



Victorian Certificate of Education 2008

SUPERVISOR TO ATTACH PROCESSING LABEL HERE

STUDENT NUMBER

Letter

Figures

Words

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ENVIRONMENTAL SCIENCE

Written examination 2

Thursday 20 November 2008

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

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 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

Which one of the following would most likely be considered a diffuse source of sulfur dioxide?

- A. the chimney of a power station
- B. a sewerage outlet in the sea
- C. a large landfill, leaking sulfur dioxide
- D. a volcano

Question 2

In an industrial area, both sulfur dioxide and oxides of nitrogen are emitted by different industries. The environmental impact of these two emissions is much greater than in another area where only sulfur dioxide is emitted.

This is an example of

- A. specificity.
- B. persistence.
- C. synergistic action.
- D. acute toxicity.

Question 3

Which one of the following could best be described as a sink for sulfur dioxide?

- A. high winds
- B. a lake
- C. a power plant chimney
- D. a coal mine

Question 4

Which one of the following forms of mercury is most likely to be involved in bioaccumulation?

- A. methyl mercury
- B. metallic (elemental) mercury
- C. oxide of mercury
- D. mercury vapour

Question 5

Which one of the following best describes the **toxicity** of mercury?

- A. the amount of mercury a person absorbs in a given time
- B. the measure of the harm done to a person by mercury absorption
- C. the total amount of time the mercury remains in the environment around the person
- D. the amount of mercury accumulated in fatty tissue in a person

Question 6

Which one of the following best describes the **dosage** of mercury for a person?

- A. the amount of mercury a person experiences in the environment around them in a given time
- B. the amount of mercury a person absorbs in a given time
- C. the measure of the harm done to a person by mercury absorption
- D. the amount of mercury accumulated in fatty tissue in a person

Question 7

Which one of the following best describes the **exposure** of a person to mercury?

- A. the amount of mercury a person absorbs in a given time
- B. the total amount of time the mercury remains in the environment
- C. the amount of mercury a person experiences in the environment around them in a given time
- D. the measure of the harm done to a person by mercury absorption

Question 8

Which one of the following best describes the **persistence** of mercury?

- A. the amount of mercury accumulated in fatty tissue in a person
- B. the total amount of time the mercury remains in the environment
- C. the amount of mercury a person absorbs in a given time
- D. the measure of the harm done to a person by mercury absorption

The following information relates to Questions 9 and 10.

A small tanker (ship) carrying chemical X runs aground on a reef. This causes a hole in the side of the ship and allows chemical X to spill into the sea. Chemical X is a toxic chemical, which is highly volatile (evaporates readily at low temperatures).

Question 9

The spill can be best considered a

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

Question 10

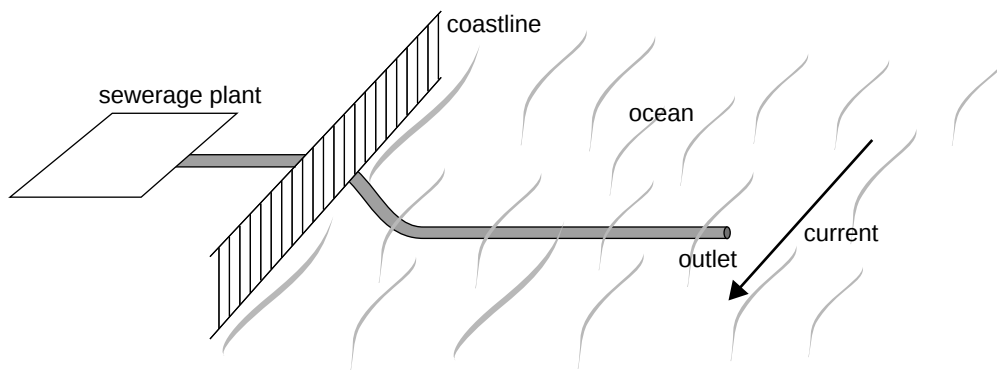
The high volatility of the chemical is most likely to reduce its

- A. toxicity.
- B. human exposure.
- C. bioaccumulation.
- D. persistence at that site.

The following information relates to Questions 11–17.

