STUDENT NAME	

Victorian Certificate of Education
2008

ENVIRONMENTAL SCIENCE

Trial Written Examination 1
June 2008

Answers/comments

Structure of book

Section	Number of questions	Number of questions to be answered	Number of marks
A	20	20	20
B	7	7	70
			Total 90

Materials

1. Question and answer book of 17 pages.
2. Answer sheet for multiple-choice questions.
3. At least one pencil and eraser.
4. One approved scientific calculator.

Instructions

5. Write your student name and class in the space provided on this book
6. Write your student name and class in the space provided on your answer sheet for multiple-choice.
7. All written responses must be in English.
8. Time allowed: 15 minutes reading time, 90 minutes writing time

At the end of the examination

9. Place the answer sheet for multiple choice questions inside the front cover of this question and answer book

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

Section A – Multiple-choice questions.

Specific instructions for Section A

Answer all questions.
All questions should be answered on the answer sheet for multiple-choice questions, in pencil. Choose the response that is correct or best answers the question, and shade the square on the multiple-choice answer sheet according to the instructions given on that sheet. A correct answer is worth 1 mark; an incorrect answer is worth no marks. No marks will be given if more than one answer is shown for any question. Marks will not be deducted for incorrect answers

Question 1

Which of the following is an example of kinetic energy?

A. Water stored in a reservoir behind a dam wall.

B. The flow of electricity.

C. Both **A.** and **B.** are examples of kinetic energy.

D. Neither **A.** nor **B.** are examples of kinetic energy.

Question 2

Which of the following is an example of potential energy?

A. Water stored in a reservoir behind a dam wall.

B. The flow of electricity.

C. Both **A.** and **B.** are examples of potential energy.

D. Neither **A.** nor **B.** are examples of potential energy.

Question 3

Which of the following **only** contains renewable energy sources?

A. solar, wind, nuclear.

B. coal, natural gas, petroleum.

C. biomass, nuclear, natural gas.

D. solar, hydroelectric, wind.

Question 4

Which of the following **only** contains fossil fuels?

A. solar, wind, nuclear.

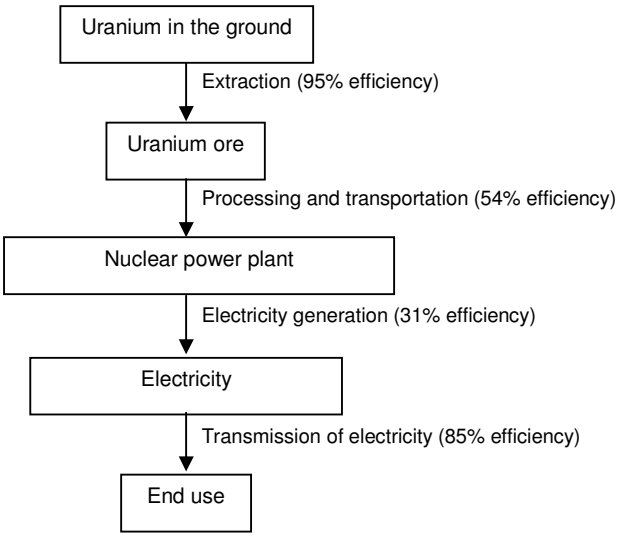
B. coal, natural gas, petroleum.

C. biomass, nuclear, natural gas.

D. solar, hydroelectric, wind.

The following information relates to Questions 5 – 6.

Nuclear power provides about 17 percent of the world's electricity. The diagram below displays the energy efficiencies involved with electricity generation from a nuclear power plant.



Question 5

Nuclear reactors make use of nuclear fission chain reactions to release energy. A fission reaction involves

A. a large atom of one element splitting to produce two smaller atoms of different elements.

B. two small atoms combining to form a larger atom of a different element.

C. the production of vast amounts of greenhouse gases such as carbon dioxide.

D. the combustion of carbon compounds with oxygen.

Question 6

What is the overall energy efficiency of using electricity produced from nuclear fuels?

