VICTORIAN CURRICULUM AND ASSESSMENT AUTHORITY

Victorian Certificate of Education 2002

SUPERVISOR TO ATTACH PROCESSING LABEL HERE

STUDENT NUMBER

									Letter
Figures									
Words									

ENVIRONMENTAL SCIENCE

Written examination 1

Wednesday 12 June 2002

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	7	7	70
			Total 90

- Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers, sharpeners, rulers, an approved graphics calculator (memory cleared) and/or 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 19 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 electronic communication devices into the examination room.

SECTION A – Multiple-choice questions

Instructions for Section A

Answer all questions in pencil on the answer sheet for multiple-choice questions.

A correct answer scores 1, an incorrect answer scores 0. Marks will **not** be deducted for incorrect answers. No mark will be given if more than one answer is shown for any question.

Question 1

A petrol-powered car driven along a level road is an example of

A. electrical energy converted to heat energy.

B. chemical energy converted to kinetic energy.

C. gravitational potential energy converted to electrical energy.

D. mechanical energy converted to gravitational potential energy.

Question 2

Which of the following gases is responsible for enhancing the Earth's greenhouse effect?

A. oxygen

B. nitrogen

C. methane

D. hydrogen

Question 3

Which of the following is an exothermic reaction?

A. melting ice

B. burning natural gas

C. heating water in a microwave oven

D. converting solar energy into electricity

Use the data in Table 1 to answer Questions 4 to 6.

Table 1. Australian sources of energy and their production and use for the year 1992

	Available demonstrated energy resources [J × 10^{15}]	Energy production in 1992 [J × 10^{15}]	Total use of energy in Australia in 1992 [J × 10^{15}]
black coal	1 400 000	4 647	1 176
brown coal	410 000	497	497
crude oil	14 000	1 158	1 441
natural gas	37 000	931	677
uranium	263 000	2 233	0
renewable	not estimated	230	230
Total	2 124 000	9 696	4 021

Question 4

What percentage of the total use of energy within Australia was provided by renewable energy sources in 1992?

A. 2.1%

B. 5.7%

C. 15%

D. 36%

Question 5

What is the best estimate of the number of years supply of brown coal remaining, based on usage in 1992?

A. 8.0

B. 19.5

C. 825

D. 4274

Question 6

Australia needs to import some energy supplies.

From the data, what energy source was imported in 1992?

A. crude oil

B. black coal

C. brown coal

D. natural gas

Question 7

Hydrogen gas (H_2) is often suggested as an alternative fuel to fossil fuel for cars.

One major environmental advantage of hydrogen gas is that it

A. is easier to store in a car than petrol.

B. is easier to transport in bulk than petrol.

C. produces no carbon dioxide when burned.

D. can be readily obtained directly from the atmosphere.

Question 8

Which of the following groups contains only non-fossil energy resources?

A. biomass, coal, solar, tidal

B. oil, solar, biomass, uranium

C. wind, water, natural gas, hydrogen gas

D. geothermal, hydrogen gas, uranium, biomass

Question 9

Energy released from uranium is not popular with the community because it

A. is a major cause of the greenhouse effect.

B. is an inefficient way to produce electricity.

C. has by-products which are perceived as being dangerous and long lasting.

D. produces large amounts of waste heat compared to a coal-fired power station.

Question 10

The process that keeps the Earth's surface temperature about 30°C warmer than it would otherwise be is known as

A. industrialisation.

B. geothermal action.

C. seasonal variation.

D. the natural greenhouse effect.

Question 11

Which of the following activities creates a vegetation sink for carbon dioxide?

A. planting trees

B. building a garden compost heap

C. making greater use of solar energy

D. burying carbon dioxide below the ground

Question 12

A likely impact of the enhanced greenhouse effect is

A. a decrease in sea levels.

B. a decrease in the height of the atmosphere.

C. increased ultraviolet radiation reaching us.

D. higher average temperatures at the Earth's surface.

Question 13

Genetic diversity of a population can be measured by determining the number of

A. different species in an ecosystem.

B. genetic differences within the population.

C. genetic differences between different populations.

D. different species in an area and their relative population sizes.

Question 14

Species richness is measured by

A. the number of species.

B. the total number of individuals.

C. the genetic diversity of all the species.

D. the relative abundance of different species.

Question 15

Which of the following is **not** an ecosystem service?

