



ENVIRONMENTAL SCIENCE

Trial Written Examination 1 June 2009

SUGGESTED SOLUTIONS

Structure of book

Section	Number of questions	Number of questions to be answered	Number of marks
A	20	20	20
B	5	5	70
			Total 90

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Please note this is a practice exam only and its degree of difficulty and content is different to the VCAA Unit 3 Examination. VAEE takes no responsibility for your success in completing the actual VCE Environmental Science Unit 4 exam.

SECTION A - Multiple-choice questions

1	A	B	C	D
2	A	B	C	D
3	A	B	C	D
4	A	B	C	D
5	A	B	C	D
6	A	B	C	D
7	A	B	C	D
8	A	B	C	D
9	A	B	C	D
10	A	B	C	D

11	A	B	C	D
12	A	B	C	D
13	A	B	C	D
14	A	B	C	D
15	A	B	C	D
16	A	B	C	D
17	A	B	C	D
18	A	B	C	D
19	A	B	C	D
20	A	B	C	D

SECTION B - Short answer questions

Question 1

a. Name the overall process represented in diagram 1.

The natural greenhouse effect^{1 mark} (*net outgoing = net incoming*)

1 mark

b. A probe detects 700 W of incoming solar radiation reaching the earth's atmosphere over a certain area. What amount of this radiation would be directly reflected by the earth's surface and atmosphere? Show your working.

$$\begin{aligned} \text{Proportion reflected} &= 103 \text{ Wm}^{-2} \text{ incoming} \div 343 \text{ Wm}^{-2} \text{ reflected} \\ &= 0.300 \end{aligned}$$
^{1 mark}

$$\begin{aligned} \text{Amount reflected} &= 0.300 \times 700 \text{ W} \\ &= 210 \text{ W} \end{aligned}$$
^{1 mark}

2 marks

c. Outline the processes occurring at "A" and "B".

At A, earth's surface absorbs mainly incoming visible, some UV and infra-red radiation.^{1 mark}

At B, infra-red is re-radiated from earth's surface.^{1 mark}

2 marks

d. Name and describe the contribution of two substances to the process shown at "C".

Choose 2 from carbon dioxide, methane, water vapour, nitrous oxide, sulphur dioxide, CFCs, PFCs, ozone, HFCs (molecular formulae accepted)^{2 marks}. *Molecules absorb and re-emit infra-red radiation in all directions.*^{1 mark}

3 marks

e. Describe one negative consequence for humans of an increase in the process occurring at "C"

Increased absorption and re-emission of infra-red radiation causes less net output of heat (infra-red radiation) from the earth's atmosphere resulting in global warming.^{1 mark} *Global warming causes rising sea levels affecting human inhabited coastal areas or low-lying islands.*^{1 mark} *OR causes coral bleaching reducing aesthetic value, food resources, ecosystem services of reefs OR other.*

2 marks

Total 11 marks

Question 2

An island off the coast of Victoria has recently been chosen as the base location for a large group of scientists who are studying the behavior of marine animals. The scientists and their families will move from Melbourne and will spend the next 4 years on the island.

A mainland town with an electric power supply provided by a nearby coal burning power station is around thirty kilometers from the island. During weekdays, half of the community will travel to this town via a small ferry in order to attend school and work. On its return trip in the afternoon this ferry will bring food supplies to the general store on the island but has capacity for other necessities as well.

In terms of climate, the island is exposed to strong ocean wind currents that blow most of the time. The terrain is very flat and dry. During summer the island experiences hot cloudless days and in winter the weather is mostly overcast.

Organisers are adamant that the marine behavior project reach completion and that data and observations are gathered daily. As such it is important that this small community is able to maintain a similar lifestyle to that which they enjoyed in Melbourne.

Name a fossil fuel source that you have studied this year _____

Name a non-fossil fuel source that you have studied this year _____

a. Explain whether the nominated non-fossil fuel source is renewable.

Answers must correctly explain whether the energy source is able to be replenished at a faster rate than it is used.

2 marks

b. Describe two disadvantages of the nominated non-fossil fuel source for use in Melbourne.

Answers should refer to Melbourne's need for high volume continuous base load or high peak load. Disadvantages could include intermittency of sources such as wind and solar AND/OR

Expense of building infrastructure for all sources AND/OR

Environmental impact, eg habitat loss in building infrastructure for all sources etc

2 marks

c. Outline how the nominated fossil energy source generates electricity.

Answers must describe the type of energy utilised by the source and how this is converted into electricity in a step-by-step description.

2 marks

d. Outline how the nominated non-fossil energy source generates electricity.

Answers must describe the type of energy utilised by the source and how this is converted into electricity in a step-by-step description.

2 marks

e. Give your recommendation to the research organisers as to how to provide sufficient energy to the island community. Your answer should refer to at least one of the nominated energy sources and should include economic considerations, environmental impacts and should address the particular needs of the community.