A. 54%%

B. 265%

C. 86%

D. 14%

Question 7

The remainder of the energy **not** converted into electricity is most likely converted into

A. carbon dioxide.

B. sound.

C. radioactive waste.

D. heat.

Question 8

The gas which makes up the greatest percentage by volume of the atmosphere is

A. oxygen (O_2).

B. nitrogen (N_2).

C. carbon dioxide (CO_2).

D. water vapour (H_20).

Question 9

The greenhouse gas which makes up the greatest percentage by volume of the atmosphere is

A. oxygen (O_2).

B. nitrogen (N_2).

C. carbon dioxide (CO_2).

D. water vapour (H_20).

Question 10

During the history of the Earth, its climate has

A. changed very little.

B. only changed following the Industrial Revolution when the anthropogenic release of greenhouse gases significantly increased.

C. changed naturally and sometimes dramatically.

D. not changed.

Question 11

Species richness is a measure of

A. the relative abundance of a species.

B. the total number of species counted.

C. functional diversity.

D. the total number of individuals in a given species.

Question 12

A threatened species is at greater risk of extinction when its conservation category changes from

A. endangered to vulnerable.

B. vulnerable to endangered.

C. critical to endangered.

D. critical to vulnerable.

Question 13

A species is regarded as endemic

A. if it is at risk of extinction.

B. if it occurs uniquely to an area.

C. if it is an exotic species.

D. if it is able to readily adapt to changing environmental conditions.

Question 14

The rare Buxton Gum (*Eucalyptus* crenulata) is a species of tree that is found only in a handful of localities in the south eastern highlands of Victoria, approximately 100km north-east of Melbourne. Recent studies have shown that the Gum is threatened as a result of its very small population size, limited gene pool and ability to breed with the closely related and more abundant Eucalyptus species *Eucalyptus ovata* (the Swamp Gum).

This scenario is an example of

A. genetic drift.

B. genetic swamping.

C. inbreeding.

D. overpopulation.

The following information relates to Questions 15 – 16.

The Lord Howe Island stick insect (*Dryococelus australis*) was once very common on Lord Howe Island, but thought to have become extinct soon after black rats were introduced to the Island 1918. In 2001 researchers discovered a tiny population of less than 30 individuals living on Ball's Pyramid, a small rocky island 23km from Lord Howe Island, and have subsequently collected two breeding pairs for breeding in captivity. The ultimate goal is to breed sufficient numbers of the stick insect to allow their reintroduction to Lord Howe Island.

Question 15

The conservation status of the Lord Howe Island stick insect is most likely listed as

A. Vulnerable.

B. Critically endangered.

C. Not threatened.

D. Extinct in the wild.

Question 16

The main goal of the captive breeding program with later release of offspring to Lord Howe Island is to increase

A. species diversity.

B. population numbers.

C. endemism.

D. genetic diversity.

Question 17

A population of the Black-footed rock wallaby (*Petrogale lateralis*) lives on Barrow Island off north-western Australia. Cut off from the mainland, they have been isolated from mainland populations for around 10 000 years. Studies have shown that the Barrow Island population have extremely low levels of genetic variability.

A consequence of this low genetic diversity is that the Black-footed rock wallabies on Barrow Island

A. are likely to be susceptible to the same selection pressures.

B. are likely to evolve into a new species of wallaby.

C. will be well adapted to their isolated environment.

D. will become extinct.

Question 18

Australia is a signatory to the Ramsar Convention, an international treaty that aims to

A. ensure that international trade in wild animals and plants does not threaten their survival.

B. lower greenhouse gas emissions that cause climate change.

C. conserve wetland habitats through sustainable use and management.

D. protect the ozone layer by phasing out the production of damaging chemicals.

Question 19

A recent study of the blue-breasted fairy-wren, a small bird endemic to Western Australia's wheatbelt region east of Perth, found that habitat loss and fragmentation was a significant threat to their survival. The establishment of wildlife corridors is one strategy that has been proposed to limit the effects of habitat fragmentation.