A. nutrient cycling

B. pollination of crops

C. protection of water quality

D. salinisation of groundwater

Question 16

Endemism refers to the

A. loss of genetic diversity.

B. structure of a vegetation community.

C. restriction of species to a particular location.

D. loss of native species through competition with exotic species.

Question 17

The conservation status of a species improves if it changes from

A. vulnerable to critical.

B. endangered to critical.

C. critical to endangered.

D. vulnerable to endangered.

Question 18

Following habitat destruction, native vegetation is often found only as remnant patches.

Connecting these remnant patches with wildlife corridors will

A. always be the best conservation strategy.

B. assist the dispersal of some species.

C. reduce the risk of extinction of all species.

D. increase the genetic diversity of all species.

Question 19

Species A and B are in a symbiotic relationship. The loss of species A would threaten species B if species B were

A. an exotic species.

B. an indigenous species.

C. a host of species A.

D. a parasite of species A.

Question 20

Which of the following is true about inbreeding?

Inbreeding

A. increases species richness.

B. increases genetic diversity.

C. is more likely to occur in large populations.

D. is breeding by genetically related individuals.

END OF SECTION A
TURN OVER

SECTION B – Short-answer questions

Instructions for Section B

Answer all questions in the spaces provided.

Question 1

Select a fossil fuel energy source and a non-fossil fuel energy source and then answer parts **a.** to **d.** of this question.

- selected fossil fuel energy source is _____
- selected non-fossil fuel energy source is _____

a. For each of these energy sources name one specific location where you would find sufficient quantities to economically supply some of the energy needs of nearby communities.

i. selected fossil fuel energy source _____

_____

ii. selected non-fossil fuel energy source _____

_____

2 marks

b. Compare the energy conversions required to generate electricity from your selected fossil fuel energy source with those of your selected non-fossil fuel energy source.

_____

_____

_____

_____

2 marks

c. Which one of your two selected energy sources can be more efficiently (greater efficiency of conversion) **and** economically converted to electricity? Give reasons for your answer.

_____

_____

_____

_____

2 marks

d. Compare the environmental impact of the two sources you have selected.

2 marks

Total 8 marks

Question 2

A power station burns brown coal to produce electricity.

Brown coal is burned in air to produce steam to drive a turbine to generate electricity. When 1.0 kg of brown coal is burned it releases 6750 kJ of energy. For each kilogram burned, 2500 kJ of electrical energy is produced.

a. Calculate the efficiency of electrical energy generation in the power station.

3 marks

b. Describe two of the energy transformations happening in the power station that account for the missing energy.

4 marks

The main chemical reactions in this process involve conversion of carbon, hydrogen and sulfur in the coal into the following exhaust gases: carbon dioxide, water (steam) and sulfur dioxide. These exhaust gases are released into the atmosphere. The masses of some of the reactants and their products are given in tonnes (t).

carbon (coal) + oxygen → carbon dioxide
12 t 32 t 44 t

sulfur + oxygen → sulfur dioxide
16 t 32 t 48 t

One hundred tonnes (t) of brown coal contain:

carbon	26 t
sulfur	0.16 t

c. If a power station consumes 500 t of brown coal in one hour, calculate the mass of each of the two exhaust gases emitted to the atmosphere.

Show your workings.

