



Victorian Certificate of Education 2010

SUPERVISOR TO ATTACH PROCESSING LABEL HERE

STUDENT NUMBER

Letter

Figures

Words

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ENVIRONMENTAL SCIENCE

Written examination 1

Wednesday 9 June 2010

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 22 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 of the following groups contains only examples of renewable energy sources?

- A. hydroelectric, coal, wind
- B. nuclear, natural gas, solar
- C. solar, wind, hydroelectric
- D. hydroelectric, natural gas, wind

Question 2

Considering the overall global effect, which of the following gases is the most significant contributor to the **natural** greenhouse effect?

- A. methane
- B. water vapour
- C. carbon dioxide
- D. chlorofluorocarbons

Question 3

Which of the following gases has the greatest impact globally on the **enhanced** greenhouse effect?

- A. methane
- B. water vapour
- C. carbon dioxide
- D. chlorofluorocarbons

Question 4

Which of the following lists of energy sources are in order of **increasing** emission of carbon dioxide per unit of energy produced?

- A. biomass, natural gas, coal, nuclear
- B. biomass, natural gas, nuclear, coal
- C. nuclear, biomass, coal, natural gas
- D. nuclear, natural gas, biomass, coal

Question 5

Figure 1 shows the atmospheric concentrations of CO₂ as measured at a particular location over the period 1960–2008.

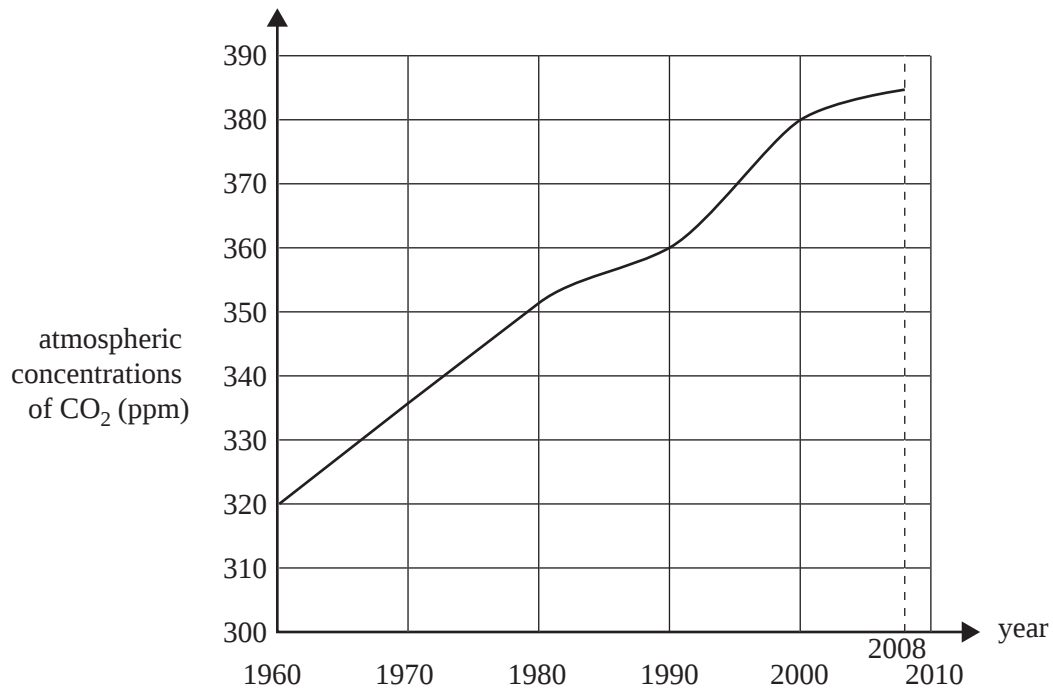


Figure 1

The percentage increase in atmospheric concentrations of CO₂ from 1960 to 2000 is closest to

- A. 12%
- B. 17%
- C. 19%
- D. 22%

The following information relates to Questions 6–8.

Figure 2 shows Earth's atmosphere (not to scale).

The arrows P, Q, R, S represent types of incoming radiation.

The arrows X and Y represent outgoing radiation.

Dotted lines indicate radiation being absorbed in the atmosphere.

