VICTORIAN CURRICULUM AND ASSESSMENT AUTHORITY

Victorian Certificate of Education 2009

SUPERVISOR TO ATTACH PROCESSING LABEL HERE

STUDENT NUMBER

									Letter
Figures									
Words									

ENVIRONMENTAL SCIENCE

Written examination 1

Wednesday 10 June 2009

Reading time: 2.45 pm to 3.00 pm (15 minutes)
Writing time: 3.00 pm to 4.30 pm (1 hour 30 minutes)

QUESTION AND ANSWER BOOK

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

- Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers, sharpeners, rulers and one scientific calculator.
- Students are NOT permitted to bring into the examination room: blank sheets of paper and/or white out liquid/tape.

Materials supplied
- Question and answer book of 18 pages.
- Answer sheet for multiple-choice questions.

Instructions
- Write your **student number** in the space provided above on this page.
- Check that your **name** and **student number** as printed on your answer sheet for multiple-choice questions are correct, **and** sign your name in the space provided to verify this.
- All written responses must be in English.

At the end of the examination
- Place the answer sheet for multiple-choice questions inside the front cover of this book.

Students are NOT permitted to bring mobile phones and/or any other unauthorised electronic devices into the examination room.

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SECTION A – Multiple-choice questions

Instructions for Section A

Answer **all** questions in pencil on the answer sheet provided for multiple-choice questions.
Choose the response that is **correct** or that **best answers** the question.
A correct answer scores 1, an incorrect answer scores 0.
Marks will **not** be deducted for incorrect answers.
No marks will be given if more than one answer is completed for any question.

Question 1

Which of the following is a non-renewable energy source?

A. coal
B. solar
C. wind
D. geothermal

The following information relates to Questions 2–7.

In the Latrobe Valley, east of Melbourne, an electricity generation company is planning to replace a thermal power station fired by brown coal with a thermal plant fired by natural gas.

Question 2

Natural gas is an example of

A. a fossil fuel, renewable energy source.
B. a non-fossil fuel, renewable energy source.
C. a fossil fuel, non-renewable energy source.
D. a non-fossil fuel, non-renewable energy source.

Question 3

An environmental advantage of natural gas over brown coal as the energy source is that natural gas

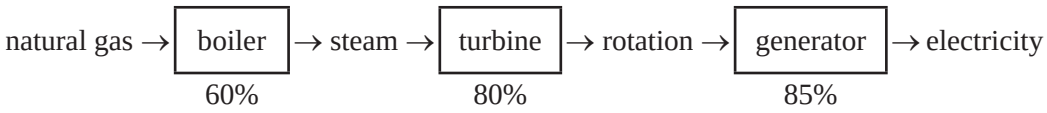
A. is more plentiful in Victoria than brown coal.
B. produces less water vapour than brown coal when burned.
C. is cheaper than brown coal as supplied to the Latrobe Valley.
D. produces less carbon dioxide emissions than brown coal for equivalent energy when burned.

Question 4

The burning of natural gas is an example of

A. an exothermic reaction.
B. an endothermic reaction.
C. conversion of heat energy to kinetic energy.
D. conversion of mechanical energy to electrical energy.

The process that will occur in the power station and the efficiency of each conversion is shown below.



Question 5

The overall efficiency of the plant will be approximately

A. 25%

B. 40%

C. 75%

D. 225%

Question 6

The law of conservation of energy means that the plant will

A. convert all the energy in the natural gas to electricity.

B. be highly efficient in converting one form of energy into another.

C. convert all the energy in the natural gas into other forms of energy.

D. be sustainable, since it will conserve unneeded energy for future use.

Question 7

The source of natural gas is in East Gippsland (off-shore in Bass Strait, about 200 km from Melbourne). The company is deciding where to locate the new gas-fired power station.

Which of the following is the best option, together with the correct reasoning?

A. The station should be located off-shore, since radioactivity from the station may affect endangered species.

B. The station should be close to the gas source, since gas in the pipeline is at a very high temperature and therefore dangerous.

C. The station should be close to the gas supply, since the gas loses energy in the pipeline but no energy is lost in the electricity transmission lines.

D. The station should be close to Melbourne, since little energy is lost by the flow of gas in the pipeline, but losses are considerable in long distance electricity transmission.

The following information relates to Questions 8–11.

