



Victorian Certificate of Education 2002

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STUDENT NUMBER

Letter

Figures									
Words									

ENVIRONMENTAL SCIENCE

Written examination 2

Friday 22 November 2002

Reading time: 2.00 pm to 2.15 pm (15 minutes)

Writing time: 2.15 pm to 3.45 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	6	6	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 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 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 diffuse source of a pollutant is best described as a source

- A. which requires a secondary transport material to spread the pollutant.
- B. where there is no single point at which the pollutant enters the environment.
- C. where the pollutant is spread through the environment by wandering animals.
- D. where the pollutant is spread evenly from a point to cover the entire environment.

Question 2

The term persistence of a pollutant in the environment refers to the

- A. concentration of the pollutant in the environment.
- B. distance a pollutant spreads in the environment in a given time.
- C. length of time required for the pollutant to disappear from the environment.
- D. measure of the harm a substance can cause to humans and other living organisms in the environment.

Use the following information to answer Questions 3–6.

A truck carrying a toxic chemical crashes off the side of a bridge over a large lake, and the whole load spills into the lake. The chemical is a highly volatile liquid (evaporates very easily).

Question 3

This spill would be considered an example of

- A. a point source.
- B. a pollutant sink.
- C. a diffuse source.
- D. bioaccumulation.

Question 4

The high volatility of the spilt chemical is likely to directly reduce its

- A. toxicity.
- B. persistence.
- C. bioaccumulation.
- D. absorption by humans.

SECTION A – continued

Question 5

Which one of the following represents a pollutant sink for the toxic chemical?

- A. evaporation and dispersion by wind into the atmosphere
- B. the truck that carried the toxic chemical
- C. persistence of the chemical within the lake ecosystem
- D. future replacement by industry of the toxic chemical with more environmentally friendly products

Question 6

A likely transport mechanism for this pollutant could be

- A. parasitic.
- B. waterborne.
- C. spread by birds.
- D. bioaccumulation.

Question 7

Life Cycle Analysis aims to quantify

- A. an estimate of the acceptable risk to human life.
- B. the effect of the pollutant on a living organism.
- C. the impact of the pollutant on a particular ecosystem.
- D. all impacts of the pollutant and its products over its entire time cycle.

Question 8

A train carrying mixed freight is derailed. The application of the Precautionary Principle would require that, in this situation, we

- A. leave the train where it is until all the cargo has rotted away.
- B. assume some of the cargo may be toxic until we have details of the train's cargo list.
- C. send in teams of workers immediately to remove all freight as a precaution against toxicity.
- D. take no precautions to protect the environment until it is certain that there are pollutants on the train.

Use the following information to answer Questions 9 and 10.

A scientist was studying a stream in a mountain area in which gold mining and processing had taken place in previous years. She measured the concentration of cyanide (a substance used in extracting gold) at a particular point in the stream, taking readings over several years. The measure of concentration is ppm (parts per million) or the equivalent unit, μg per g by mass. $1 \mu\text{g} = 10^{-6} \text{ g}$. Her data is shown in the graph below.