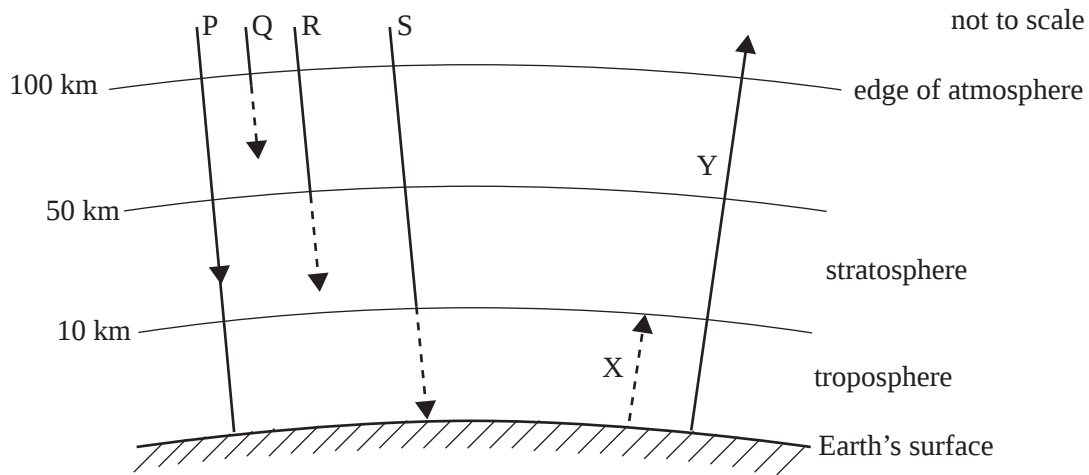


Figure 2

Question 6

Which of the following options best identifies the type of incoming radiation?

	ultraviolet	visible	infrared
A.	S	R	Q
B.	R	Q	S
C.	R	P	S
D.	S	R	P

Question 7

Which of the following options best identifies the type of outgoing radiation?

	ultraviolet	visible	infrared
A.	X	X	Y
B.	none	Y	X
C.	Y	X	Y
D.	none	Y	none

Question 8

Which of the following options correctly links each gas with the radiation that each gas predominantly absorbs?

	carbon dioxide	water vapour	stratospheric ozone
A.	UV	IR	visible
B.	visible	UV	IR
C.	IR	UV	IR
D.	IR	IR	UV

The following information relates to Questions 9–11.

1 tonne = 1000 kg

kilo (k) = 10^3

mega (M) = 10^6

A thermal electricity generating plant is powered by coal. Each kilogram of the particular quality of coal used produces 5 MJ of energy.

Question 9

Burning of coal in the boiler is the first step in the process of generating electricity.

This burning of coal in the boiler is best described as

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

Question 10

The boiler burns approximately 50 tonnes of coal per hour.

Which of the following is the best estimate of the coal energy used per hour?

- A. 2.5×10^9 MJ
- B. 1.8×10^7 MJ
- C. 2.5×10^5 MJ
- D. 1.8×10^3 MJ

Question 11

When burning 50 tonnes of coal per hour, the output of the electricity generator is 25 MJ per second.

The percentage efficiency of the whole power station is closest to

- A. 0.01%
- B. 0.36%
- C. 3.6%
- D. 36%

The following information relates to Questions 12–16.

The Southern Bent-wing Bat is a medium-sized bat which stays in caves during the day and hunts for insects in forests and wetlands at night.

Question 12

A group of scientists has monitored a population of the Southern Bent-wing Bat in a small cave system over a seven-year period. The number of bats estimated for each year is given in the table below.

Year	2002	2003	2004	2005	2006	2007	2008
Number	110	110	115	122	110	110	114

The average population size living in the cave system over the seven-year period is best calculated as

- A. 110
- B. 111
- C. 112
- D. 113

Question 13

The probability (calculated risk) of extinction of this Southern Bent-wing Bat population over the next fifteen years is estimated to be 0.70. A larger population in a second separate cave system has a probability of extinction estimated to be 0.20 over the same period.

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

- A. 0.14
- B. 0.27
- C. 0.50
- D. 0.97

Question 14

The Southern Bent-wing Bat roosts and breeds only in caves and mine shafts in southeastern South Australia and southwestern Victoria.

This means that the species

- A. has a wide variety of habitats.
- B. is at risk of genetic swamping.
- C. is endemic to this region of Australia.
- D. needs demographic variation to occur to maintain population size.

Question 15

The total population of the Southern Bent-wing Bat has declined consistently from approximately 125 000 in 1964, to about 40 000 in 2004.

It is likely that a decline of such numbers would have resulted in the conservation category of the species being reclassified from

- A. critical to vulnerable.
- B. critical to endangered.
- C. endangered to critical.
- D. endangered to vulnerable.

Question 16

A number of reasons are suggested for the declining numbers of the Southern Bent-wing Bat.