The Snowy Mountains Hydroelectric Scheme was built in southeastern Australia between 1949 and 1975. The system provides 3.5% of energy needs to the mainland electricity grid for Queensland, New South Wales, the Australian Capital Territory, Victoria and South Australia.

Question 8

The water stored in Lake Jindabyne, one of the dams in the Snowy Mountains Scheme, to generate hydroelectric power is an example of

A. kinetic energy**.**

B. potential energy.

C. mechanical energy.

D. non-renewable energy.

Question 9

The production of electricity that occurs in the hydroelectricity system

A. is low in efficiency, because water is heated up during the process.

B. is low in efficiency, since many steps are involved in the conversion process.

C. results in the loss of water due to friction through the tunnels and aqueducts in the system.

D. is highly sustainable, because the water can be used in irrigation systems after passing through the power station.

Question 10

Hydroelectricity provides a low percentage of mainland Australia's energy needs because

A. coal power stations are a more renewable source of electrical energy than hydro power.

B. water is needed more for irrigation, and should not be used up in hydroelectricity generation.

C. there is insufficient water in southeastern Australia to provide a high percentage of electrical power needs.

D. wind turbine farms and solar panels are able to provide for the base load (constant throughout the day) electricity needs of southeastern Australia.

Question 11

The use of hydroelectric energy sources is in accord with the Kyoto Protocol, because the main aim of the Kyoto Protocol is to

A. reduce carbon dioxide emissions.

B. encourage the use of renewable energy sources.

C. encourage the use of sustainable energy sources.

D. create wetlands for the use of migratory water birds.

Question 12

The following activities in the environment contribute to human survival.

- cleansing of water resources
- breakdown and absorption of pollutants
- soil formation and protection

These activities can best be described as

A. ecosystem services.

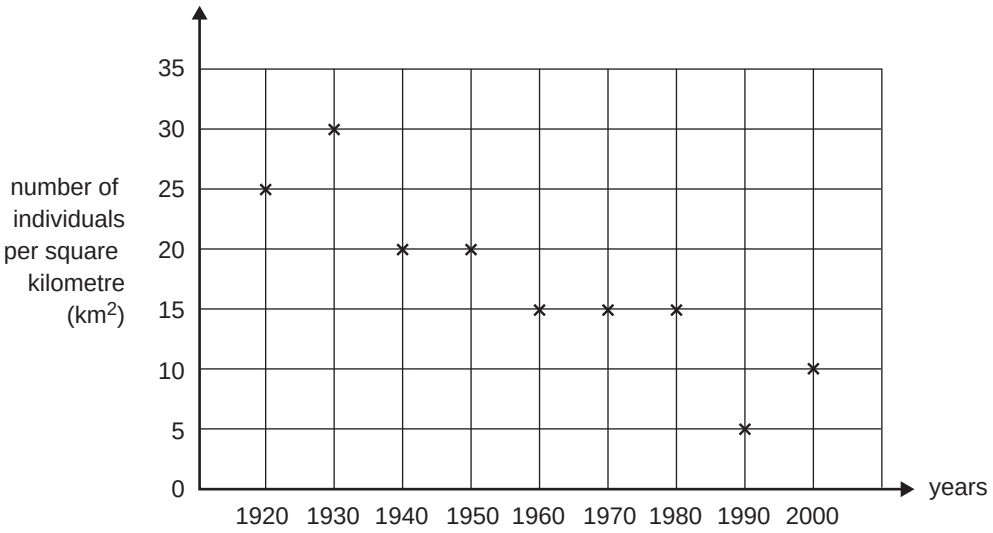
B. ecosystem diversity.

C. population diversity.

D. environmental control.

The following information relates to Questions 13–16.

The following graph represents the change in size of an endangered native mammal population near Bendigo, Victoria. The population was sampled from 1920 to 2000 over a 12 km^2 area.



Question 13

The best estimate of the percentage decrease of the native mammal population from 1940 to 1990 is

A. 33%

B. 66%

C. 75%

D. 150%

Question 14

Sampling of the native mammal used a method known as 'capture – mark – release – recapture' and the Lincoln Index as described below.

$$N = \frac{MC}{R}$$

where

N = estimate of total population size

M = total number of animals captured and marked on the first visit

C = total number of animals captured on the second visit

R = number of animals captured on the first visit that were recaptured on the second visit.

