



# Victorian Certificate of Education

## 2007

SUPERVISOR TO ATTACH PROCESSING LABEL HERE

### STUDENT NUMBER

Figures

Words


Letter

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# ENVIRONMENTAL SCIENCE

## Written examination 2

Thursday 22 November 2007

Reading time: 9.00 am to 9.15 am (15 minutes)

Writing time: 9.15 am to 10.45 am (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 21 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 question and answer 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**

The term dosage refers to the

- A. concentration of the pollutant in the environment.
- B. length of time the pollutant persists in the environment.
- C. amount of the pollutant required to cause harm in an organism.
- D. amount of the pollutant absorbed by an organism per unit of body mass.

**Question 2**

Insecticides are best applied to fields of crops on days with low wind speeds and low temperatures.

This is to account specifically for the insecticide's

- A. airborne transport mechanism and solubility in water.
- B. airborne transport mechanism and high rate of evaporation.
- C. bioaccumulative potential and solubility in water.
- D. bioaccumulative potential and high rate of evaporation.

**Question 3**

*Belladonna* is a toxic weed commonly found in gardens.

Although human deaths linked to *Belladonna* are generally very few, increased toxicity may occur if leaves from this plant are ingested along with some medications.

This is an example of

- A. synergistic action.
- B. bioaccumulation.
- C. chronic toxicity.
- D. acute toxicity.

**Question 4**

PCBs (polychlorinated biphenyls) are a health risk to humans due to bioaccumulation.

Which one of the following properties contributes most to bioaccumulation?

- A. high volatility
- B. solubility in water
- C. solubility in fatty tissues
- D. artificial manufacture by industry

**Question 5**

Acute toxicity from a pollutant refers to

- A. harmful effects due to the pollutant's long-term persistence in the environment.
- B. harmful effects of a single dose of the pollutant.
- C. the health effects of breathing the pollutant over a long period.
- D. the length of time during which a person is exposed to the pollutant.

**Question 6**

Chronic toxicity from a pollutant refers to

- A. breathing in a large amount of the pollutant.
- B. the harmful effects of repeated doses of the pollutant.
- C. the immediate symptoms of breathing the pollutant.
- D. the length of time a person is exposed to the pollutant.

*The following information relates to Questions 7–9.*

Obsolete electronic devices, such as outdated computers and mobile phones, are known as 'e-waste'.

Disposing of e-waste is hazardous to environmental and human health, because it contains a variety of toxic substances such as cadmium, arsenic and lead. Cadmium is a heavy metal with similar properties to mercury.

**Question 7**

Cadmium is toxic to humans as it

- A. dissolves readily in water.
- B. is very dense.
- C. bioaccumulates in body tissue.
- D. has low persistence in the environment.

One environmental scientist has proposed three possible solutions to address the issue of e-waste.

- establishing more long-term enclosed landfills
- increasing the charges for disposing of waste in existing long-term enclosed landfills
- developing more high-technology recovery and recycling centres

**Question 8**

The high-technology recovery and recycling centre is likely to be a successful solution as it will reduce the

- A. cost of mobile phone calls.
- B. number of mobile phones being disposed of.
- C. number of mobile phones being manufactured.
- D. amount of e-waste being released into the environment.

**Question 9**

Increasing the charges for the disposal of toxic waste is likely to increase ecological sustainability by

- A. increasing income for local authorities.
- B. leading to the opening of more landfill sites.
- C. leading to illegal dumping in remote areas.
- D. encouraging development of recycling methods which are currently uneconomic.

The following information relates to Questions 10 and 11.

Exposure to sulfur dioxide in the air can cause both acute and chronic effects. Exposure to very high levels can be life threatening. Acute exposure may lead to dryness of the nose and throat, sneezing, coughing and eye problems.

Chronic exposure may lead to permanent breathing damage.

A study of air quality in a large city examined the link between daily death rates and atmospheric concentrations of sulfur dioxide and airborne particles. The results from 12 days of the study are presented in Figure 1.