The reasons include

- clearing of forest habitats
- disturbance of breeding sites by tourists
- decrease in the insects the bats feed on due to pesticide use.

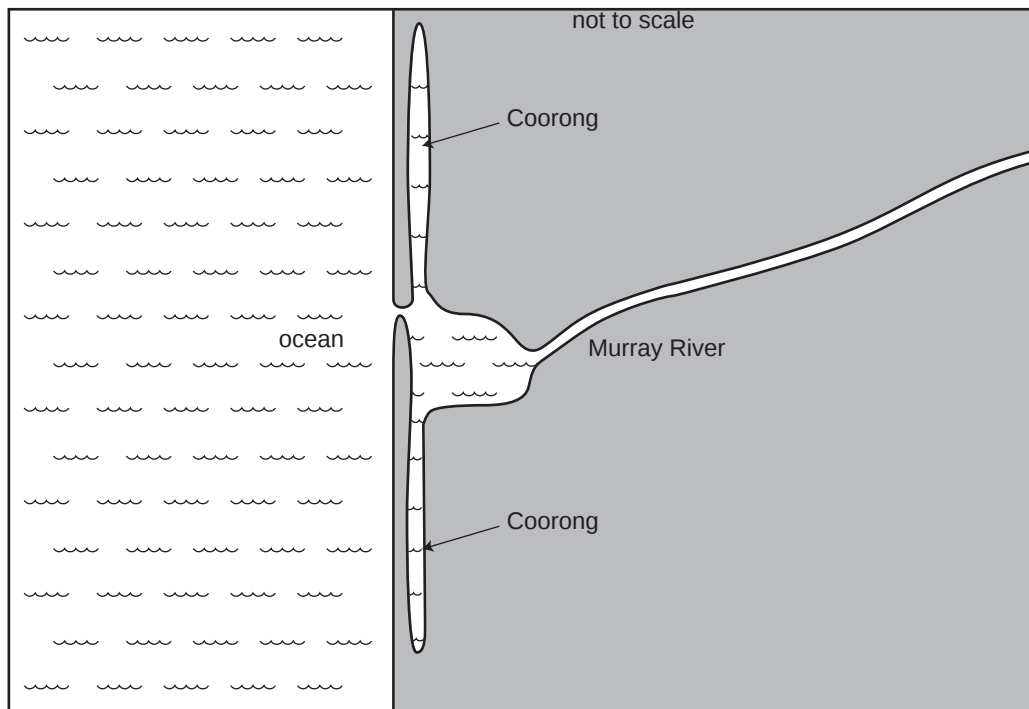
However, scientists lack data to identify the specific cause.

In response to this lack of data, the precautionary principle would most strongly suggest that

- A.** a captive breeding program should be established to rebuild species diversity.
- B.** authorities should still develop and implement strategies to address each of the possible causes.
- C.** there is little that can be done to deal with the decreasing population, since the cause is unknown.
- D.** the scientists should undertake further investigation to identify the main threat and write a risk assessment report.

The following information relates to Questions 17–20.

The Coorong is a long, shallow lagoon in South Australia that stretches more than 100 kilometres. The Coorong is separated from the Southern Ocean by narrow sand hills. Australia's longest river, the Murray, flows into the Coorong.



The Coorong has a unique arrangement of 23 types of wetland and provides habitats for nationally threatened species such as the Orange-bellied Parrot, the Southern Mount Lofty Ranges Emu-wren and the Murray Cod. The Coorong is a major transit point for water birds that are migrating from their winter feeding grounds to their breeding grounds overseas.

The area is currently used for recreational fishing, camping, boating, walking, wildlife observation and scientific research.

Since the 1930s, high volumes of water have been extracted (removed) from the Murray River for human use leaving insufficient water for the environment. Salinity in the Coorong has increased due to decreased freshwater flows from the Murray River. More recently, extended drought has added to the ecological stress of the site.

Question 17

The main aim of conservation planning for the Coorong wetlands should be to

- A. preserve the environment in its original state.
- B. ensure the short-term sustainability of the environment.
- C. actively manage the environment for optimal extraction of mineral resources.
- D. manage or regulate use of the environment so that it does not exceed the capacity of the species or ecosystem to be renewed.

Question 18

Which of the following treaties most strongly mandates protection for the Coorong?

- A. CITES
- B. Kyoto Protocol
- C. Ramsar Convention
- D. National Greenhouse Strategy

Question 19

To assess the species diversity of the Coorong wetlands, three factors related to the environment need to be evaluated.