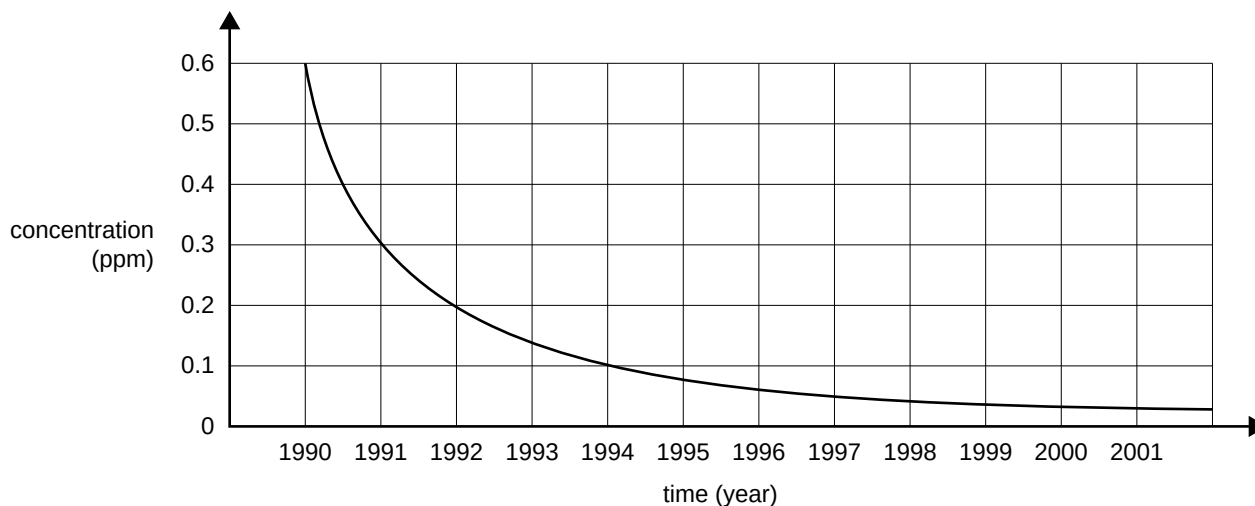


Figure 1. Concentration of cyanide (ppm) versus time (year)

Question 9

What was the change in concentration between 1991 and 1994?

- A. 0.1 ppm
- B. 0.2 ppm
- C. 0.4 ppm
- D. 0.5 ppm

The acceptable concentration of cyanide in water for human consumption in this region is less than 0.1 ppm.

Question 10

In what year could the stream, at that point, be allowed to be first used safely for drinking water?

- A. 1991
- B. 1995
- C. 2000
- D. never; cyanide is a toxic heavy metal

Question 11

Which one of the following is an example of the process of **bioaccumulation**?

- A. decline of ecosystem function because the level of a pollutant increases
- B. development of cancer in a person because they ingested a toxic pesticide
- C. failure of an organism to reproduce successfully because they consumed a pollutant
- D. increase in the amount of chemical in a shellfish because the rate of intake exceeds the rate of removal

Question 12

A development is ecologically sustainable if it

- A. does not cause the extinction of any species.
- B. conforms to environmental regulatory frameworks.
- C. minimises the amount of soil contamination occurring.
- D. can be maintained indefinitely without degradation of the ecosystem.

Question 13

Which one of the following approaches would result in ecologically sustainable development of Victoria's native forests?

- A. a complete ban on logging
- B. logging permitted only when there is a strong demand for wood
- C. logging permitted only every second year
- D. logging limited to the rate of regrowth

Question 14

The main function of Regulatory Frameworks should be to attempt to

- A. balance community needs against environmental damage.
- B. reduce the environmental impact of developmental projects to zero.
- C. give local communities complete control over major projects in their region.
- D. provide sufficient checks themselves, so that local community consultation is not needed.

Use the following information to answer Questions 15–17.

Environmental management strategies must be developed to ensure the ecological sustainability of the environment. These are developed by regulatory agencies such as national parks services.

A species of shrub in a national park will not reproduce successfully unless there is sufficient viable* seed when a fire occurs. The amount of viable seed initially increases with time since the last fire and then declines. This is shown in Figure 2 below.

The national park is managed with the aim of ensuring that there is an appropriate ‘fire interval’ in places where the shrub exists. A fire interval is the time in years between two successive fires.