Wildlife corridors are believed to

A. facilitate the movement of animals through suboptimal habitat.

B. increase genetic drift and inbreeding between subpopulations.

C. reduce competition from exotic species.

D. all of the above.

Question 20

Population Viability Analysis (PVA) can be used by conservation biologists to

A. monitor the success of conservation management strategies.

B. measure the biodiversity of a particular area.

C. rank potential management options aimed at reducing the risk of a population's extinction.

D. analyse genetic differences between two different populations.

Section B – Short answer questions.

Question 1

The use of incandescent light bulbs in Australia is currently being phased out and replaced by fluorescent bulbs. By 2010 it will be illegal to sell standard incandescent bulbs.

The poor energy efficiency of incandescent light bulbs when compared with fluorescent bulbs is the main reason behind their being phasing out.

a. Assuming that the energy efficiency of an incandescent light bulb is 4% and the fluorescent bulb's energy efficiency is 22%; calculate the amount of electrical energy that must be input to each bulb to get an output of 100J of light energy. Show all working.

Incandescent light bulb	**Fluorescent light bulb**
$Energy\ efficiency\ (\%) = \frac{useful\ energy\ output}{total\ energy\ input} \times 100$ therefore $Total\ energy\ input = \frac{useful\ energy\ output}{energy\ efficiency\ (\%)} \times 100$ $Total\ energy\ input = \frac{100}{4} \times 100$ $= 2500J$ (2 marks)	$Total\ energy\ input = \frac{useful\ energy\ output}{energy\ efficiency\ (\%)} \times 100$ $Total\ energy\ input = \frac{100}{22} \times 100$ $= 455J$ (2 marks)

4 marks

b. What is the Second Law of Thermodynamics? Your answer should make reference to the energy efficiency of the light bulbs calculated in part **a.**

When energy is converted from one form to another, some of the useful energy is always converted to lower-quality, less-useful energy. (1 mark)

In the example of the light bulbs, only 4% (for the incandescent bulb) and 22% (for the fluorescent bulb) of the electrical energy entering the bulbs is converted to light (useful energy), most of the remaining energy would be converted to heat (lower-quality, less useful energy). (1 mark)

2 marks

Question 2

Melbourne is the second largest city in Australia with a population of approximately 3.8 million people. It is a major centre of commerce and industry, including being home to Australia's busiest seaport and other major manufacturing industries including Ford and Toyota. Despite having an integrated public transport system including the largest tram network in the world, Melbourne has a high dependency on private cars for transport with an extensive network of roads spreading through all suburbs.

a. Name one fossil energy source that is used to supply part of Melbourne's energy requirements.

One of coal, natural gas, petroleum or other fossil fuel. No marks

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Describe how this fossil fuel energy source is used to help meet the energy needs of Melbourne.

Answer depends on fossil fuel selected, but should include

- role of fossil fuel *wrt* energy needs of Melbourne e.g. coal used to generate electricity (1 mark)
- fossil fuels ability to meet Melbourne's energy needs e.g. coal fired powered stations able to meet Melbourne's electricity energy needs (both base and peak loads); coal widely available, cheap to use & infrastructure already setup. (2 marks)

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3 marks

b. Name one non-fossil fuel energy source that you have studied.

One of hydroelectric, wind, solar, biomass, nuclear or other non-fossil fuel. No marks

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Describe how this non-fossil fuel energy source is used to help meet the energy requirements of a specific geographic location (town or region).