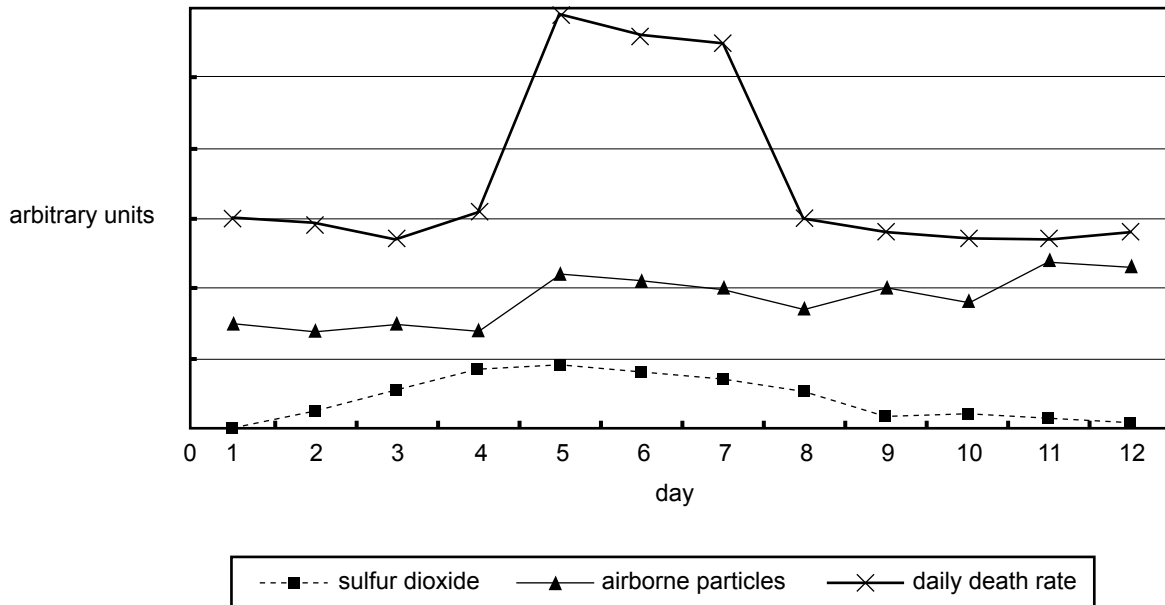


Figure 1. Air pollution and death rates

### Question 10

Which one of the following **best** describes the results from the air quality study as presented in Figure 1?

- A. High concentrations of sulfur dioxide lead to the highest death rates.
- B. High concentrations of airborne particles lead to the highest death rates.
- C. The highest death rates happen when both concentrations of sulfur dioxide and airborne particles are high.
- D. There is no link between pollutant concentrations and daily death rate.

### Question 11

The effect of sulfur dioxide and airborne particles on death rates found during the air quality study is best described as

- A. not significant.
- B. bioaccumulation.
- C. synergistic action.
- D. pollutant specificity.

*The following information relates to Questions 12–17.*

An old water storage dam is to have its dam wall repaired.

To access the dam wall for repairs, a large amount of water stored in the dam needs to be released into a river.

**Question 12**

In releasing the water into the river, which one of the following environmental consequences will most likely need to be avoided?

- A. erosion
- B. evaporation
- C. dryland salinity
- D. increased salinity in the river

**Question 13**

In developing an Environmental Risk Assessment for the project, which of the following groups would not usually need to be consulted?

- A. ecotourists
- B. local residents
- C. local irrigators
- D. local government

**Question 14**

The main purpose of the Environmental Risk Assessment is to

- A. ensure maximum local employment on the project.
- B. eliminate any disruption to the environment during repair.
- C. minimise the number of people likely to object to the project.
- D. balance any environmental damage against the benefit of the repair.

**Question 15**

Which one of the following factors **best** indicates that the dam repair is ecologically sustainable?

- A. disruption to local wildlife is temporary
- B. employment is created during the repair project
- C. habitat of endemic threatened populations has been disturbed
- D. previously submerged heritage buildings can be investigated

**Question 16**

After the dam is repaired, it is found that soil sediments in the flood plain of the river contain significant levels of phosphorus which were not present before the water release.

A scientist suggests that this can be corrected by planting a particular type of vegetation that absorbs and bioaccumulates phosphorus from the soil.

This is an example of

- A. recycling.
- B. soil bioremediation.
- C. water conservation.
- D. waste minimisation.

