



**Victorian Certificate of Education
2007**

SUPERVISOR TO ATTACH PROCESSING LABEL HERE

STUDENT NUMBER

Letter

Figures
Words

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ENVIRONMENTAL SCIENCE
Written examination 1

Wednesday 13 June 2007

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

<i>Section</i>	<i>Number of questions</i>	<i>Number of questions to be answered</i>	<i>Number of marks</i>
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 a 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.

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 one of the following is a non-fossil energy source?

- A. coal
- B. oil
- C. uranium
- D. natural gas

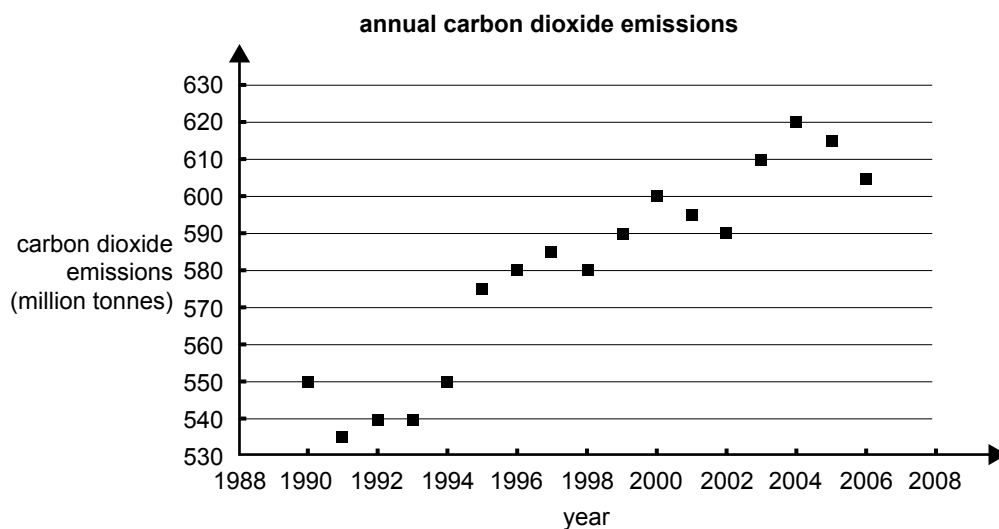
Question 2

Which one of the following is the best description of the enhanced greenhouse effect?

- A. increased warming at the earth's surface due to more ultraviolet radiation passing through the depleted ozone layer
- B. increased trapping of heat in the lower atmosphere caused by rising concentrations of greenhouse gases
- C. atmospheric thickening caused by smoke and other pollutants
- D. the natural rise and fall of global surface temperatures

Question 3

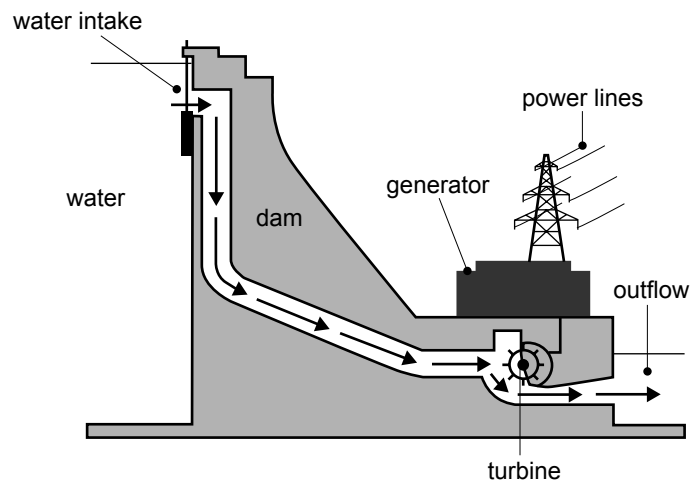
The graph below shows annual emissions of carbon dioxide from a country.



The percentage increase in carbon dioxide emissions from 1990 to 2006 is

- A. 0.10%
- B. 1.0%
- C. 10%
- D. 35%

Questions 4–5 refer to the following diagram of a hydroelectric power station.



Question 4

What type of energy does the water behind the dam represent?

