



Victorian Certificate of Education

2004

SUPERVISOR TO ATTACH PROCESSING LABEL HERE

STUDENT NUMBER

Letter

Figures

Words

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ENVIRONMENTAL SCIENCE

Written examination 2

Friday 19 November 2004

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

<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, 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 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 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

In a study of air pollution, 1000 volunteers wore air pollution monitors for a week.

The **exposure** of volunteers to airborne pollutants refers to

- A. the number of toxic pollutants detected.
- B. the number of different pollutants detected.
- C. the amount of the pollutants experienced by the volunteers during the study.
- D. the total number of volunteers involved in the project over the time that the study was conducted.

Question 2

Which of the following criteria best indicates that a development is ecologically sustainable?

- A. It does not decrease biodiversity.
- B. It conforms to environmental regulatory frameworks.
- C. It does not contribute significantly to global warming.
- D. It can continue for a long time without harm to the ecosystem.

Question 3

The main purpose of regulatory frameworks is to

- A. balance community needs against environmental degradation.
- B. remove the need for developers to act responsibly themselves.
- C. ban developmental projects unless they have zero impact on the environment.
- D. avoid the need for nongovernment organisations to be involved in decisions regarding developmental projects.

Question 4

The amount of paper a company sends to the local landfill is reduced when the company purchases printers that can print on both sides of the paper.

This is an example of

- A. recycling.
- B. synergistic action.
- C. life cycle analysis.
- D. waste minimisation.

Use the following information to answer Questions 5–7.

A disused mine site is contaminated by unacceptably high levels of nickel (a heavy metal) in the soil. An environmental scientist is assessing options for decontaminating the site. One of the options being considered is to grow a particular species of plant that is able to extract nickel from the soil. The nickel is then concentrated in the leaves and stems of the plant, and each year the plants will be harvested and the nickel extracted.

Question 5

The concentration of the nickel in the plants is an example of

- A. mobility.
- B. persistence.
- C. bioaccumulation.
- D. synergistic action.

The plants are able to produce 8000 kilograms per hectare of dry plant biomass each year, and each plant can store 10 grams of nickel for each kilogram of dry plant biomass (1 kilogram = 1000 grams).

Question 6

What is the maximum mass of nickel that can be extracted each year by the plants from one hectare of land?

- A. 10 grams
- B. 800 grams
- C. 10 000 grams
- D. 80 000 grams

Question 7

The environmental scientist conducts an Environmental Impact Assessment for the decontamination project. The aim of this Environmental Impact Assessment is to

- A. prevent all adverse environmental impacts.
- B. describe the existing environmental condition of the site.
- C. ensure that sound environmental decisions are made.
- D. stop the project proceeding if it will damage the environment in any way.

Use the following information to answer Questions 8–10.

Scientists use sensitive gas detectors in a laboratory at Cape Grim in northwestern Tasmania, as shown in Figure 1, to measure concentrations of air pollutants.