**Question 17**

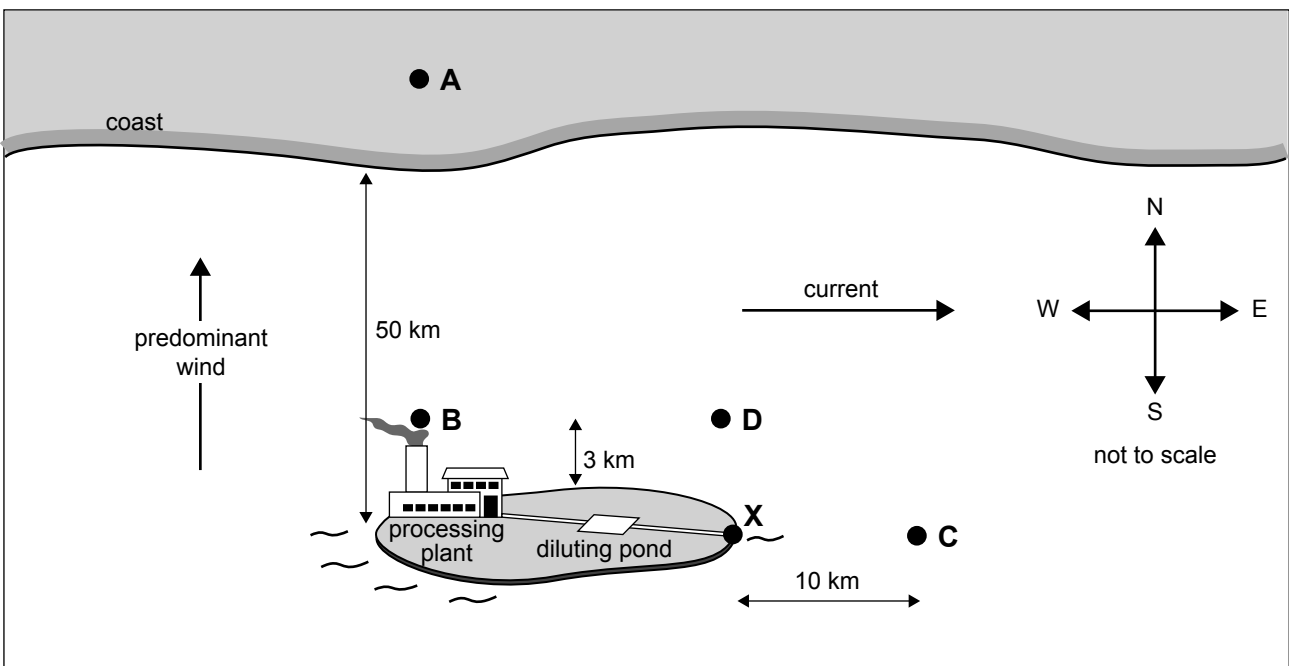
After completion of the work, a scientist conducts an evaluation of the effectiveness of the Environmental Management Plan for the project.

Which one of the following would be evidence for the success of the Environmental Management Plan?

- A. The dam no longer leaked.
- B. The work came in under budget.
- C. No native animals were disturbed during the work.
- D. Two years later, the ecology of the area downstream of the dam is similar to the ecology before the work was done.

*The following information relates to Questions 18–20.*

A mining operation, which also includes some preliminary processing, is conducted on a small island 50 km south of a coastline. This is shown below in Figure 2. A strong west to east current flows along the coast. The predominant wind is from the south.



**Figure 2**

Two pollutants are released into the environment from the island.

- sulfur dioxide from the high chimney at the processing plant into the air
- a highly soluble liquid waste, diluted in the pond and then released once per day into the sea at point X

**Question 18**

At which one of the following locations in Figure 2 would you expect to observe the largest concentration of sulfur dioxide?

- A. on the coast – location A
- B. 3 km north of the island – location B
- C. 10 km east of the island – location C
- D. 4 km north of the point X – location D

**Question 19**

At which one of the following locations in Figure 2 would you expect to observe the largest concentration of the liquid waste?

- A. on the coast – location A
- B. 3 km north of the island – location B
- C. 10 km east of the island – location C
- D. 4 km north of the point X – location D

**Question 20**

45 kg of the liquid waste is produced each day. Before release, the daily liquid waste is diluted by mixing with water in a 12 000 L (litre) pond, and then the mixture released once per day into the sea at point X.