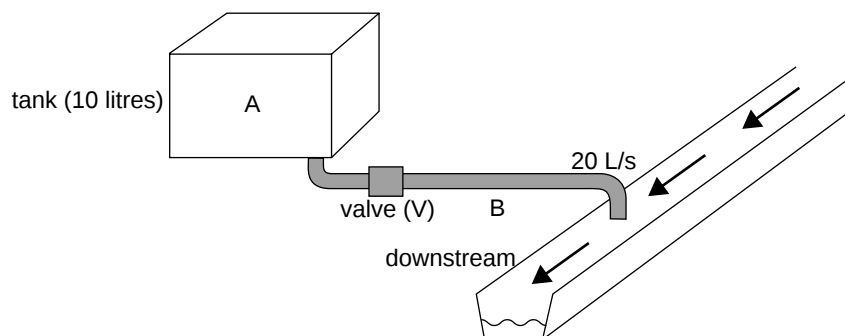
A large outlet is being planned to release treated water from a sewerage treatment plant into the ocean. The treated water is not toxic, but has an unpleasant smell and so can be considered a pollutant.

The outlet feeds the treated water into deep ocean, with a strong current, which spreads this treated water.



Engineers often use scale models to study proposed environmental projects.

This project is modelled below.



The model consists of a 10 litre supply tank, A, which delivers the water through a pipe, B, into a stream of water flowing along a channel, to model the ocean current.

The water flows through the channel at 20 litres per second (L/s).

To simulate the pollutant, 100 g of a chemical is thoroughly mixed into the supply tank with the valve (V) closed.

Question 11

Which one of the following best gives the concentration of the chemical in the supply tank A?

- A. 0.10 g/L
- B. 1.0 g/L
- C. 10 g/L
- D. 100 g/L

Question 12

With the water flowing in the channel, the valve (V) is now opened and the supply tank empties in 20 seconds.

Which one of the following best gives the concentration of the chemical in the stream flow downstream of pipe B?

- A. 0.10 g/L
- B. 0.25 g/L
- C. 1.0 g/L
- D. 25 g/L

Question 13

As part of the planning for the sewerage outlet project, an Environmental Risk Assessment is to be carried out.

Which one of the following is the main aim of an Environmental Risk Assessment?

- A. to determine the least expensive way to protect the environment
- B. to reduce the number of people who are concerned about the project
- C. to ensure that there are no adverse effects on the environment from the project
- D. to evaluate the balance of positive benefits against possible harmful effects

Question 14

The planning also needs to take into account regulatory frameworks.

Which one of the following best describes a regulatory framework?

- A. a set of standards agreed by all scientists
- B. government legislation to ensure that projects meet acceptable standards
- C. a set of guidelines agreed by the local community concerning the project
- D. agreed guidelines to take responsibility for ecological sustainability away from the planners, constructors and operators

Question 15

A scientist states that the sewerage outlet project must be ecologically sustainable.

This means that the project must

- A. not affect the ecology of the nearby ocean area in any way.
- B. meet the needs of the current population without compromising the needs of future generations.
- C. take into account the particular ecology of the nearby area.
- D. maintain the biodiversity of the nearby ocean area.

As part of monitoring the sewerage outlet project, a scientist randomly sampled the number of individuals from four different fish species in an area of one square kilometre around the outlet. The measurements were taken before the outlet was constructed and one, two and three years after it began operating. The amount of treated water from the sewerage plant was the same throughout the three-year period.

The data is shown below.

	before operating	one year	two years	three years
species W	5000	4000	6000	4000
species X	3000	4000	3000	4000
species Y	2000	3500	3000	4000
species Z	4000	2800	4200	3000

Question 16

The percentage change in the total number of fish in the sampled area from before the opening of the sewerage outlet project until the end of three years is best given by (+ indicates increase; – indicates decrease)