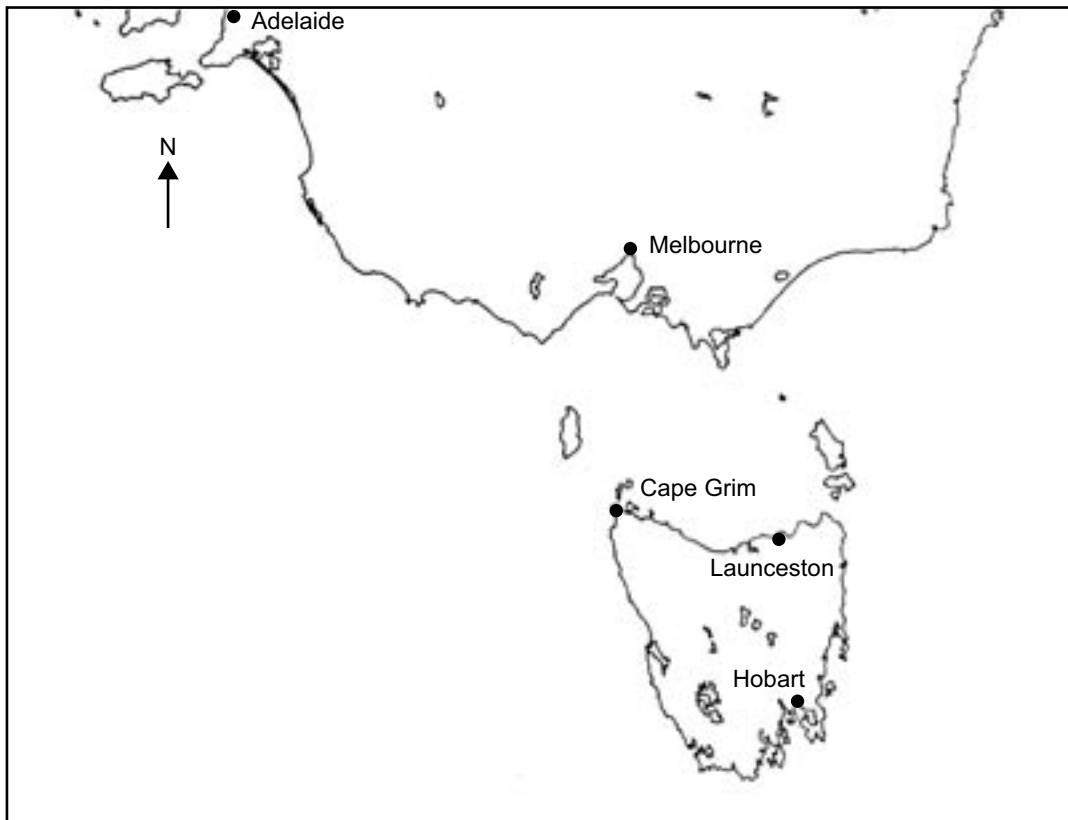


Figure 1

Figure 2 shows average concentrations of the pollutant carbon monoxide, measured at Cape Grim, in parts per billion (ppb), over a 20-day period. The letter above each bar shows the direction from which the wind was coming on each day. 'N' indicates wind from the north, 'W' indicates wind from the west, and 'S' indicates wind from the south.

Carbon monoxide is a reasonably stable, toxic gas of approximately the same density as air.

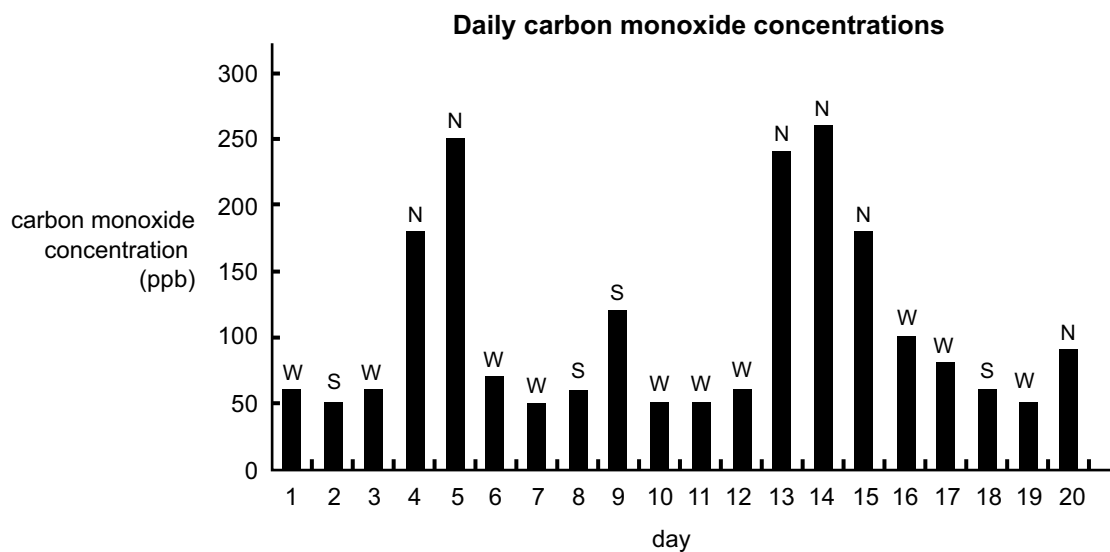


Figure 2

Question 8

The transport mechanism taking carbon monoxide to Cape Grim is

- A. wind.
- B. gravity.
- C. ocean currents.
- D. cars and trucks.