For full marks, answers will describe how the recommended energy source or mix of energy sources is economically viable for the research project^{1 mark} and environmentally sound for the surrounding habitat^{1 mark}. Recommendations should afford the community similar comforts to Melbourne, whether by choice of a continuous source or with the use of a battery/storage mechanism. ^{1 mark}.

Answers should also briefly explain the process by which this source will generate electricity for the island. ^{1 mark}

The best answers will flow logically and could include an introduction and concluding sentence stating the recommended energy source or sources. ^{1 mark}

5 marks
Total 13 marks

Question 3

Name one local threatened animal species you have studied.

Species must be of local significance

a. Briefly describe the habitat of this species.

Answers should specifically describe the type of ecosystem in which the animal is located by referring to both abiotic and biotic factors, in particular those factors that are relevant to the main threats facing the animal.

2 marks

b. Define the term 'endemic' and comment on whether this term applies to the nominated species.

An animal that is endemic to an area is found only in that area and does not exist in the wild in other regions. ^{1 mark} *Answers must refer to the specific location of the species* ^{1 mark}.

2 marks

State the IUCN conservation category assigned to this species.

Vulnerable OR endangered OR critically endangered

c. Justify this conservation category with reference to population numbers and main threats to the species.

Answers must give a numerical value to the abundance of the animal, even if this is an educated estimate ^{1 mark}. *Answers must describe the main threats to the animal* ^{1 mark} *and describe how these have caused the appropriate level of risk of extinction within the appropriate time frame according to the nominated IUCN classification* ^{1 mark}.

3 marks

d. Describe 2 realistic recommendations for the management of this species. Explain how each strategy combats the main threats outlined in c. above.

Management strategies must logically address the threats from "c". The description of each strategy should be thoroughly described and related to the main threats. ^{2 marks per strategy}

4 marks

e. Explain how one of the above management options could be monitored and evaluated.

Answers should outline a quantitative method of monitoring the success of one strategy ^{1 mark}, *give an indication of what is meant by evaluation in this context* ^{1 mark} *and a numerical value that could be used to evaluate success* ^{1 mark}.

3 marks

Total 14 marks

Question 4

The Siberian tiger is a threatened species that once ranged throughout Eastern Russia. Today, after many localised extinctions, it is endemic to Far Eastern Siberia, where it is now protected. The International Union for the Conservation of Nature has determined the tiger to be at high risk of extinction in the near future.



Siberian Tigers (*Panthera tigris altaica*) in Amersfoort Zoo (Netherlands); picture taken by Wilma Verburg 10/09/2005
The mother, 3-year old Kira, and one of her children, born June 27, 2005

The wild population in the Far East is mostly confined to low mountains, having been displaced by humans from lower areas. Its most common habitats are mountain river valleys and pads overgrown with pine and oak, as well as among mountains with deciduous shrubs or in oak or nut-tree groves. Within its present range, the diet of the tiger consists of wild game such as deer and boar. In similar habitat where it has suffered localised extinction, the tiger would often feed on livestock and domestic animals.

Genetic studies have revealed low variability in the wild Far Eastern population. On the other hand, captive cats appear to show higher genetic diversity. This may suggest that the wild population has experienced a very recent loss of population numbers caused by human pressure, with the founders of the captive population being captured when genetic variability was higher in the wild.

a. Use the information above to determine the IUCN conservation category allocated to the Siberian tiger.

Endangered (High risk of extinction in the near future) ^{1 mark}

1 mark

b. Explain, using examples from the stem, how all three levels of biodiversity are important for the survival of the Siberian tiger.

1. *It is important to maintain ecosystem diversity because the tiger moves through various habitats in order to gain access to the full range of prey* ^{2 marks}.

2. *It is important to maintain species diversity in order that the food chain is maintained for the tiger and sufficient prey is available* ^{2 marks} OR *so that ecosystem services are maintained so tigers have viable options for their den and clean water to drink. etc*

3. *Genetic diversity must be maintained in order that the tiger has viable genes that will allow it to survive adverse changes such as disease.* ^{2 marks} AND/OR *to prevent inbreeding depression which will lead to increased prevalence of genetic disease and reduced survivability/ reproductive capacity AND/OR to prevent genetic drift which will result in further loss of genetic diversity and further reduced ability to resist adverse change.*

6 marks

c. State two specific threats to the survival of the Tiger.

Hunting/culling^{1 mark} OR habitat loss^{1 mark} OR habitat degradation

2 marks

d. Suggest one advantage and one disadvantage of each of the following management strategies for the tiger. *Many answers accepted here, some suggestions below. 1 mark awarded for each valid and distinct advantage or disadvantage associated with that particular strategy.*

i. Captive breeding

Advantage: If successful and well managed can increase population numbers and genetic variation^{1 mark}

Disadvantage: Tigers may become domesticated and will not contribute to ecosystem processes or functioning in their natural habitat^{1 mark}

2 marks

ii. Reintroduction

Advantage: Increases population numbers and genetic diversity in the wild, due to, in this case, captive populations having higher genetic diversity than wild populations^{1 mark}.

