge of biodiversity.
	a		This question sought an explanation of the following three types of biodiversity, and as mentioned in the multiple-choice section, the different types are not clear in most students' minds: • genetic diversity refers to variation of genetic types within a species • species diversity refers to number of different species • ecosystem diversity refers to the variety of different types of habitats or ecosystems available.
	0/3	20	
	1/3	26	
	2/3	37	
	3/3	17	
	b		This required a calculation of Simpson's index – a measure of biodiversity. Both sites had an index of 0.48. Since the study guide mentions measures of biodiversity, it was expected that students would have encountered some indices in field or simulated data work. However, it was not expected that Simpson's index would be known as such; hence full information was given in the question. This was by far the best done question on the paper.
	0/4	17	
	1/4	7	
	2/4	11	
	3/4	8	
	4/4	57	
	c		This required interpreting the index in terms of species diversity and was well done. In the few cases of a correct consequential interpretation based on an erroneous calculation in b), full marks were given.
	0/2	33	
	1/2	17	
	2/2	50	
	d		This question was not as well answered as expected. Species richness refers to the number of different species at a site – with only two at A and four at B: hence B had the greater species richness.
	0/2	27	
	1/2	24	
	2/2	49	
	5e		This question sought an explanation of the term 'vulnerable'. Some indication was expected that 'vulnerable' was part of a spectrum of categorizations, e.g. vulnerable, endangered, critical. 1 mark was given for a general definition, indicating somehow at risk without any indication of a point on a scale.
	0/2	15	
	1/2	44	
	2/2	42	

	5f 0/3 63 1/3 18 2/3 13 3/3 6	This question was very poorly done, with many not attempting it. It sought reference to the fact that the only at risk species – *Litoria raniformis*, which is vulnerable – was located at site B, and hence this required particularly careful management. Many students considered site A needed better care, since *Litoria raniformis* was extinct there. There was no indication in the question that that species had ever been there; it may have been totally unsuited for it. However, since this response showed some reasoning, it was rewarded with part marks.
6	This question sought to examine strategies for managing endangered species, in terms of a scenario described in the stem of the question.	
	a 0/4 7 1/4 13 2/4 42 3/4 32 4/4 6	Asked for one advantage and one disadvantage of each strategy, and a wide variety was mentioned. Some responses were either very general ('helped the population') or the disadvantage was simply the inverse of the advantage. These scored only part marks.
	b 0/4 55 1/4 30 2/4 9 3/4 3 4/4 3	Sought some simple quantification of the risk, which it was assumed would have been encountered in a simple way in case studies by students. This question was very poorly done, despite the fairly detailed guidance given in the question. Option 2: Two separate populations. Overall risk is obtained by multiplying the two risks together: $0.4 \times 0.4 = 0.16$ Option 3: This would reduce the risk by 0.1 compared with Option 1: $0.2 - 0.1 = 0.1$
	c 0/3 32 1/3 17 2/3 28 3/3 23	Sought some other management options. Common acceptable responses included wildlife corridors, removal of predators or introduced species and feeding the birds. Common reasons for not achieving full marks were that the answer was too general or simply repeated translocation or re-introduction strategies, or did not mention an advantage or disadvantage. Students should read the question carefully to make sure they fully answer the actual question, which sought one advantage and one disadvantage in addition to mentioning a strategy.
7	This question tested general knowledge of the significance of data as applied to field studies in environmental planning; and was intended to favour students who had done some actual field work (either in the field or with simulated data). It was hoped that students who had actually conducted analyses of data would have some idea of the significance of data and variation without actual detailed mathematical and statistical calculations.	
	a 0/2 24 1/2 6 2/2 70	Asked for calculation of averages in a simple situation. The average before was 10, and after was 8.2 (8 was accepted).
	b 0/3 67 1/3 15 2/3 8 3/3 10	It was hoped that the very small numbers in the sample, compared with the variation in sites, would indicate to students, even without any quantitative factors, that the sample was too small to be significant. Type I and II errors were defined, as simply remembering which is I and which is II. This is not an aim of the course, but rather being able to apply that in a real scenario. Relatively few students attempted this question, although the biologist made a Type I error, in falsely rejecting the null hypothesis, when the data spread was too great compared with the sample sizes.
	c 0/2 36 1/2 30 2/2 34	Sought ways of improving the significance of the study, and most students made some reasonable attempt at this, generally in terms of increasing the number of sites, the size of each site, or the time over which the study was undertaken.