- A. kinetic
- B. potential
- C. electrical
- D. chemical

Question 5

The law of conservation of energy means that the hydroelectric power station

- A. converts all of the water's energy into electricity.
- B. efficiently transforms one type of energy into another.
- C. converts all the water's energy into different forms of energy.
- D. conserves the environment by generating no greenhouse gases.

The following information relates to Questions 6–8.

An engineer is evaluating energy source options for a city. She finds that the following options would be feasible.

Option 1 – A nuclear (uranium) powered generating plant

Option 2 – Wind power generating plant

Option 3 – Natural gas powered generating plant

Question 6

Which one of the following is an **advantage** of the nuclear plant (Option 1) compared with the natural gas plant (Option 3)?

- A. Uranium is a renewable energy source.
- B. Uranium is in plentiful supply in most countries.
- C. A nuclear plant is more acceptable in a populated area.
- D. No carbon dioxide is produced during operation of a nuclear plant.

Question 7

Which one of the following is an **advantage** of natural gas (Option 3)?

- A. It is renewable.
- B. It is non-renewable.
- C. There are many sources worldwide.
- D. It produces no carbon dioxide greenhouse gas emissions when burned.

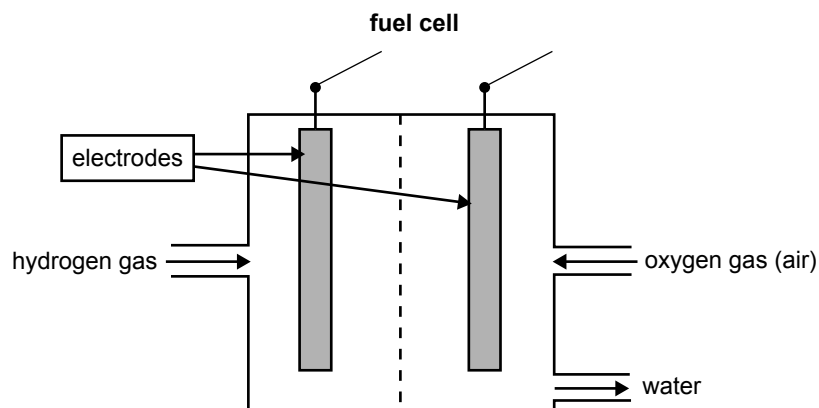
Question 8

Which one of the following is a **disadvantage** of wind power (Option 2)?

- A. It is renewable.
- B. It is non-renewable.
- C. It produces no greenhouse gas emissions.
- D. It will only produce electricity part of the time.

The following information relates to Questions 9–10.

Fuel cells are one way of generating electricity. They are considered a possible method of powering cars. A hydrogen–oxygen fuel cell consists of two electrodes. Hydrogen gas, the fuel, is pumped to one electrode and oxygen gas (air) to the other. The hydrogen and oxygen react in an exothermic reaction to produce water.



Question 9

The term ‘exothermic’ refers to a reaction

- A. in which heat is given out.
- B. in which heat is absorbed.
- C. which proceeds very rapidly.
- D. which requires high temperatures before it begins.

Question 10

Each kilogram of hydrogen gas used (with excess oxygen) contains approximately 13 000 kJ of chemical energy, and in the fuel cell produces 3 500 kJ of electrical energy.

The percentage efficiency of conversion of the fuel cell is

- A. 0.27%
- B. 7.3%
- C. 27%
- D. 73%

Question 11

The Kyoto Protocol is an agreement that ultimately aims to reduce the

- A. amount of carbon dioxide emissions.
- B. energy efficiency of motor vehicles.
- C. use of renewable energy resources.
- D. number of coal-fired power stations.

Question 12

A captive breeding program removes five breeding pairs from a population of a threatened species at Location A. Forty of their offspring are then reintroduced to Location A.

The main outcome of this reintroduction is to increase

- A. population numbers.
- B. ecosystem diversity.
- C. number of species.
- D. genetic diversity.

Question 13

A scientist monitors a population of butterflies in a particular habitat over a period of six years, taking a number of counts at identical times of the day and year. The average number of butterflies recorded for each year is given in the following table.

2001	2002	2003	2004	2005	2006
80	82	78	84	83	81

The scientist concludes that the population is threatened, since it decreased over the period 2004–2006.

Which one of the following statements could best be made about the scientist's conclusion?