Which of the following groups best identifies these factors?

A.	Variety of species found	Number of threatened species	The degree of inbreeding
B.	Variety of species found	The relative abundance of each species	The size of populations
C.	Number of exotic species	Number of threatened species	The relative abundance of each species
D.	Types of ecosystems in the area	The climate of the area	The size of populations

Question 20

The Coorong wetlands are valuable for ecosystem function and human survival.

Which of the following correctly shows an ecosystem service, a biological resource and a social benefit?

	ecosystem service	biological resource	social benefit
A.	Nursery for protection of small fish as they develop	Trapping of sediment and nutrient recycling	Wildlife observation and scientific research
B.	Trapping of sediment and nutrient recycling	Nursery for protection of small fish as they develop	Camping and boating
C.	23 types of wetland	Recreational fishing for Murray Cod	Nursery for protection of small fish as they develop
D.	Habitat of tea-tree shrublands and native grasslands	Trapping of sediment and nutrient recycling	Walking and wildlife observation

SECTION B**Instructions for Section B**

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

Question 1

Name a **fossil** fuel energy source you have studied. _____

Name a **non-fossil** fuel energy source you have studied. _____

You should use these two sources in answering Questions 1a. to d.

You have been asked to design the electricity supply for a city of 100 000 people.

- a.** Describe the steps involved in using your nominated fossil fuel source to provide electricity to the homes and industries in the city.

4 marks

- b.** Describe the steps involved in using your nominated non-fossil fuel energy source to provide electricity to the homes and industries in the city.

4 marks

-
-
-
-
-
-

[illegible]

SECTION B – continued
TURN OVER

Question 2

- a.** Australia is currently very dependent on non-renewable energy sources. Many people are concerned about the decreasing availability of these non-renewable energy sources.

Name three non-renewable energy sources. Outline to what degree they currently contribute to Australia's energy needs.

i. _____

ii. _____

iii. _____

1 + 3 = 4 marks

b. Describe the accessibility of each of these three non-renewable energy sources.

i. _____

ii. _____

iii. _____

3 marks

c. Name two renewable energy sources.

i. _____ ii. _____

Explain how these renewable energy sources could be integrated into Australia's current energy use to extend or replace non-renewables.

In your answer mention any difficulties that would have to be dealt with.

4 marks

The use of scientific data is important for developing strategies to protect the habitats of threatened species and to preserve their populations.

- c. Describe a process of gathering data that has been used for the planning of the conservation of your nominated threatened species.

3 marks

- d. Describe a strategy or management plan developed to protect your nominated species. State how this plan addresses the threat to the population and its habitat.

4 marks

- e. Explain how scientific data was used in the evaluation of the strategy or management plan.

3 marks

SECTION B – continued
TURN OVER

Question 4

The Grey-crowned Babbler is an endangered species in Victoria. It is listed under the *Flora and Fauna Guarantee Act 1988*. Babblers are birds that live in family groups of 3 or more individuals. Northeastern Victoria is an important region for the Grey-crowned Babbler. They live in remnant wooded vegetation among farmland, such as along roadsides.

Chris, a conservation manager, worked with local farmers to implement a management plan to improve habitat for this endangered species. She considered two areas, A and B. In Area A revegetation was carried out over five years. Trees and shrubs were planted to fill gaps and widen the vegetation along roadsides and across the corners of paddocks next to roadside vegetation. No revegetation was carried out in Area B.

In 2000, before starting the management, Chris carried out surveys in each of the two areas, A and B. She counted the number of birds in each family group in each area. She repeated these surveys in 2009. The data in Table 1 below shows the number of individuals in each group of Grey-crowned Babblers that Chris counted in her surveys in 2000 and again in 2009.

For example, in Area A in 2000, she recorded 5 groups of babblers which had 5, 3, 4, 6 and 4 individuals respectively in each group.

Table 1

	Area A (revegetation)		Area B (no revegetation)	
	2000	2009	2000	2009
Group 1	5	5	5	4
Group 2	3	6	5	5
Group 3	4	6	4	3
Group 4	6	5	3	5
Group 5	4	4	5	
Group 6		5		
Group 7		6		
Group 8		7		
Average number of individuals	4.4	5.5		

After carrying out the surveys in 2009, Chris believed that the number of groups of babblers had increased since 2000, and that the average size of groups (number of individuals present) was larger than in 2000.

- a. Table 2 below shows the average size of babbler groups in Area A. Calculate the average size of babbler groups in Area B in 2000 and 2009, showing your working.