In one study, 25 animals were initially captured, marked and then released. On the second visit, 42 animals were captured – 3 of these were marked.

Given these conditions, the estimated total population size is

A. 28

B. 263

C. 350

D. 945

Question 15

In 2000, 4 individuals (2 male and 2 female) from this population near Bendigo were joined by 8 individuals from a New South Wales population as part of a captive breeding program.

The result of this program for the Bendigo population would most likely be an increase in

A. endemism.

B. genetic diversity.

C. species diversity.

D. ecosystem diversity.

Question 16

One consequence of small population size is demographic variation.

This means the population is particularly vulnerable to chance variation in

A. rainfall and temperature.

B. ratio of male and female individuals born.

C. number and type of species present in an ecosystem.

D. harmful genes present in the gene pool due to chance alone.

The following information relates to Questions 17–19.

The Northern Hairy-nosed Wombat is a subspecies of wombat, found only in a small pocket of land in southern Queensland.

Question 17

Wildlife authorities consider removing a number of individuals from this unique population and relocating them to a similar habitat in northern New South Wales.

The most likely reason for this action is to

A. avoid genetic swamping.

B. maintain genetic diversity.

C. improve ecosystem diversity.

D. safeguard against a catastrophic destruction of their habitat, such as by flood.

Question 18

The Northern Hairy-nosed Wombat is considered to be at high risk of extinction in the immediate future.

Its conservation category is best described as

A. at risk.

B. vulnerable.

C. endangered.

D. critical.

Question 19

The export of Northern Hairy-nosed Wombats from Australia is illegal, except under strict zoo programs.

The treaty that best covers this is the

A. CITES.

B. Kyoto Protocol.

C. Ramsar Convention.

D. International Free Trade Agreement.

Question 20

There are **two** separate populations of an endangered species.

The probability (calculated risk) of extinction of population A in the next twenty years is estimated to be 0.10, and of the second, larger population, B, is 0.05.

Which of the following best gives the probability of extinction of both populations in the next twenty years?

A. 0.005

B. 0.10

C. 0.15

D. 0.50

END OF SECTION A
TURN OVER

SECTION B – Short answer questions

Instructions for Section B

Answer **all** questions in the spaces provided.

Question 1

Name a fossil fuel and a non-fossil fuel energy source you have studied this year.

fossil _____

non-fossil _____

a. Name and describe one specific geographic location (town, region) where the nominated **fossil** fuel energy source is currently used or could be economically used to provide for the energy needs of the location.

Discuss whether the nominated fossil fuel energy source will be able to supply the energy requirements of the location.

_____

_____

_____

_____

_____

_____

_____

_____

4 marks

b. Name and describe one specific geographic location (town, region) where the nominated **non-fossil** energy source is currently used or could be economically used to provide for the energy needs of the location.

Discuss whether the nominated non-fossil fuel energy source will be able to supply the energy requirements of the location.