- A. The data does not support his conclusion, because the variation from 2004–2006 is less than the expected random variation from year to year.
- B. The data does not support his conclusion, because the overall numbers are too small.
- C. The data supports his conclusion, because the population declined from 2004–2006.
- D. There is insufficient information to draw any conclusion.

Question 14

A species whose conservation category is 'critical' is one which is considered likely to

- A. become rare within the next century.
- B. eventually become threatened or vulnerable.
- C. soon become extinct in all or part of its range.
- D. remain abundant in some areas but be locally extinct in other areas.

Question 15

Genetic diversity within a population refers to the

- A. variety of populations in a diverse area.
- B. ability of a mating pair to produce viable offspring.
- C. range of genetic variation between different populations.
- D. range of genetic variation among individuals within the population.

Question 16

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 between genetically similar individuals.

Question 17

In Victoria, the conservation status of the Striped Legless Lizard is 'endangered', while the Swamp Skink is regarded as 'vulnerable'.

This means that the Striped Legless Lizard

- A. is in competition with the Swamp Skink.
- B. will survive for longer than the Swamp Skink.
- C. has a population size smaller than the Swamp Skink.
- D. is at greater risk of extinction than the Swamp Skink.

Question 18

The Forty-spotted Pardalote is a small insect-feeding bird that occurs only in southeastern Tasmania, where it is rare and lives in eucalypt forests.

This is an example of a species that is

- A. endemic to Tasmania.
- B. at risk from genetic swamping.
- C. protected under the Ramsar Convention.
- D. an important pollinator of eucalypt forests.

Question 19

The main goal of the CITES Convention is to ensure that

- A. only healthy animals are traded between member countries.
- B. international trade in wild animals and plants does not threaten their survival.
- C. the economic benefits of trade are shared by poorer countries.
- D. limits are set on the number of endangered species that can be exchanged between zoos.

Question 20

A small population of an indigenous animal species has survived for many years in a large but isolated habitat. A large number of individuals of the same species from a different population move into the habitat.

The genetic consequence of this is likely to be

- A. inbreeding.
- B. genetic swamping.
- C. genetic crowding.
- D. overpopulation.

SECTION B – Short answer questions**Instructions for Section B**

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

Question 1

The average temperature at the earth's surface level is determined by the greenhouse effect, both natural and enhanced. This temperature has varied considerably over thousands of years.

- a. For each of the changes **i.–iii.** below you should
- identify the likely effect on surface temperature on earth, and
 - explain how this change occurs in terms of the mechanism of the greenhouse effect. Where relevant, your explanation should include reference to the different types of radiation (ultraviolet, visible, infrared) and their interaction with the atmosphere.
- i. A decrease in the sun's energy output

Temperature would be (circle correct answer) **LOWER** **UNCHANGED** **HIGHER**

Explanation _____

- ii. An increase in carbon dioxide concentration in the atmosphere

Temperature would be (circle correct answer) **LOWER** **UNCHANGED** **HIGHER**

Explanation _____

iii. A decrease in the ozone layer in the stratosphere

Temperature would be (circle correct answer) **LOWER** **UNCHANGED** **HIGHER**

Explanation _____

3 + 3 + 3 = 9 marks

b. Explain the difference between the **natural** and **enhanced** greenhouse effects.

2 marks

c. Explain the impact of the **enhanced** greenhouse effect on life on earth.

2 marks

Total 13 marks

Question 2

- a. A student makes the following statement: 'Fossil fuels are non-renewable, while non-fossil fuels are all renewable'. Explain why this statement is incorrect. Give one example to support this.

3 marks

- b. Name a fossil and non-fossil energy source you have studied this year and explain whether each is renewable or non-renewable.

Fossil _____

Non-fossil _____

4 marks

- c. Describe how the **fossil energy** source named in **part b.** is used to meet the need of a specific geographic location, city or region. You should include advantages and disadvantages of this energy source for the particular application.

4 marks

- d. Describe how the **non-fossil** energy source named in **part b.** is used to meet the need of a specific geographic location, city or region. You should include advantages and disadvantages of this energy source for the particular application.

4 marks

Total 15 marks

Question 3

a. Explain the meaning of the term 'biodiversity'.

2 marks

b. Outline two ways in which biodiversity is significant to human survival and wellbeing.

3 marks

c. Name a threatened species that you have studied this year.