- A. – 7%
- B. + 7%
- C. + 70%
- D. + 107%

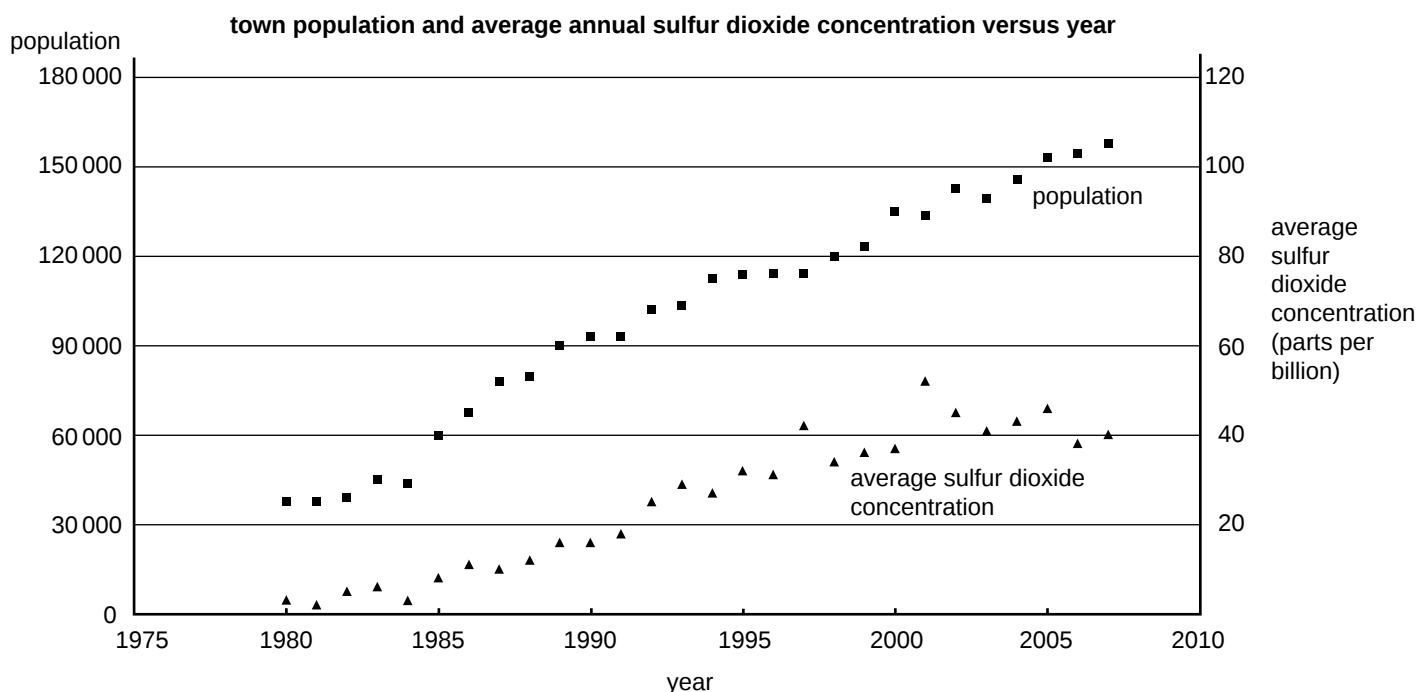
Question 17

The scientist reports that because the numbers of fish of species W and Z have decreased over the three years, the plant has had a negative impact on the ecosystem.

Which one of the following statements is the best comment on this report?

- A. The scientist is correct.
- B. There is insufficient data to draw any conclusion.
- C. The scientist is incorrect, since variation in numbers is more likely to be due to random variation and sampling effects.
- D. The variation is due to loss of biodiversity, as species Y is beginning to dominate the numbers.

Questions 18 and 19 refer to the following graph, which presents data from an isolated coastal town.

**Question 18**

Based on the data in the graph, which one of the following statements is the best conclusion?

- A. The increase in town population has caused an increase in sulfur dioxide concentrations.
- B. Sulfur dioxide concentration increases have led to a population increase.
- C. There is some relationship between sulfur dioxide concentration and population size.
- D. There is no relationship between sulfur dioxide concentration and population size.

Question 19

Which one of the following is the most likely reason for the measured upward trend in sulfur dioxide concentrations?

- A. increased rainfall
- B. an increased number of air-monitoring stations
- C. increased emissions from people's breath
- D. increased local power generation from fossil fuels

Question 20

A company is developing a new insecticide for use in the cotton industry. Before it releases the chemical, it evaluates the potential problems and harm this insecticide may cause to the health of humans and the environment.