Table 2

Average group size in Area A in 2000	4.4
Average group size in Area A in 2009	5.5
Average group size in Area B in 2000	
Average group size in Area B in 2009	

2 marks

- b. Evaluate the evidence and discuss whether it supports Chris's opinion that there were more groups of babblers in 2009 than in 2000, and that the average size of babbler groups had increased in the period from 2000 to 2009.

3 marks

- c. Chris concluded that the management plan to improve habitat for the Grey-crowned Babbler had been successful. However, one of her colleagues disagreed. The colleague argued that any change in populations of the Grey-crowned Babbler between 2000 and 2009 was due to variation in the climate and its effect on food availability for the babblers. Outline the evidence and reasoning that Chris could use to support her conclusion that changes in babbler populations were the result of the management program.

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3 marks

- d.** What could Chris have done differently in her surveys to strengthen her conclusions?

2 marks

- e. When a species such as the Grey-crowned Babbler is listed under the *Flora and Fauna Guarantee Act 1988*, an Action Statement must then be prepared. What should an Action Statement include?

3 marks

Question 5

A scientist, Dale, carried out surveys of frogs in three regions in East Gippsland, Victoria, as part of an environmental impact assessment. Each region, 20 km² in size, was allocated three days and nights for the survey and the team searched for frogs in the range of ecosystems present in the region (forests, streams, wetlands, swamps and other ecosystems). The surveys were conducted in spring. The weather was fine and sunny during the surveys in regions X and Y, but there were two days of heavy rain while the team was surveying region Z. The number of frogs recorded in each region is shown in Table 3 below.

Three measures are commonly used to describe aspects of biodiversity.

Species richness refers to the number of different species.

Abundance refers to the total number of individuals of each species.

Species diversity is a measure that incorporates the species richness (number of species) and the relative abundance of each. A quantitative index is often used to calculate species diversity.

Table 3: Number of frogs recorded during surveys in three regions in East Gippsland

Species	Conservation status	Region X	Region Y	Region Z
Southern Brown Tree Frog	not threatened	8	10	35
Leaf Green Tree Frog	not threatened	7	3	
Lesueur's Tree Frog	not threatened	4		
Green and Golden Bell Frog	vulnerable		2	
Common Froglet	not threatened	15	11	75
Eastern Banjo Frog	not threatened	5	9	20
Spotted Marsh Frog	not threatened	9		10
Striped Marsh Frog	not threatened	4		10
Southern Barred Frog	critical		5	
Giant Burrowing Frog	vulnerable	2		

- a. List the regions X, Y, Z in order of descending species richness.

highest _____

middle _____

lowest _____

2 marks

- b. Dale uses Simpson's Index as a measure of species diversity of the frogs in each region. Simpson's Index (D) is defined as

$$D = 1 - (p_1^2 + p_2^2 + p_3^2 + p_4^2 + p_5^2 + p_6^2 + p_7^2 + p_8^2 + p_9^2 + p_{10}^2) \text{ for 10 species}$$

$$\text{where } p_1 = \frac{\text{number of individuals of species 1 in region}}{\text{total number of individuals in region}}$$

By using Simpson's Index, he calculated the species diversity of region X to be 0.838 and of region Z to be 0.67.

Using Table 4 below, calculate Simpson's Index for region Y.

Table 4: Region Y

Species	No. of individuals	$p = \frac{\text{No. of individuals of this species}}{\text{Total no. in region Y}}$	p^2
Southern Brown Tree Frog	10		
Leaf Green Tree Frog	3		
Lesueur's Tree Frog	0		
Green and Golden Bell Frog	2		
Common Froglet	11		
Eastern Banjo Frog	9		
Spotted Marsh Frog	0		
Striped Marsh Frog	0		
Southern Barred Frog	5		
Giant Burrowing Frog	0		
	Total no. =		Sum of p^2 =

Simpson's Index (D) = $1 - \text{Sum of } p^2 =$

3 marks

- c. The survey is to be part of an environmental impact assessment of the conservation values of each region. Considering all the data, discuss the relative importance of each region for the conservation of frog species, identifying which region you consider requires the greatest protection. Justify your answer using information from Table 3 and your calculations from Table 4. Include an evaluation of which region should be given priority for protection.

This image shows a single page from a notebook or ledger. It features approximately 20 evenly spaced horizontal grey lines across its entire width. The lines are thin and light-colored, providing a guide for writing without being distracting. There are no vertical margin lines, headers, footers, or other markings present on the page. The background is a uniform off-white color.

6 marks