Briefly describe a specific population of this species. Include its location, habitat and the main threats to this population of the species.

4 marks

- d. Which conservation category does this species belong in? Explain why.

3 marks

- e. Describe a management strategy to protect this species and a method of monitoring the success of this management strategy.

5 marks

Total 17 marks

Question 4

The Spotted Tree Frog is a critically endangered species. It is found mostly to the northwest side of the Great Dividing Range between the Central Highlands in Victoria and Mt Kosciusko in New South Wales. These frogs inhabit vegetation along the banks of fast flowing, rocky mountain streams in moist woodlands.



Introduced (exotic) fish species such as trout eat the eggs and tadpoles (young frogs) of the Spotted Tree Frog.

An ‘exotic fish exclusion’ management strategy has been implemented. The strategy aims to reduce predation by introduced fish species. The strategy involves placing barriers to prevent trout and other exotic species moving up the stream.

To evaluate the effectiveness of this exotic fish exclusion strategy, the abundance of Spotted Tree Frogs was measured in eight survey sites in the Central Highlands of Victoria both before and after implementation of the strategy.

Each survey site was 50 m × 50 m (0.25 hectares) in area.

The total streamside area of the region of the Central Highlands under study is 300 hectares.

The survey results are shown in the following table.

Abundance of Spotted Tree Frog before implementation	Abundance of Spotted Tree Frog after implementation
6	3
5	5
2	7
3	2
6	2
3	6
3	4
4	3

- a. Describe one possible advantage **and** one possible disadvantage of implementing this strategy.

2 marks

- b. Estimate the total number of Spotted Tree Frogs in the **entire** streamside area (300 hectares) of the region of the Central Highlands under study before implementation of the exotic fish exclusion management strategy. Show your calculations.

2 marks

- c. Based on the data provided, explain whether the management strategy was successful. Justify your response using the data.

3 marks

- d. The Spotted Tree Frog has been listed under the *Flora and Fauna Guarantee Act 1988*. Describe **one** major action that is a consequence of this listing.

2 marks

Total 9 marks

Question 5

In assessing species diversity, both the number of species and their relative abundance in a habitat are important.

Often simple indices are used to assess the species diversity of a habitat. Susan develops a simple index to determine whether species diversity is increasing or decreasing in particular habitats.

This index (S) combines both number of species and their relative abundance. It is given by

$$S = \frac{\text{sum of difference of each species from the mean (absolute/positive value)}}{\text{number of species}}$$

A **lower** value of S indicates a greater species diversity.

In studying a particular habitat, X, the following data was found.

	1995		2000	
	Number	Difference from mean	Number	Difference from mean
Species 1	80	20	60	0
Species 2	40	20	30	30
Species 3	70	10	40	20
Species 4	80	20	160	100
Species 5	30	30	30	30
Species 6	60	0	40	20
Total number	360		360	
Mean	60		60	

$$\begin{aligned} \text{Susan's index} &= \frac{20 + 20 + 10 + 20 + 30 + 0}{6} &= \frac{0 + 30 + 20 + 100 + 30 + 20}{6} \\ &= 100/6 = 16.7 &&= 200/6 = 33.3 \end{aligned}$$

Susan argues that the index indicates that the species diversity of the habitat has decreased significantly over the five-year period.

Bob argues that the total number of individuals is the same (360), and the number of species the same (6), and that the species diversity has not decreased.

a. Is Susan or Bob correct? Explain your response.

4 marks

To assess the change in species diversity of a different habitat, Y, Susan counts the number of individuals of each species in the habitat three years apart. The data is shown below.

	2001	2004
Species A	10	5
Species B	20	10
Species C	30	70
Species D	30	10
Species E	10	5

- b. Calculate the mean (average) number of individuals per species for the years 2001 and 2004.

2001

2004

2 marks

- c. Calculate Susan's index for each year. Show your working clearly.

	2001		2004	
	Number	Difference from mean	Number	Difference from mean
Species A				
Species B				
Species C				
Species D				
Species E				
Total number				
Mean				

Susan's index =

Susan's index =

2001

2004

5 marks

- d. Evaluate the usefulness of Susan's index for comparing species diversity change in habitats. You should use in your answer the sets of data provided in both case studies (pages 16 and 17).

5 marks

Total 16 marks