i. carbon dioxide

ii. sulfur dioxide

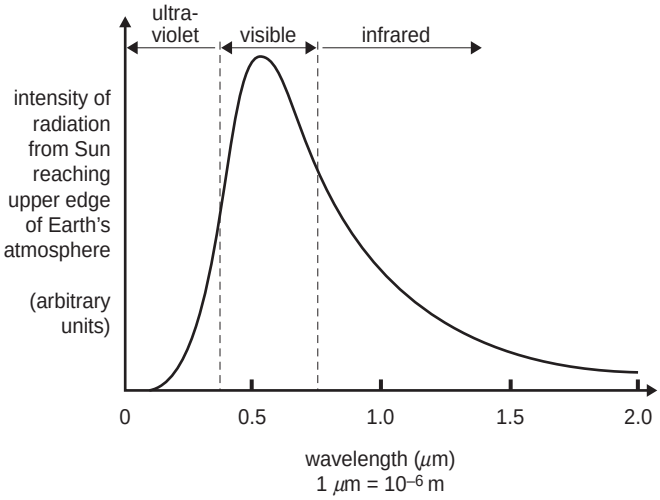
4 marks

Total 11 marks

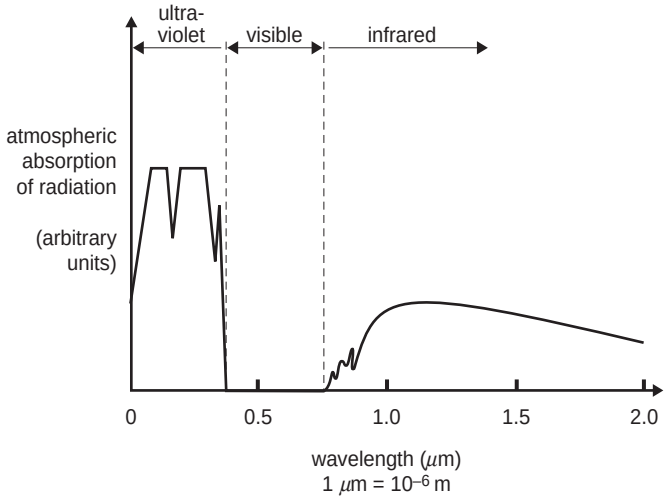
Question 3

The following graphs may help you answer Questions 3a.–f.

Graph 1 shows the intensity of radiation reaching the upper atmosphere of the Earth from the Sun as a function of wavelength. Graph 2 shows the proportion (%) of incoming radiation absorbed in the Earth's atmosphere at different wavelengths.



Graph 1: Intensity of radiation reaching Earth (upper atmosphere) from Sun versus wavelength



Graph 2: Proportion of the incoming radiation absorbed in the Earth's atmosphere versus wavelength

a. What is the approximate wavelength of the radiation of the highest intensity reaching the upper atmosphere?

2 marks

b. With reference to the above graphs, what is the difference between ultraviolet, visible and infrared radiation?

2 marks

c. Most of the energy reaching the surface of the Earth from the Sun is in the visible part of the spectrum. Using the information from the graphs explain why this occurs.

1 mark

d. Name one gas that contributes to absorption of infrared radiation by the atmosphere.

1 mark

e. The wavelength of radiation re-emitted from the Earth's surface is different from that reaching the Earth's surface. Explain how it differs.

2 marks

CONTINUED OVER PAGE

f. Explain the greenhouse effect in terms of the different types of radiation involved. Refer to the graphs in your answer. You may use a diagram if you wish.

3 marks

Total 11 marks

Question 4

a. Give the scientific terms describing two common threats to biodiversity in a population in a large region.

i. _____

_____

ii. _____

_____

2 marks

b. Define each of these scientific terms.

i. _____

_____

_____

ii. _____

_____

_____

2 marks

c. Give an example of the effect of these two threats on a particular population.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

2 marks

Total 6 marks

Question 5

a. Three types of biodiversity are genetic, species and ecosystem diversity. Explain what each term means, showing the different meaning of each term.

genetic _____

_____

_____

_____

species _____

_____

_____

_____

ecosystem _____

_____

_____

_____

3 marks

Use the following information to answer Questions 5b.–5f.

Various statistical calculations are used to measure species diversity. These indices are expressed as a number. One of these is Simpson's index.

For four species, Simpson's index (D) is defined as

$$D = 1 - (p_1^2 + p_2^2 + p_3^2 + p_4^2)$$

where

$$p_1 = \frac{\text{number of individuals of species 1 at the site}}{\text{total number of individuals at the site}}$$

$$p_2 = \frac{\text{number of individuals of species 2 at the site}}{\text{total number of individuals at the site}}$$

$$p_3 = \frac{\text{number of individuals of species 3 at the site}}{\text{total number of individuals at the site}}$$

$$p_4 = \frac{\text{number of individuals of species 4 at the site}}{\text{total number of individuals at the site}}$$

A lower Simpson's index indicates lower biodiversity.