Question 9

In Figure 2, the high levels of carbon monoxide, on certain days, are most likely to have come from

- A. Hobart.
- B. Adelaide.
- C. Melbourne.
- D. Launceston.

Question 10

Over time, carbon monoxide disappears from the atmosphere due to reaction with hydroxyl radicals in the air.

In this process, hydroxyl radicals are acting as a

- A. sink.
- B. point source.
- C. diffuse source.
- D. transport mechanism.

Use the following information to answer Questions 11–13.

Researchers set up an experiment to study the effects of air pollutants on plants. In a series of trials, they exposed trays containing 50 *Viola hederacea* plants to various concentrations of ozone gas and sulfur dioxide gas in a large glasshouse.

Each trial lasted for a week. A new tray of plants was used for each trial. The results of the experiment are presented in Table 1.

Table 1

Trial number	Concentration of ozone (parts per million)	Concentration of sulfur dioxide (parts per million)	Number of plants surviving after the trial
1	0.040	0	50
2	0.080	0	48
3	0.40	0	34
4	1.0	0	17
5	0.0	1.0	50
6	0.0	10	14
7	0.40	10	2
8	1.0	10	0

Question 11

Which of the following best describes the **dosage** of pollutants received by a plant in a trial?

- A. the length of the trial
- B. the percentage of plants that died in the trial
- C. the concentration of gas in the glasshouse
- D. the mass of gas absorbed per gram of the plant

Question 12

Trials 7 and 8 indicate that the low survival rate of the plants in these two trials demonstrates

- A. chronic toxicity.
- B. specificity of ozone gas.
- C. synergistic action of the pollutants.
- D. bioaccumulation of ozone and sulfur dioxide.

Question 13

The length of the trial would affect the

- A. toxicity.
- B. exposure.
- C. specificity.
- D. persistence.

Use the following information to answer Questions 14–17

Enterococci are bacteria that are present in the gut of all humans. The World Health Organisation regards these as the best bacterial indicator for monitoring the quality of sea water for swimming. Victoria's Environment Protection Authority (EPA) monitors the levels of *enterococci* in the water at Melbourne's beaches to indicate contamination from sewerage.

Question 14

An environmental indicator is best described as a material that

- A. measures the health of the environment.
- B. is a toxic substance in the environment.
- C. measures the total number of pollutants in the environment.
- D. is a potentially dangerous chemical or biological agent in the environment.

The graph below shows the *enterococci* concentration over a 20-day period. The maximum allowable *enterococci* concentration for safe swimming is set by the EPA at 3500 live organisms per 100 mL of sea water in a single sample.

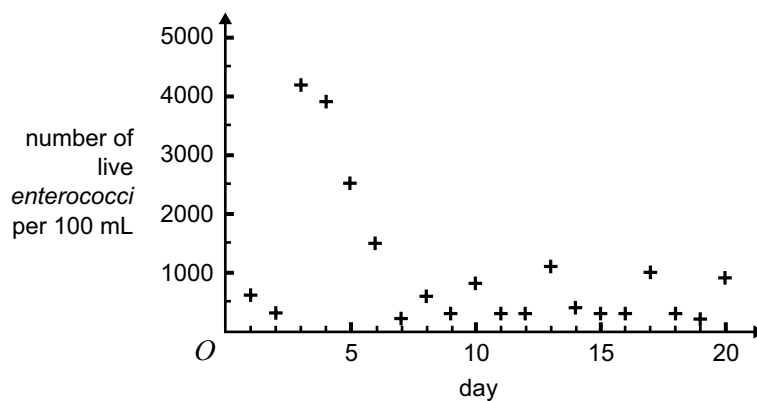


Figure 3

Question 15

From Figure 3, determine the approximate percentage of days on which swimming was unsafe.

- A. 10%
- B. 40%
- C. 60%
- D. 90%

Question 16

Which of the following is the best estimate of the average *enterococci* concentration (live organisms per 100 mL) over the 20-day period?

- A. 100
- B. 1000
- C. 3000
- D. 4000

Question 17

High *enterococci* concentrations on days 3 and 4 could be caused by

- A. water escaping from a steel plant.
- B. gradual death of *enterococci* in the water.
- C. a heavy rainstorm causing overflow of sewerage systems into stormwater drains.
- D. continual discharge of water from the Melbourne Water sewerage treatment plant.