* viable = capable of living

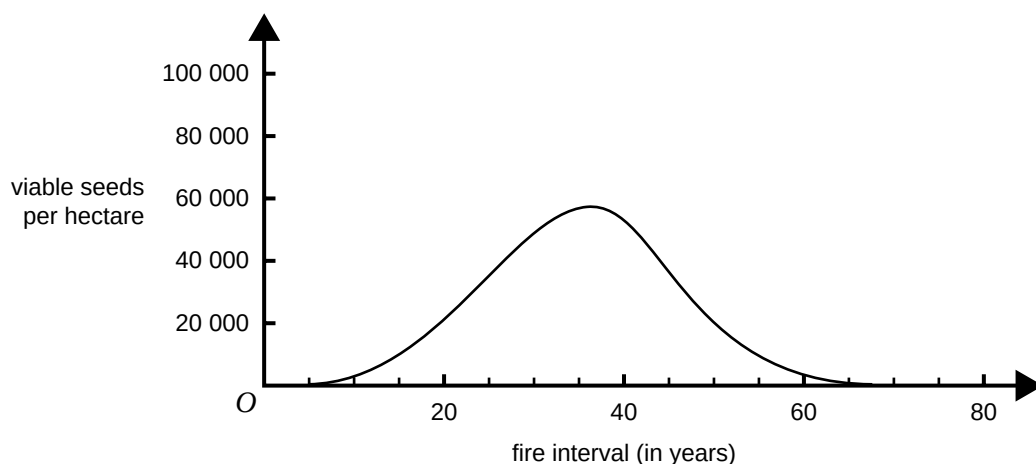


Figure 2. Number of viable shrub seeds per hectare versus time (in years) since last fire

Question 15

Studies show that the shrub needs at least 20 000 viable seeds per hectare for the species to reproduce successfully. Using the data in the above graph (Figure 2), which of the following fire intervals would allow the species to reproduce successfully?

- A. 15 years
- B. 30 years
- C. 55 years
- D. 65 years

Question 16

The habitat of this shrub may be invaded by a weed species. The number of viable seeds per hectare produced by this weed is shown in the graph below. This weed also requires 20 000 seeds per hectare to reproduce successfully.



Figure 3. Number of viable weed seeds per hectare versus time (in years) since last fire

Using the above graph (Figure 3), which of the following fire intervals would ensure that reproduction of the weed was **not** successful?

- A. 20 years
- B. 40 years
- C. 60 years
- D. 80 years

Question 17

Using both graphs (Figures 2 and 3), which of the following fire intervals would **allow** the shrub to reproduce successfully, but would **prevent** the successful regeneration of the weed?

- A. 15 years
- B. 30 years
- C. 45 years
- D. 60 years

Question 18

Acid sulfate soils can occur naturally in the environment near river mouths. These soils contain higher than normal levels of metal sulfides. Exposure of these metal sulfides to oxygen in a moist environment can generate unsatisfactory levels of sulfuric acid.

A swampy site next to a river mouth has just been identified as having acid sulfate soil. The Environmental Management Plan for this site could involve

- A. introducing a species of animal which can survive in an acidic environment.
- B. treatment with a suitable chemical to reduce the acidity.
- C. planting exotic salt-tolerant trees and shrubs.
- D. turning the site over to intensive agriculture.

Question 19

In a recent study 200 people wore small air pollution monitors for five days in winter and again in summer. The study was designed to assess personal exposure to a range of air pollutants.

In a study of this type, **exposure** is defined as

- A. the number of pollutants studied.
- B. the total number of people involved.
- C. the total air pollution that all Australians would experience.
- D. how much of the pollutants people were exposed to over the 10 days.

Question 20

A company applies to the government for permission to build a new factory to manufacture chemicals near a city. The government decides to undertake an Environmental Risk Assessment.

The main objective of the Environmental Risk Assessment is to determine

- A. whether the chemical factory is likely to be economical.
- B. a complete list of all pollutants that the factory might release.
- C. the damage that the factory might do to people and the environment.
- D. the conditions under which the factory will be given an operating license.

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

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

Question 1

Use **one** pollutant you have studied to answer the following questions.

- a. Briefly describe the pollutant.

2 marks

- b. Give details of the **source** or **sources** of this pollutant.