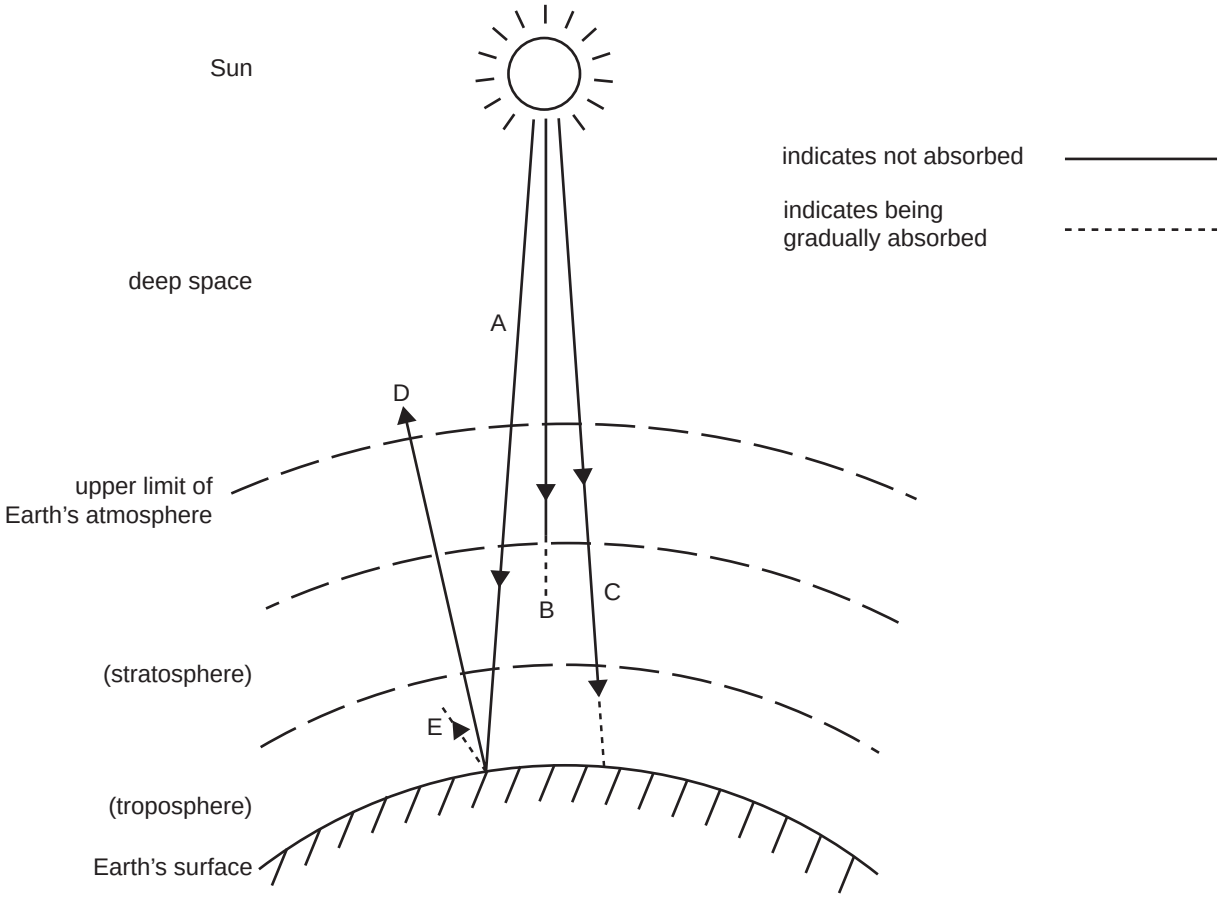
4 marks

c. Evaluate the overall sustainability (this may include environmental, economic and/or social) of the two energy sources. In your answer discuss their relative benefits and costs and include a judgment about which is the more beneficial and cost effective.

5 marks

Question 2

The diagram below (**not to scale**) shows the Sun, Earth and parts of the Earth's atmosphere.
The lines/arrows A–E can indicate ultraviolet (UV), visible or infrared radiation (IR).



a. For each of A–E, write in the box UV, visible or IR to indicate which type of radiation best fits that line.

Line	Radiation type (UV, visible, IR)
A	
B	
C	
D	
E	

5 marks

b. For the fossil fuel energy source you nominated in Question 1, explain the mechanism by which it contributes to the enhanced greenhouse effect, and what can be done to reduce this.

4 marks

c. Name two naturally occurring greenhouse gases.

1. _____

2. _____

2 marks

d. Name a greenhouse gas that does not occur naturally but has been introduced into the atmosphere by human activity, and has contributed to the enhanced greenhouse effect.

_____

1 mark

e. Name a gas contributing to the greenhouse effect that occurs naturally but has been substantially increased by human activity.

_____

1 mark

Question 3

Name one threatened animal species that you have studied this year.

_____

a. Describe one known population of this species, including reference to the geographic location, size of the population and the likelihood of long-term survival of this specific population.

4 marks

b. **i.** State the degree of threat in terms of the standard conservation categories. What are the criteria for inclusion in this conservation category?

ii. Discuss the main threats to this population and the likelihood of extinction.

2 + 3 = 5 marks

c. Outline what monitoring process has been undertaken. Describe any numerical data that has been collected which provides information on the species' conservation category.

4 marks

d. Describe a management strategy that has been implemented to protect this particular population at this location.

3 marks

e. Evaluate the effectiveness of this strategy and include some data to support your evaluation.

4 marks

Question 4

The Mallee Emu-wren is a small bird that lives in mallee vegetation, especially where there is a dense undergrowth of Porcupine Grass.

The density of this undergrowth, and hence its suitability for the Mallee Emu-wren, varies depending on the age of the vegetation.

Three different classes of mallee vegetation, A, B and C, in different areas, have different densities as the vegetation ages.