Answer depends on non-fossil fuel selected, but should include

- name of a specific geographic location (town or region) e.g. Portland, Victoria. (1 mark)
- how the non-fossil fuel meets the energy requirements of the named location e.g. Portland windfarm project will meet the base load requirements of Portland & surrounding areas (up to 120 000 homes) when fully completed in 2008 and currently meets baseload for 18 000 homes. Does not meet the peak load requirements which is supplied through coal fired power stations in Gippsland via the national electricity grid. (2 marks)

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3 marks

c. Evaluate the potential of your non-fossil fuel energy source described in part **b.** to substantially meet the energy needs of Melbourne, replacing its current reliance on fossil energy sources. You should make mention of its availability, economy and environmental impact.

Answer depends on non-fossil fuel selected,

Must include a statement with a judgement on the non-fossil fuels ability to substantially meet Melbourne's energy needs (both base and peak loads). (2 marks)

e.g. Wind power could be used to partially meet Melbourne's electrical energy base load needs if there were more wind farms built, however it could not meet Melbourne's peak loads which are very high due to heavy industry etc. Coal can meet both base and peak loads.

Answer must also include (1 mark each)

- Availability of fuel source e.g. Melbourne is close to suitable windfarm sites on the coast and inland so wind power is viable *wrt* availability. Coal is freely available with infrastructure already in place.

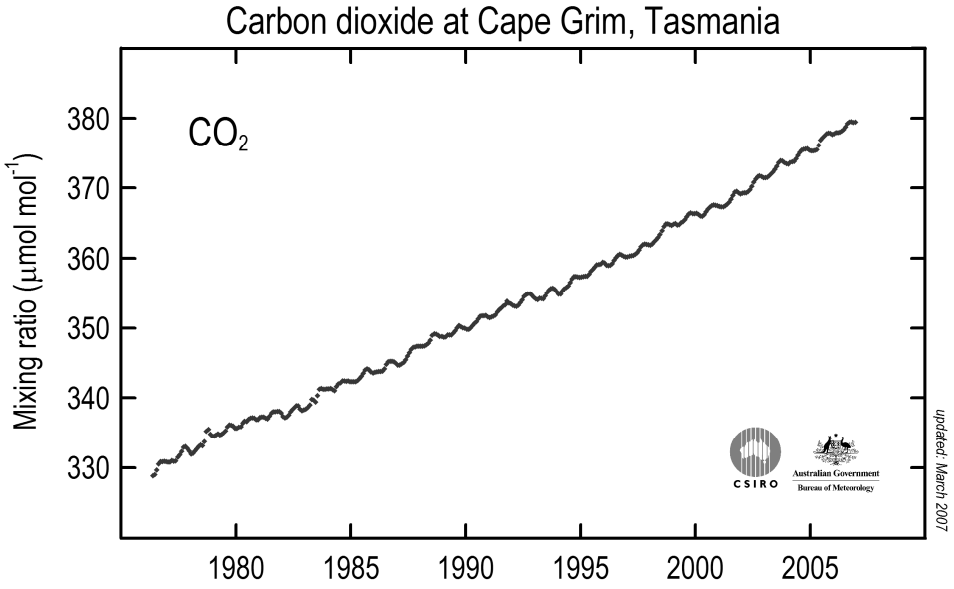
- Economy of use e.g. currently not enough windfarms are available to provide Melbourne's energy needs, so they would need to be built (expensive when compared to coal fired power stations which are already available) however once built the cost of their running is minimal (compared to coal fired power stations), so windpower is economically viable.

- Environmental impact e.g. land clearing/loss of habitat may occur during windfarm construction, but most sites have already been cleared and are often farmland (therefore not always important habitat); fossil fuels used during construction of windfarms resulting in pollution, however once in operation there is minimal environmental impact unlike coal which continues to have a major environmental impact during use through emission of greenhouse gases.