The concentration, g/L (grams per litre), in the pond immediately before release is best given by

- A. 0.267 g/L
- B. 3.75 g/L
- C. 267 g/L
- D. 3750 g/L

**SECTION B – Short answer questions**

**Instructions for Section B**

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

**Question 1**

Name a pollutant, other than mercury and sulfur dioxide, you have studied this year.

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a. Describe how this pollutant affects human health.

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3 marks

b. Name a specific situation where this pollutant would be found. Include a description of the situation, and the pollutant's impact on the environment.

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4 marks



- c. In the life cycle of this pollutant, describe
- i. its source, indicating whether it is a diffuse or point source

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- ii. its transport mechanism

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- iii. its natural sink

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2 + 1 + 1 = 4 marks

- d. Name a population of humans or animals affected by this pollutant.

- i. Describe the exposure of this population to the pollutant and the dosage required to cause harm.

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- ii. Describe the steps taken to reduce exposure and dosage.

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2 + 2 = 4 marks

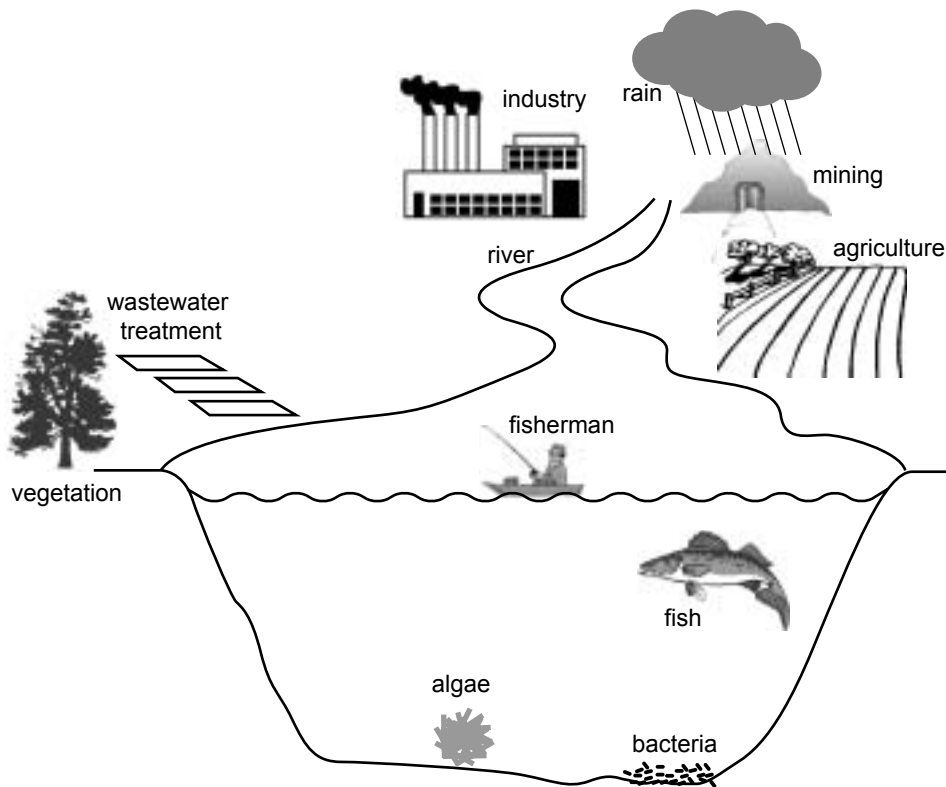


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**Question 2**

Mercury is a pollutant that can be present in the air, in water and in soil. Figure 3 is a diagram of the mercury cycle showing pathways by which mercury enters and leaves a lake.



**Figure 3**

- a. In terms of the chemical and physical properties of mercury, explain how it is a serious pollutant threat to human health.

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3 marks

b. Describe **one** transport mechanism shown in Figure 3 by which mercury reaches the lake.

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3 marks

c. At the bottom of the lake, bacteria transforms the mercury into methyl mercury. Explain why methyl mercury can be a problem for ecosystems.

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3 marks

- d.** In the situation described in Figure 3, would the pollutant you nominated in Question 1 create an environmental problem? Explain why it would or would not.