2 marks

- c. Explain how this pollutant enters and is distributed through the environment (its **transport mechanism**).

3 marks

- d. Describe the pollutant's impact on humans, the natural environment or both. State one population class on which the selected pollutant has an adverse impact. Describe this impact.

3 marks

- e. No specific action was taken by humans to remove the pollutant. Describe how the pollutant would naturally become degraded or removed from the environment.

Include a comment on its **persistence** in your answer.

3 marks

- f. Describe a strategy for reducing the impact of this pollutant on the health of the chosen population. Estimate its effectiveness or potential effectiveness.

3 marks

Question 2

For 50 years, an isolated industrial factory has released into the environment a range of pollutants, including sulfur dioxide and small particles of lead (a heavy metal).

The pollutants are all carried into the atmosphere in hot gases emitted from a tall chimney. Sulfur dioxide dissolves easily in water. Lead does not dissolve in water and will last for a long time in soil.

To check the industrial factory's environmental impact, scientists undertook extensive sampling of soil to a distance of 10 kilometres around the factory.

Figure 4 shows soil concentrations of lead due to emissions from the factory. Darker areas show higher lead concentrations. Lighter areas show lower concentrations, with white areas showing no measurable lead.

Concentrations of sulfur dioxide at ground level were measured for a year at locations around the factory. The average concentrations of sulfur dioxide measured at each location are shown as a number on the diagram in ppm (parts per million).

Prevailing wind is from west to east.

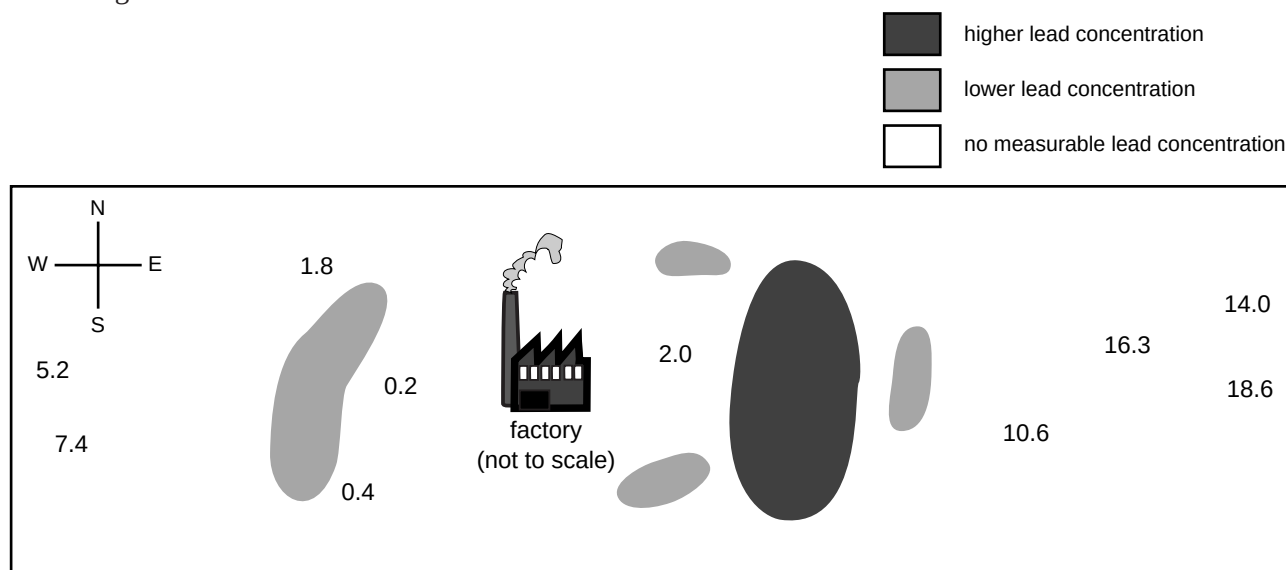


Figure 4. Distribution of lead and sulfur dioxide

- a. Give an explanation for the observed distributions of sulfur dioxide and lead around the factory. In your answer, refer to transport mechanisms and the characteristics of the two pollutants. You should also refer to probable local weather conditions which may have affected the distribution.