Use the following information to answer Questions 18–20

A group of students set up an experiment to model the waterborne transport of pollutants. The experiment simulates a river, the angle of inclination of which can be changed to produce a fast or slow (sluggish) water flow. The experiment is shown below in Figure 4.

A waterwheel at Y measures the speed of the flow.

At X, three simulated pollutants are introduced at an ongoing, steady rate, in carefully measured amounts, well mixed with water inflow. The simulated pollutants are

- I** – fine sand, to simulate an insoluble, heavy particulate pollutant
- II** – an insoluble organic liquid, to simulate an insoluble, very volatile pollutant
- III** – a very soluble salt

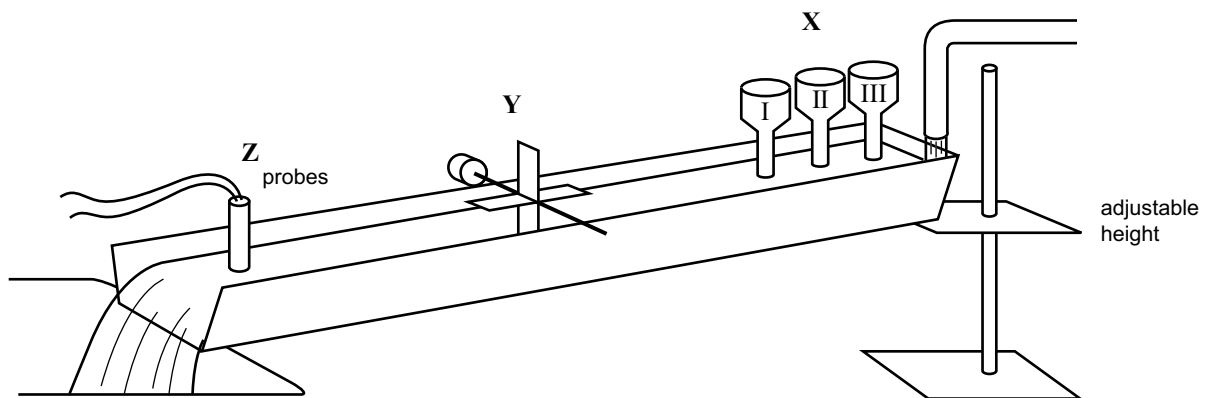


Figure 4

At Z, suitable probes connected to a data logger (an automatic computer recording device) measure the concentration of each simulated pollutant over a short period.

In the **first experiment** the flow rate at Y is very slow.

In a **second experiment** inclination of the model is increased, thus increasing the flow rate at Y.

Question 18

The concentration of which of the simulated pollutants, measured at Z, is likely to change from the **first** to the **second** experiments?

- A. I
- B. II
- C. III
- D. none

Question 19

To investigate the effect of wind, the students use an electric fan to blow air over the model.

The concentration of which of the simulated pollutants, as measured at Z, is likely to change?

- A. I
- B. II
- C. III
- D. none

The cross sectional area of the trough is 0.020 m^2 (square metres). At one inclination the flow at Y is measured to be 0.50 m s^{-1} (metres per second). $1000 \text{ litres} = 1 \text{ m}^3$ (cubic metre).

Question 20

Which of the following best gives the volume of water passing Y per second?

- A. 0.10 litres/second
- B. 1.0 litres/second
- C. 5.0 litres/second
- D. 10 litres/second

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

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

Question 1

- a.** Explain what is needed for a material to be called a ‘pollutant’. You should name **two** properties that define a material as a pollutant.

3 marks

- b.** Name a pollutant you have studied this year.
Explain how this pollutant meets the criteria which you described in part **a.** above.

3 marks

c. In the life cycle of this pollutant, describe

i. its source and transport mechanism

ii. its effect on the health of the environment and/or human health

iii. how it leaves the environment.

2 + 2 + 2 = 6 marks

d. Describe a management plan, or actions that have been taken, to monitor and control the impact of this pollutant. Include some evaluation of the effectiveness of these measures, referring to any monitoring or evidence available.

4 marks

SECTION B – continued
TURN OVER

Question 2

A large industrial factory is located 2 km north of the coastline of a large bay. The area is mapped in Figure 5.