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4 marks

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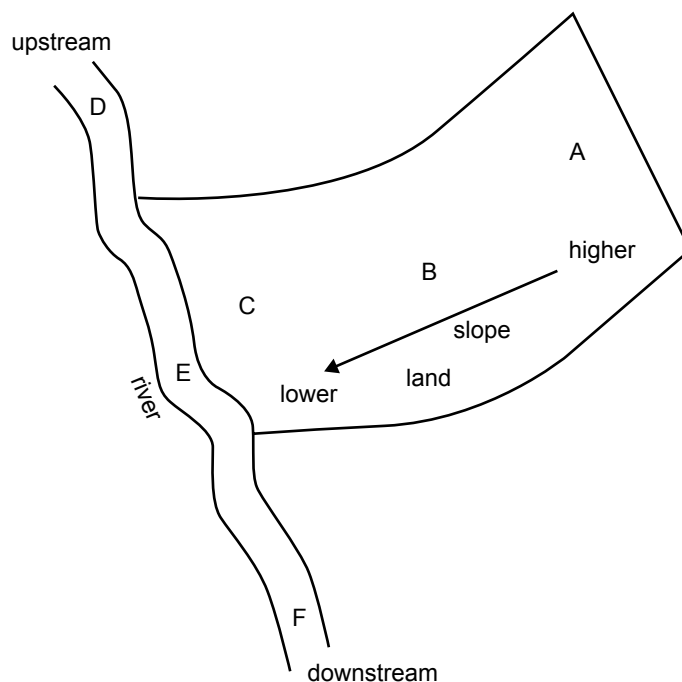
**TURN OVER**

### Question 3

A developer intends to build houses on a large block of land. The land was used by a factory that closed in 1987. The factory, which was at **location A**, released arsenic and the hydrocarbon pollutant cyclohexane into the soil.

Arsenic is a heavy metal with similar characteristics to mercury. Cyclohexane is a volatile liquid, insoluble in water.

The land slopes downwards towards the river, as indicated by the arrow on Figure 4. The river flows from the top of the map to the bottom as indicated in Figure 4.



**Figure 4**

A scientist measured concentrations of the two pollutants in

- topsoil at **locations A, B and C** on land
- river water at **locations D, E and F**.

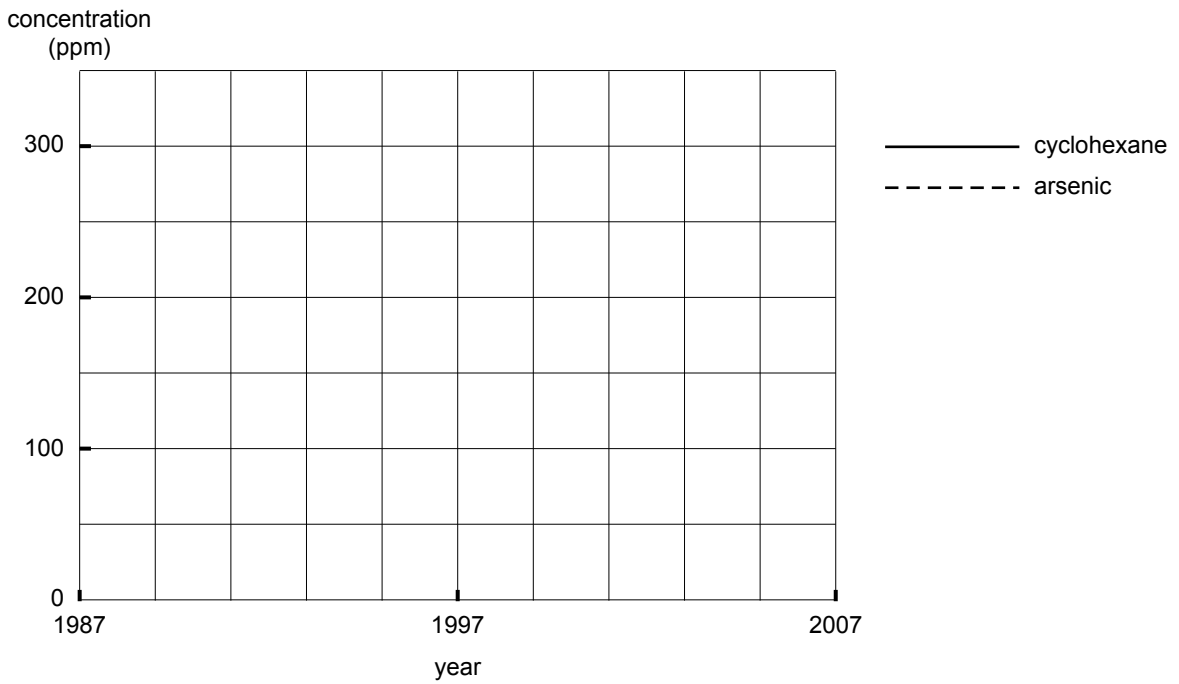
The following table shows her results.