5 marks

Question 3

The following graph shows changing atmospheric concentration of carbon dioxide as measured at the Cape Grim Baseline Air Pollution Station located in remote north-western Tasmania.



a. Atmospheric carbon dioxide concentrations at Cape Grim have increased significantly since measurements were first taken in the mid-1970s and continue to increase. Calculate the percentage increase in carbon dioxide concentrations between 1980 and 2005. Show your working.

$$\%\ increase\ in\ CO_2\ conc = \frac{amount\ of\ increase}{initial\ value} \times 100$$

$$= \frac{40}{335} \times 100$$

$$= 12\%$$

2 marks

b. Similar trends have been observed for other air monitoring stations around the world. Name two main sources of carbon dioxide that could be used to explain this trend of increasing global atmospheric carbon dioxide concentrations.

Two of

- burning of fossil fuels (could perhaps be more specific and name two from here e.g. burning of coal in coal fired powerstations and burning of petrol in automobiles)
- deforestation
- plant burning.

2 marks

c. Carbon dioxide is an important greenhouse gas. Increasing global atmospheric carbon dioxide concentrations have been named as a major contributor to the enhanced greenhouse effect.

Explain the role that increasing global atmospheric concentrations of greenhouse gases such as carbon dioxide, play with respect to the **enhanced greenhouse effect**.

Your answer should include a fully labelled diagram, with reference to

- the types of incoming solar radiation
- the types of radiation re-emitted from the earth's surface
- radiation absorbed in the atmosphere.

Answer must include a diagram or maximum of 4 marks.

Diagram and/or explanation must highlight

- types of incoming solar radiation & their fate
  - UV = ~95% absorbed by ozone layer & plays not part in EGE.
  - Visible light (& very small amount of IR) reach the earth's surface.
- earth's surface absorbs the visible light (& IR) and degrades it to longer-wavelength IR (heat) which is re-emitted back into the troposphere.
- increase in concentration of greenhouse gases such as carbon dioxide in troposphere has resulted in less of this re-emitted heat 'escaping' into space than would normally be expected and is instead absorbed by the greenhouse gases.
- greenhouse gas molecules radiate the heat back towards the earth's surface.
- this results in increasing amount of heat being 'trapped' in earth's atmosphere rather than 'escaping' into space (i.e. energy input > energy output), leading to increasing atmospheric temperatures – the Enhanced Greenhouse Effect.

6 marks

d. With reference to one specific geographic location (town or region), describe how the enhanced greenhouse effect may impact on life.

Answer depends on location listed.

If no location max of 2 marks.

Answer must describe how the EGE may impact on life, not just list the physical changes that may occur.

e.g. The enhanced greenhouse effect may impact on the life of people living along the Surfcoast of Victoria through their homes being damaged by an increase in violent storms. Food may become more expensive as longer periods of drought will mean farm produce will be more difficult to produce.

3 marks

e. i. Outline **one** strategy for reducing the enhanced greenhouse effect.

Various strategies could be outlined.

Must name one strategy (1 mark) and include expansion (2 marks)

- increasing energy efficiency e.g. Improving energy efficiency of automobiles, meaning decreased reliance on fossil fuels and less greenhouse gases emitted.
- emission trading e.g. national and/or global limits on greenhouse gas emissions are set. Industries/countries agree to meet these limits by selling and trading their emission rights. Outcome is that less greenhouse gases are emitted on a global scale due to the increase emphasis to use non greenhouse gas polluting means of generating energy such as windpower, solar, etc.
- vegetation sinks e.g. Forests absorb carbon dioxide and sequester it, so increasing the amount of forests can remove some carbon dioxide (a greenhouse gas) from the atmosphere.

3 marks

ii. Evaluate the effectiveness of this strategy for reducing the enhanced greenhouse effect. You should make reference to the positive and negative aspects that implementing the strategy may have on society and the environment.

Answer must include

- a statement with a judgement of how effective the strategy is in reducing the EGE (1 mark).
- a description of the strategy's positive (e.g. encourage new industries/jobs and reduce emissions of greenhouse gases) and negatives (e.g. increase costs of automobiles) on society (1 mark) and the environment (1 mark).