4 marks

- b. Animals living in the area of the industrial factory were found to have lead concentrations in their bodies 100 times that of the plants growing in the soil where lead concentrations are highest. Discuss the reasons for this finding.

2 marks

- c. The factory closes. Describe the changes that you would expect to find one year later if you repeated all the measurements of sulfur dioxide and lead concentrations.

2 marks

Question 3

A group of students constructs a laboratory model of a pollution spill. They use (coloured) methylated spirits to simulate the pollutant. A tank of water of volume 10 litres is used to simulate a lake. Methylated spirits mixes easily with water; and is much more volatile (evaporates much more easily into air) than water.

Figure 5 shows the model. Methylated spirits can be added either by directly pouring into the water or by using a slow drip-feed set up in one corner of the tank as shown in Figure 5 below.

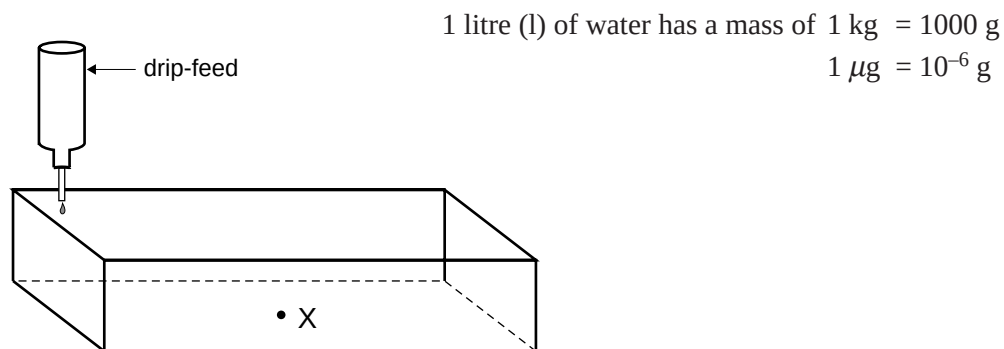


Figure 5

- a. Does the drip-feed act as a point or diffuse pollutant source? Give reasons for your answer.

2 marks

- b. In a second experiment the students add 10 g of methylated spirits, spreading it evenly through the whole volume. Calculate the immediate concentration in ppm or μg per g. Show working and units.

3 marks

In a third experiment, the students drip-feed methylated spirits into the tank from the corner drip-feed over a long period. They measure the concentration at a point, X, at the centre of the tank. Figure 6 below shows the concentration at X over the time period.

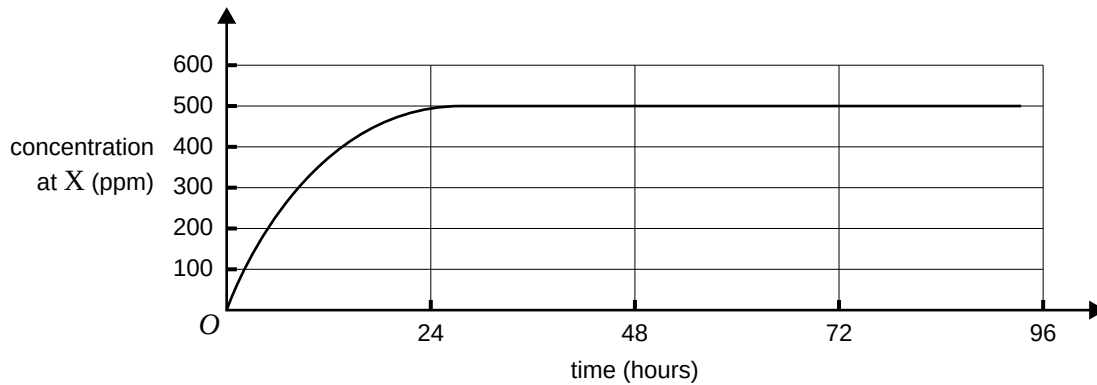


Figure 6

- c. Explain the graph (Figure 6) in terms of pollutant characteristics – source, transport mechanism, dissipation mechanism (removal from the tank).