**Table 1**

Location	Cyclohexane concentration (ppm)			Arsenic concentration (ppm)			
	Year	1987	1997	2007	1987	1997	2007
A (soil)		200	30	20	300	285	280
B (soil)		180	25	20	80	70	65
C (soil)		100	15	10	60	50	50
D (water)		undetectable	undetectable	undetectable	0.8	0.5	0.7
E (water)		12	2	1	0.9	0.5	0.8
F (water)		12	3	1	0.8	0.6	0.7



- a. Using the data for **location A** only, draw two lines showing the concentrations of cyclohexane and arsenic, by year, on the graph below.



2 marks

- b. Explain the scientist’s observations for each pollutant as shown in **Table 1**. Your answer should refer to both spatial distribution and time variations.

i. Cyclohexane \_\_\_\_\_

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ii. Arsenic \_\_\_\_\_

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4 + 4 = 8 marks

Total 10 marks

**Question 4**

Name an environmental science project that you have investigated this year.

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- a. Describe this project. Your description should include the aim of the project, its location, and its time frame.

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4 marks

- b. Explain how this project contributes to ecologically sustainable development.

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4 marks

- c. Outline the role or influence of **either** regulatory frameworks **or** interest groups in the development and operation of the project.

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3 marks

- d. Evaluate how effectively the project meets the aim as described in **part a**. You should include evidence to support your evaluation.

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6 marks

Total 17 marks

**SECTION B – continued**

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**Question 5**

Macquarie Island is one of Australia’s Antarctic islands, situated about 1500 km southeast of Tasmania. There are no permanent human inhabitants on Macquarie Island and the only access is by sea.

Macquarie Island is recognised for its rich and diverse animal life and so has been listed as a World Heritage Area. Around 3.5 million seabirds migrate to the island to breed each year. Most of these seabirds are penguins.

Tourist ships have been visiting annually since 1992 and various commercial ecotourism programs have been operating on the island, especially during summer.

Explorers and visitors to Macquarie Island since the 1800s have introduced rats and rabbits. Rabbits cause damage to the environment by digging burrows, resulting in soil erosion and landslides. Rats prey on the eggs and chicks of seabird species.

Monitoring of ecotourism operations has indicated that Rockhopper Penguins are particularly sensitive to nearby human activities associated with research and management programs.

The two greatest threats from visitors to Macquarie Island are the

- introduction of exotic species
- disturbances to the wildlife and environment by humans.

Consequently, the Macquarie Island Management Plan 2006 has outlined that it is essential that the risk of these threats is kept to a minimum.

a. State **two** criteria that any ecotourism activity must meet to be described as ecotourism. Briefly explain how **each** criterion relates to ecotourism activity on Macquarie Island.

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4 marks

A tourist operator proposes to construct a landing strip for small aircraft. This will enable a greater number of tourists to visit without enduring the long and usually rough sea voyage.

Arguments in favour of this proposal include

- more international awareness of Antarctic species
- greater research opportunities for observing the behaviour of migratory species
- allowing more media and camera crews to report from the island
- direct access to Antarctic region from Australia's mainland
- fewer ships arriving will minimise environmental impacts on the coastline
- more comfortable travel to island

Arguments against the proposal include

- environmental cost of fuel used in aircraft greater than for ships (CO<sub>2</sub> emissions)
- land degradation
- greater disturbance to seabirds from noise of aircraft
- would require more accommodation to be built whereas people can sleep overnight on ships
- more visitors would generate more waste which would need to be managed

- b. Using the principles of ecologically sustainable development and the information given, evaluate the arguments for and against the proposal.

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6 marks

Total 10 marks