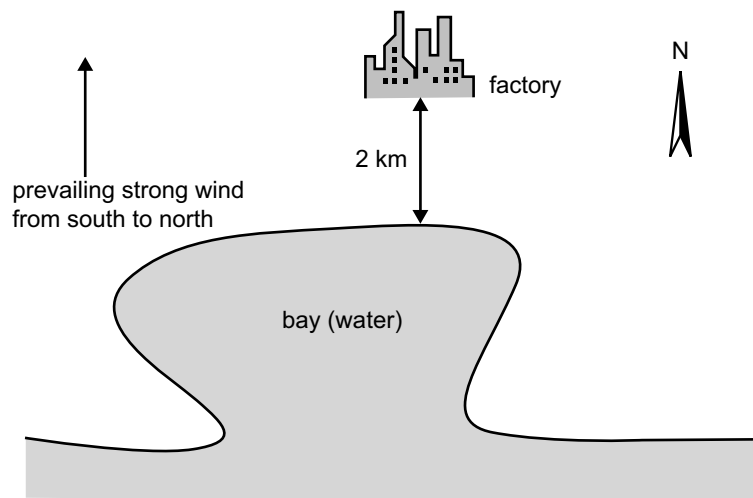


Figure 5

Torrential rain causes flooding of the factory; the flood waters drain slowly into the bay. Three pollutants spill from damaged storage bins at the factory.

I – a very light (volatile) liquid organic chemical, insoluble in water

II – a heavy metal particulate

III – a nitrate salt soluble in water

- a. Compare the probable paths through the environment of both pollutant I and pollutant III. Include reference to transport mechanisms and sinks in your answer.

4 marks

- b. Two days after the flood, one of the pollutants is observed well north of the factory. Which of them would you expect it to be? Give a reason to support your response.

3 marks

- c. Describe where you would expect to observe each of the **three** pollutants several weeks later, after the floods subside.

3 marks

Monitoring a year later shows that one of the pollutants is present in large fish in the bay. However, the pollutant is not detectable in the water of the bay itself or in plants near the shoreline.

- d. Which of the three pollutants would you expect this to be? Explain your response.

4 marks

The Environmental Management Plan for the factory was reviewed as a result of the flood.

- e. Suggest two measures that could be taken to avoid similar problems in future.

4 marks

Question 3

- a. Name an environmental science project you have studied this year, describe the project, and outline the project's objectives.

4 marks

- b. Describe the environmental impacts of the project (either its positive outcomes or its negative environmental consequences). Evaluate the balance of positive and negative consequences of the project.

4 marks

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- This image shows a single sheet of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page. There are approximately 20 lines visible. The paper has a slight shadow on its right side, suggesting it's resting on a surface.

SECTION B – continued
TURN OVER

Question 4

An energy company wishes to build an electricity-generating windfarm on cleared farmland near the coast in western Victoria. A gravel access road will be built through the farmland to the construction site. The road will be maintained throughout the life of the windfarm.

At the construction site, 20 wind turbines, each 100 metres tall, will be built. Structures of this size are known to cause death of birds that fly into them. As part of the Environmental Impact Assessment (EIA) for this project, the energy company is required to predict the possible impact of the windfarm on bird species.

- a. What is the purpose of an Environmental Impact Assessment (EIA) for this project?

2 marks

The orange-bellied parrot is of particular concern because there are fewer than 200 birds in the wild. During winter the orange-bellied parrot feeds exclusively in coastal areas of mainland Australia, particularly in western Victoria. While on the mainland, the species is seen from time to time at its known feeding areas and is thought to fly between possible feeding areas both during the day and night.

The energy company used the density of birds seen flying in the area to predict the number of bird deaths. Bird surveys were conducted from midday to 1.00 pm on five different days in winter. The surveys recorded a total of 65 different bird species. The orange-bellied parrot was not detected during any of the surveys.

- b. Discuss the adequacy of the surveys for measuring the impact of the windfarm on both common and rare species.

3 marks

- c. Identify **two** issues, other than the effect on wildlife, that should be addressed in the EIA for the proposed windfarm project. For each issue, identify one measure that could be undertaken to reduce the environmental impacts.

4 marks

- d. List the factors that should be considered when conducting a life cycle analysis for the proposed windfarm project.