3 marks

Question 4

In 1994 a new species of conifer, *Wollemia nobilis* was discovered about 150km west of Sydney in a rainforest gorge of the Blue Mountains. Better known as the Wollemi Pine, before being found it had been presumed extinct for around two million years. Today fewer than a hundred trees are known to be growing wild in three localities not far apart from each other.

Studies have shown that the Wollemi Pine is at risk of extinction in the wild primarily due to its limited genetic variability.

a. Explain why the Wollemi Pine's genetic diversity would be an important factor for its survival.

Low genetic diversity, particularly in a very small populations, can result in

- genetic drift – which can lead to a decrease in the ability of the population to adapt to changing conditions. (1 mark)
- Inbreeding – which increases the chance of offspring inheriting deleterious alleles, leading to lower reproduction and survivability rates. (1 mark)

Or explain one in detail (2 marks)

2 marks

b. Outline **one** management strategy that could be implemented that would improve the Wollemi Pine's chances of survival.

Low genetic diversity is the pines greatest threat to survival. Strategy to address this could be

- collect gametes from individual plants in different localities (which would presumably have greater genetic diversity than those from within the same locality). (1 mark)
- breed them to increase the total number of individuals. (1 mark)
- new plants could then be used to establish new populations in different localities to where

they are currently found. (1 mark)

For full marks strategy should include methods that increase both genetic diversity (however this difficult with such a small population number) and overall population numbers.

3 marks

Question 5

A study was conducted to investigate the changes in a marine coastal reef community following a large destructive storm event. For the study a single reef which had previously been sampled prior to the storm was again sampled 30 days after the storm event.

The results of this study are shown below.

Species	Number of individuals before the storm	Number of individuals following the storm.
Species 1	40	10
Species 2	20	5
Species 3	30	0
Species 4	15	0
Species 5	20	10
Species 6	30	30
Species 7	0	70
Species 8	0	30

a. What was the species richness recorded at the reef before and after the storm?

Species richness before the storm	Species richness following the storm.
6	6

2 marks

The Berger-Parker Diversity Dominance Index is a simple species diversity index that can be used to assess the biodiversity of disturbed environments. The Index expresses the proportional importance of the most abundant species. It is given by

$$\text{Berger-Parker Index (D)} = \frac{\text{the total number of individuals (N)}}{\text{the number of individuals in the most common species } (N_{max})}$$

A higher value of D indicates a greater species diversity.

b. Calculate the Berger-Parker Diversity Index for both before and after the storm at the reef.

	Before the storm	Following the storm
Total number of individuals (N)	141	155
Number of individuals in the most common species (N_{max})	40	70
Berger-Parker Index (D) (N / N_{max})	$\frac{141}{40} = 3.53$	$\frac{155}{4070} = 2.21$

4 marks

c. Evaluate the impact that the storm event had on the coastal reef's biodiversity. Your answer should include reference to **both** species richness and species diversity.

For full marks students should

- make reference (preferably quote data) to both species richness (1m) and the calculated biodiversity indices (1m) and show a good understanding of the meaning of each (1m)
- use the available evidence to come to a conclusion *wrt* the storms impact on diversity (1m).

e.g.

The storm had a significant impact on the biodiversity of the coastal reef. Even though when based on species richness (6 for both before and after the storm) alone, the storm had no impact on the reef's biodiversity; there was however a significant change with when based on Berger-Parker's Index. This index showed a decrease in diversity after the storm (D = 2.21) from the diversity before the storm (D = 3.53). This decrease in biodiversity can be seen in the raw data with the significant change in relative abundance of each species that occurred after the storm. Before the storm species evenness was relatively high with no one species dominating the abundance (max abundance of a species (Sp 1) was 40 out of a total of 141 individuals), however after the storm a new species was dominant (species 7 with an abundance of 70 out of 155).