The Mallee Emu-wren is classified as Endangered in Victoria. A scientist, Simon, carried out surveys of the Mallee Emu-wren in a nature reserve to determine the effects of different densities of vegetation on the suitability of habitat for this species. He carried out surveys on four sampling areas, in each of the three classes of mallee vegetation (A, B and C), based on the age of the vegetation. The number of Mallee Emu-wrens that he recorded in each sampling area is shown in the table below. Each sampling area covered 10 hectares.

Class of vegetation

Sampling area	Class A	Class B	Class C
1	3	1	0
2	5	3	0
3	2	0	0
4	2	2	0

a. Calculate the average occurance of the Mallee Emu-wren (expressed as the number of individuals per hectare) in each class of vegetation. Show your working.

A

individuals per hectare

B

individuals per hectare

C

individuals per hectare

3 marks

To obtain an estimate of the total population of Mallee Emu-wrens in the nature reserve (total area 1900 hectares), Simon measured the area of each class of vegetation. His results were as follows.

Class	Area
A	400 hectares
B	500 hectares
C	1000 hectares

b. Using this data and your estimate of average density, calculate the estimated population size of the Mallee Emu-wren for the entire reserve. Show your working.

3 marks

As an endangered species, the Mallee Emu-wren is also listed under the *Flora and Fauna Guarantee Act 1988* in Victoria.

c. Describe the steps that are legally required to be followed after listing a species under this Act.

3 marks

d. Discuss the likely consequences of the steps you have described in **part c.** for the conservation status of the Mallee Emu-wren in the reserve. Explain why you consider it will either benefit or not benefit this species.

3 marks

Question 5

An environmental scientist, Annie, carried out surveys of butterflies as part of a project to examine the benefits of revegetation in a cleared farmland region where little native vegetation remained. She surveyed butterflies at study sites in each of three types of habitats.

- remnant native vegetation (remnant)
- revegetation with indigenous trees and shrubs (revegetation)
- plantations of a single species of eucalypt (plantation)

After carrying out regular surveys at three sites in each habitat type, she recorded the following species of butterfly in each habitat type.

Species	Remnant	Revegetation	Plantation
Australian Painted Lady	✓	✓	✓
Common Brown	✓	✓	✓
Marbled Xenica	✓	✓	
Ringed Xenica		✓	
Common Grass Blue	✓	✓	✓
Caper White	✓		
Cabbage White (introduced)	✓	✓	✓
Meadow Argus	✓	✓	
Satin Azure	✓		
Yellow Admiral	✓		

Annie decided to use Jaccard's Index to compare the butterfly communities in the revegetation and plantation habitats with that in remnant vegetation. Jaccard's Index provides a measure of the similarity between communities. Communities that have high similarity have higher values of the index.

Jaccard's Index of similarity, S_1, between two communities, A and B, is calculated as

$$S_1 = \frac{\text{number of species that are common to both sites (that is, found in both A and B)}}{\text{total number of species that are found in one or both of A and B when combined}}$$

Annie first calculated Jaccard's Index of similarity between the butterfly communities of the revegetation and plantation habitats. There were 4 species in common and a total of 7 species recorded in these two habitat types.

Therefore, Jaccard's Index $= \frac{4}{7} = 0.57$.

a. Showing your working, calculate Jaccard's Index of similarity between the butterfly communities of remnant vegetation and revegetation

remnant vegetation and plantation.

2 marks

b. As a result of these calculations, state which two butterfly communities are most similar.

2 marks

c. A proposal is made to establish large areas of plantation across the farmland region. It is suggested that this will have benefits for biodiversity as well as having economic values when the plantation is later harvested for timber.

Discuss one benefit and one limitation of this proposal for the conservation of butterflies in this farmland region.

benefit

limitation

4 marks

d. Butterflies depend on particular plants as a food source for their larval stage (caterpillar). Annie observes that some patches of remnant vegetation in the region are grazed by cattle and have depleted undergrowth with few plants. She recommends that these remnant patches be fenced to exclude the cattle, so that undergrowth plants can recover and act as a food source for the butterflies.

Describe an investigation that Annie can use to test whether this recommendation to fence remnants of native vegetation will actually benefit butterfly populations. Explain how you will assess whether the fencing will be successful for this purpose.

4 marks

END OF QUESTION AND ANSWER BOOK