4 marks

Question 5

The diagram (not drawn to scale) shows a freeway that passes through a tunnel. Large fans force air from the tunnel up through a 50-metre high chimney out into the atmosphere. The arrangement is shown in Figure 6.

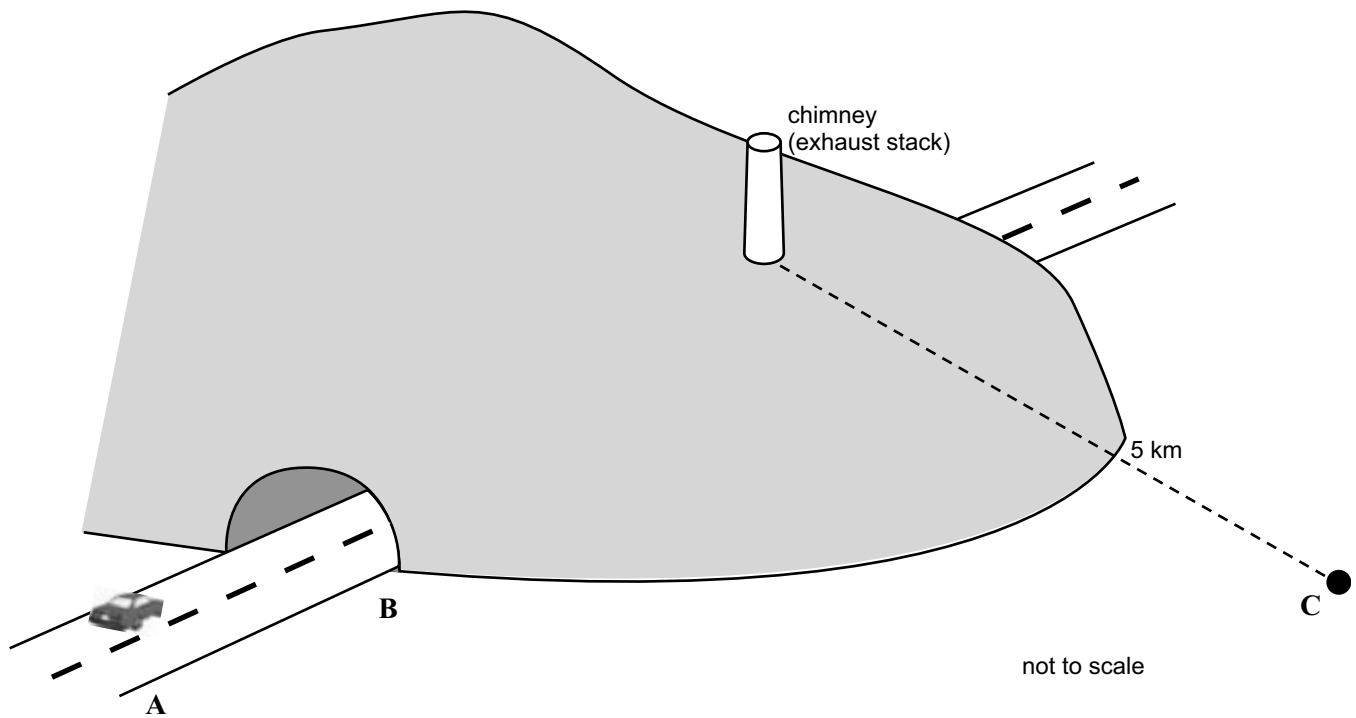


Figure 6

- a. Between points A and B, does the freeway, with heavy traffic, act as a point or diffuse pollutant source? Give a reason for your answer.

3 marks

A study found two main types of pollutants released by the chimney. The first type were larger particles made up principally of unburned carbon from diesel exhausts, as well as metal particles from engines. The second form of pollutant were gases such as carbon monoxide and oxides of nitrogen.

Most of the larger particles were scattered within a kilometre or so of the chimney. In dry weather, researchers measured the gaseous pollutants in the air 5 kilometres away at location C. However, after significant rain, researchers found that the concentrations of the gaseous pollutants at location C were significantly lower than following dry periods.

- b.** Using the different characteristics of the two pollutants, explain these observations.

4 marks

Following a community campaign about the effects of air pollution from the chimney on the health of people living nearby, the government calls for an environmental risk assessment.

- c.** Outline the steps that should be taken in the assessment.

4 marks