A table is often used to do the calculations for Simpson's index for each site. These tables are reproduced in part **b.**

A biologist is studying frogs in urban areas of Melbourne. She estimates the number of individuals of each species at numerous different sites. The data from two of her sites is presented in the table below.

Species	Number counted at Site A	Number counted at Site B
Crinia signifera	60	210
Limnodynastes tasmaniensis	0	30
Litoria ewingii	40	30
Litoria raniformis	0	30

b. Calculate Simpson's index for each of the sites, using the blank tables provided below. Show working.

Site A Species	No. of Individuals	$p = \frac{\text{No. individuals}}{\text{Total No.}}$	p^2
Crinia signifera	60		
Limnodynastes tasmaniensis	0		
Litoria ewingii	40		
Litoria raniformis	0		
	Total no. =		Total p^2 =

D = 1 – Total p^2 = ____

Site B Species	No. of Individuals	$p = \frac{\text{No. individuals}}{\text{Total No.}}$	p^2
Crinia signifera	210		
Limnodynastes tasmaniensis	30		
Litoria ewingii	30		
Litoria raniformis	30		
	Total no. =		Total p^2 =

D = 1 – Total p^2 = ____

4 marks

c. Explain what these results from part **b.** tell us about the species diversity of the two sites.

2 marks

d. Species richness is another measure of biodiversity. Compare the species richness of the two sites.

2 marks

Litoria raniformis is listed as a 'vulnerable' species in Victoria, while the other three species are at low risk.

e. Explain the term vulnerable.

2 marks

f. How should the environmental management of sites A and B differ because of the conservation categories of the four species?

3 marks

Total 16 marks

Question 6

An isolated population of an endangered species of bird contains 100 birds. Two strategies are suggested for managing the population: **Translocation** (the transfer of some birds to a new habitat); or **Reintroduction** (the removal of a small number of birds for a captive breeding program and reintroducing the captive birds and their offspring into the original population).

a. Describe one advantage and one disadvantage of each of these strategies.

Translocation

Advantage _____

Disadvantage _____

Reintroduction

Advantage _____

Disadvantage _____

4 marks

The two strategies, Translocation and Reintroduction, are evaluated using Population Viability Analysis. Risk is defined as the probability of the population surviving the next twenty years, expressed as a decimal fraction. The overall risk of extinction of two independent populations is found by multiplying the two individual risks together.

Option 1

The first option is to do nothing, in which case the risk of extinction of this population over the next 20 years is 0.2.

Option 2

The second option is translocation of 50 birds from the population to a new, isolated habitat. The risk of extinction for each separate population is now 0.4.

Option 3

The third option is reintroduction of birds from a captive breeding program. In this option, 20 birds are removed from the original population, bred in captivity, and all the captive birds are progressively reintroduced into the original population. This would reduce the risk of extinction of the total population by 0.1, compared to option 1.

b. Calculate the risk of extinction faced by the total population of the species under options 2 and 3.

Show working.

Option 1	0.20
Option 2	
Option 3	

4 marks

c. Describe one other possible management option to protect the population. Give at least one advantage and one disadvantage of this action.

_____

_____

_____

_____

3 marks

Total 11 marks

Question 7

A marine biologist assessed the impact of a sewerage outfall by monitoring a shellfish population that inhabits the nearby shore. She sampled five areas, each of one square metre, before and after the outfall was in use. Her data is shown in Table 2 below.

Table 2

Site	number of shellfish per m^2 before the outfall was in use	number of shellfish per m^2 after the outfall was in use
A	12	5
B	18	10
C	2	15
D	8	3
E	10	8

a. Calculate the mean number of shellfish per m^2 before and after the sewerage outfall was in use.

i. Before

ii. After

2 marks

The standard deviation (measure of spread) before was 8, and after was 6.

The biologist concluded that the outfall had a significant impact on the shellfish population.

b. Do you agree with the biologist's conclusion? Your answer should include reference to the data above, and you should make mention of Type I (falsely rejecting the null hypothesis) and Type II (falsely accepting the null hypothesis) errors.

3 marks

c. Suggest **two ways** of improving the study in order to make a better judgment about the impact of the sewerage outfall on the shellfish population.

method 1 _____

_____

method 2 _____

_____

2 marks

Total 7 marks

END OF QUESTION AND ANSWER BOOK