4 marks

Question 6

Lake Connewarre is a large estuarine, shallow lake near the mouth of the Barwon River south of Geelong. It is an important wetland habitat for many birds including the threatened Curlew Sandpiper (*Calidris ferruginea*). The Curlew Sandpiper is a small wading bird which breeds on the tundra of Arctic Siberia in the northern hemisphere and then migrates to the southern hemisphere during the northern winter.

Australia is a signatory to the Ramsar Convention. Lake Connewarre is included within the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar Site, one of 11 wetland Ramsar sites found in Victoria.

Describe how the Ramsar Convention relates to the Curlew Sandpiper's conservation.

Because the Curlew Sandpiper is a migratory bird, its survival is dependant upon its habitat being conserved both here in Australia and in Siberia (1m).

The Ramsar Convention is an international treaty which aims to protect wetlands habitats, especially for water birds, therefore signatories to the Ramsar Convention (of which Australia & Russia is) should be protecting the Curlew Sandpiper's habitat (1m).

2 marks

Question 7

Name a threatened species you have studied this year.

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a. **i.** Which International Union for the Conservation of Nature (IUCN) conservation category has this species been assigned to?

Answer depends on the threatened species that has been studied but should be vulnerable, endangered or critically endangered.

1 mark

ii. Explain the meaning of this conservation category.

For full marks students need to show an understanding of the meaning of the conservation category, including

- Indication of where the chosen species lies on the spectrum of threat. (1m)
- reference to the likelihood of the species extinction under current circumstances. (1m)

e.g. Leadbeaters possum is classified as endangered.

Endangered means that Leadbeaters possum is not critically endangered but is facing a very high risk of extinction in the wild in the near future.

2 marks

b. The Flora and Fauna Guarantee Act 1998 is the principle legislation in Victoria aimed at protecting biodiversity. Explain the relevance of this act as it relates to the protection of your threatened species.

Once a species is listed under the Flora and Fauna Guarantee Act as threatened there is a legal requirement that action is taken to protect it. (1m)

This will include preparation of an action statement which outlines the management issues together with the management actions (should be specific here *wrt* the chosen species e.g.) that need to be taken to ensure the long term survival of the species. (1m)

2 marks

c. Describe the main threats to this species that has placed it at risk of extinction.

Answer will depend upon threatened species selected. Answer

- must relate to chosen species.
- should include the main threat/s to that species (and not just generalised threats)
- should describe at least two threats in detail (or three in lest detail).

3 marks

d. Outline **two** specific strategies that have been used, or could be used, as part of a wider management plan to conserve this species from the threats described in part **b**.

For full marks answer must outline specific strategies (e.g. captive breeding followed by reintroduction in order to increase population numbers and/or genetic diversity of the species) and not a wider management plans (e.g. preparation of an Action Statement). (2m for each strategy)

4 marks

e. Evaluate the effectiveness of each of these strategies outlined in part **d** in reducing the risk of extinction to this species.

Your answer should include reference to the processes involved, or that would be involved, in evaluating the effectiveness of each strategy.

For full marks answer must

- relate to two the strategies outlined in part **d**.
- make specific reference to studies (e.g. monitoring) that have been undertaken (or could be undertaken) and by who e.g. Dept of Sustainability & Environment) to evaluate the strategy's effectiveness and what the results were. (2m)
- indicate how the strategy aims to reduce the risk of extinction (e.g. population numbers in the wild will increase following the reintroduction of captive bred animals). (1m)
- include an assessment of the success or otherwise of each strategy. (2m)

5 marks

ENVIRONMENTAL SCIENCE

Trial Written Examination June 2008

Section A answer sheet

Student:	Teacher:

Specific instructions for Section A

- Answer all questions
- All questions should be answered on the answer sheet for multiple-choice questions, in Pencil.
- Choose the response that is **correct** or **best answers** the question, and shade the square on the multiple choice answer sheet below.
- A correct answer is worth 1 mark, an incorrect answer is worth no marks.
- No marks will be given if more than one answer is shown for any question.
- Marks will not be deducted for incorrect answers

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

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