3 marks

- d. Describe a real-life situation which this experiment could be modelling.

3 marks

Question 4

During your study of Environmental Science this year, you have studied at least one major environmental project and assessed its impact and the strategies for reducing this impact. Use either this project or one other project to answer the following questions.

- a. Briefly describe the project.

2 marks

- b. Describe the environmental impacts and risks associated with the project.

3 marks

- c. Outline the management procedures used to assess the environmental risks and impacts. Your answer should include reference to groups consulted.

3 marks

- d. Outline the Environmental Management Plan developed to minimise the impact of the project on the environment, both during the planning and construction phase, and during the life cycle of the project. Include steps taken to monitor the environmental impact of the project.

4 marks

- e. Can this project be correctly described as 'ecologically sustainable'? Give a reason for your answer.

2 marks

- f. Estimate the success (or potential success) of the strategies used to minimise any adverse environmental impact of the project.

3 marks

Question 5

A new section of freeway is to be built across hilly, open country in rural Victoria. The construction will require the excavation of cuttings through the ridges. The excavated material will be used to construct embankments across the lowest areas in the valleys. Two bridges are needed to cross a major river.

The main construction offices and workshop will be located on a large cattle farm. The freeway will pass through this farm. No native habitat remains on this farm. The trees in the windbreaks are European pines and the pasture has been improved by over-sowing with imported grass species. Construction of this section of freeway is scheduled to take about 36 months.

The aims of the Environmental Management Plan for this construction project are to

- minimise land disturbance
- minimise the erosion of soil, particularly on river banks and hillsides
- control sediment run-off into the local water-courses
- rehabilitate the site on completion of construction.

The ground over which the freeway is to be built will be stripped of its topsoil so that this soil can be used for rehabilitation purposes. Once construction has started and the topsoil has been stripped off the construction area, it will need to be stockpiled for about 30 months before the rehabilitation* work begins.

*Rehabilitation: Restore disturbed areas as closely as possible to their original state.

- a. Dust and sediment in stormwater run-off should be minimised during construction. Describe the operation of **two** measures that could be implemented to manage the soil stockpiles.

Measure 1 _____

Measure 2 _____

4 marks

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- This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

SECTION B – continued
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Question 6

Melbourne Water has a policy of ‘closed catchments’ for almost all of its water supply dams. This means no human access or activity is permitted in the dams or their catchment areas.

A local council, backed by its community, argues that a medium-size dam, part of Melbourne’s water supply, should be opened to limited and controlled recreational activities.

The arguments put forward by the council include:

- Its region is an economically poor area, with high unemployment; tourism is its only asset and potential income. The dam and its surrounds are vital for tourism.
- Modern monitoring, control and filtration processes make it safe to allow limited access. Most water supply authorities throughout the world, including other Australian cities, allow limited usage around their dams.

The activities suggested by different groups in the local community include:

- picnicking on the shores
- bushwalking, with or without overnight camping allowed
- water-skiing
- non-powered boating (that is, sailing and rowing)
- swimming
- horse riding

- a. List and discuss two issues that should be addressed in an Environmental Impact Assessment of this proposal.

Factor 1

Factor 2

4 marks

- b.** Name one potential pollutant that might be introduced by one or more of the activities put forward by community groups. Discuss the possible environmental impact.

2 marks

- c.** Describe a suitable process for decision-making in this case. What bodies or organisations should be involved?

2 marks

- d.** Outline one argument for and one against the proposal.

For

Against

2 marks

END OF QUESTION AND ANSWER BOOK