Disadvantage: Viable habitat may not be present if this crisis management strategy is undertaken in isolation ie: with no preventative strategies employed as well OR captive animals may have lost survival skills both resulting in death of reintroduced individuals^{1 mark}

2 marks

iii. Translocation

Advantage: If suitable habitat exists elsewhere and can be protected to allow tigers to increase population size^{1 mark}

Disadvantage: Animals must be removed from already small population and may not survive due to systemic factors in the habitat decline not being accounted for/tackled^{1 mark}

2 marks

e. Outline two important functions of CITES in the protection of the Siberian tiger.

CITES has listed the Siberian tiger as a protected species^{1 mark} and prevents international trade of products^{1 mark} such as pelts

2 marks

Table 1 below gives an estimation of the number of Siberian tigers in captivity since the worldwide program began in 1982:

Year	1982	1989	1994	1999	2004	2009
No. animals in captivity	83	92	116	131	146	160

f. Evaluate the success of the international captive breeding program by stating an aim and by determining percentage change.

An aim of captive breeding programs is to increase population numbers^{1 mark}. The program has been successful, as a 93% increase in the number of tigers has occurred since its inception in 1982^{2 marks}

3 marks

Total 20 marks

Question 5

Shane is an ecologist studying the Great Barrier Reef in Northern Queensland. He wishes to determine whether coral bleaching has reduced species diversity in a 1000m² site within the reef between 1995, 2000 and 2005.

He identifies a random sample of ten species from the area, two of which are the large green sea turtle and the leatherback turtle which are both indentified as endangered by the IUCN.

In order to compare the species diversity over the years, he wishes to design a simple index that incorporates both relative abundance and species richness.

Shane's index is defined as: $S = (1 - \text{highest value of } p) \times \text{species richness}$

Where $p = \text{No. individuals in species} / \text{Total number individuals}$

Calculate Shane's index for the site in 2000 and 2005 (1995 has been calculated for you):

	1995		2000		2005	
SPECIES	Abundance	P = no/total	Abundance	p = no/total	Abundance	p = no/total
Dugong	1	0.0031	0	0	1	0.0031
Yellow-faced angle fish	5	0.0153	4	0.0133	1	0.0031
Trevally	20	0.0612	42	0.1395	28	0.0867
Large Green Sea Turtle	1	0.0031	1	0.0033	2	0.0062
Goby	230	0.7033	215	0.7143	273	0.8452
Humpback Whale	1	0.0031	0	0	1	0.0031
Sea urchin	41	0.1254	20	0.0664	0	0
Leatherback Turtle	3	0.0092	2	0.0066	3	0.0093
Manta Ray	24	0.0734	16	0.0531	14	0.0433
Tiger shark	1	0.0031	0	0	0	0
	TOTAL = 327	HIGHEST P = 0.7033	TOTAL = 301	HIGHEST P = 0.7143	TOTAL = 323	HIGHEST P = 0.8452

RICHNESS = 10	$S = (1 - 0.7033) \times 10 = 2.966$	RICHNESS = 7	$S = (1 - 0.7143) \times 7 = 1.9999$	RICHNESS = 8	$S = (1 - 0.8452) \times 8 = 1.238$
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b. Explain whether a high or low value of S indicates greater species diversity:

A high value^{1 mark} means low dominant proportion and high species richness

2 mark

c. Explain why both relative abundance and species richness are important in determining the species diversity of a habitat. Refer to the data in table 2 in your answer.

A SUGGESTED ANSWER COULD BE:

Relative abundance is important in determining whether all species are thriving. A high value of p indicates when there is a dominant species with many other species existing in relatively low numbers within the area.^{1 mark} This situation has occurred in 2005, where the Goby is abundant but many other species have decreased in abundance.^{1 mark} This has caused Shane's index to be lowest in 2005.

Species richness, the number of different species found in an area, should also be considered. Between 1995 and 2000 there has been a decrease in species richness from 10 to 7 of the area, with 3 species from 1995 not in evidence in 2000.^{1 mark} This was reflected in the reduced value of Shane's index (from 2.966 to 1.999).

3 marks

d. Evaluate whether the barrier reef area has declined in quality between 1995 and 2005. Your answer should refer to relative abundance, species richness and endangered status.

A SUGGESTED ANSWER COULD BE:

Based on the data shown, the Great Barrier Reef area has decreased in species diversity, but this decrease has not affected the 2 endangered animals present.^{1 mark} Overall, a decrease in species richness and relative abundance has occurred, represented by a reduction from 2.966 to 1.238 for Shane's index between 1995 and 2005.^{1 mark} This indicates that the area has decreased in quality.^{1 mark} However the between year variation for the endangered turtle species is random and numbers do not appear to have decreased or increased.^{1 mark}

4 marks

- END OF EXAM -