This evaluation could best be described as

- A.** a regulatory framework.
- B.** a life-cycle analysis.
- C.** an ecologically sustainable development.
- D.** an Environmental Risk Assessment.

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

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

Question 1

Name a pollutant, **other than mercury or sulfur dioxide**, that you have studied this year.

You should use this pollutant to answer questions **a.–f.**

Pollutant _____

- a.** Describe, in detail, the characteristics of this pollutant. Include in your answer details of the properties that make it harmful to human health or the environment.

4 marks

b. Consider the life cycle of this pollutant.

i. Identify a major source of this pollutant.

ii. State whether this is a point or diffuse source, giving a reason.

iii. Identify the major transport mechanism for this pollutant.

iv. Identify a natural sink for this pollutant.

1 + 1 + 1 + 1 = 4 marks

c. Name a specific population of humans or animals affected by this pollutant.

Population _____

Describe the method(s) of exposure to the pollutant and comment on the dosage required to cause measurable harmful effects for the specific population you have nominated.

3 marks

- d.** Describe one health and safety guideline that needs to be followed when measuring levels of your nominated pollutant.

2 marks

- e.** Describe a strategy that has been developed to reduce the impact of this pollutant on human health or the environment.

3 marks

- f.** Evaluate the effectiveness of this strategy, including evidence to support your evaluation.

4 marks

Total 20 marks

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Question 2

- a. The following table compares some of the general characteristics of elemental mercury (Hg) and sulfur dioxide (SO₂).

For each pollutant, circle the appropriate description of each characteristic.

General characteristic	Pollutant	
	Elemental mercury (Hg)	Sulfur dioxide (SO ₂)
i. Physical state at room temperature	solid / liquid / gas	solid / liquid / gas
ii. Solubility in water	high / low	high / low
iii. Solubility in fat	high / low	high / low
iv. Persistence in environment	long term / short term	long term / short term

4 marks

The following information relates to parts b. and c.

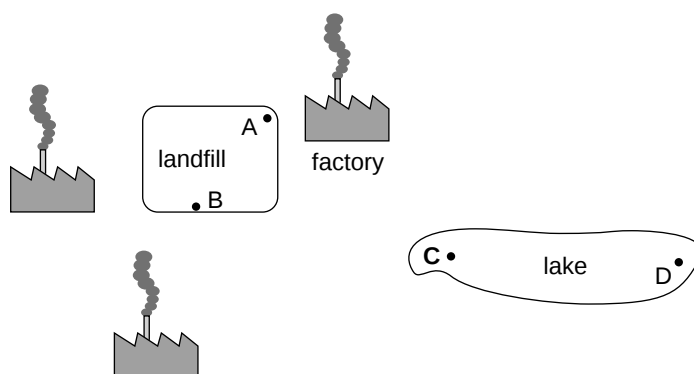
Copper and nitrogen dioxide have some characteristics similar to mercury and sulfur dioxide, respectively.

Like sulfur dioxide, nitrogen dioxide can be converted into a strong acid by exposure to rainwater.

Like mercury, elemental copper can be converted into copper salts by exposure to strong acid. Many copper salts are water soluble and toxic in aquatic systems such as lakes.

A disused landfill containing old copper pipes and concrete building waste is being cleaned up so that the land can be used for forest plantation.

The landfill is located very near to both an industrial area, where a number of factories emit gaseous nitrogen dioxide (NO₂), and a lake filled by local rainwater and groundwater.



An environmental scientist measures the concentration of

- **acid** in soil from the landfill (locations A, B)
- **copper salts** in water from the nearby lake (locations C, D).

Location	Acid (pH)	Copper salts (mg/L)
A (soil)	4.2	—
B (soil)	5.1	—
C (water)	—	3.2
D (water)	—	2.8

Any pH level below 6.0 indicates high acid concentration.

Copper salts can bioaccumulate in living tissue. The minimum concentration of copper salts that can be present in aquatic systems before measurable harmful effects are produced is 1.9 mg/L.

- b. Using the information provided, describe the likely source and transport mechanism for the copper salts observed at locations C and D.

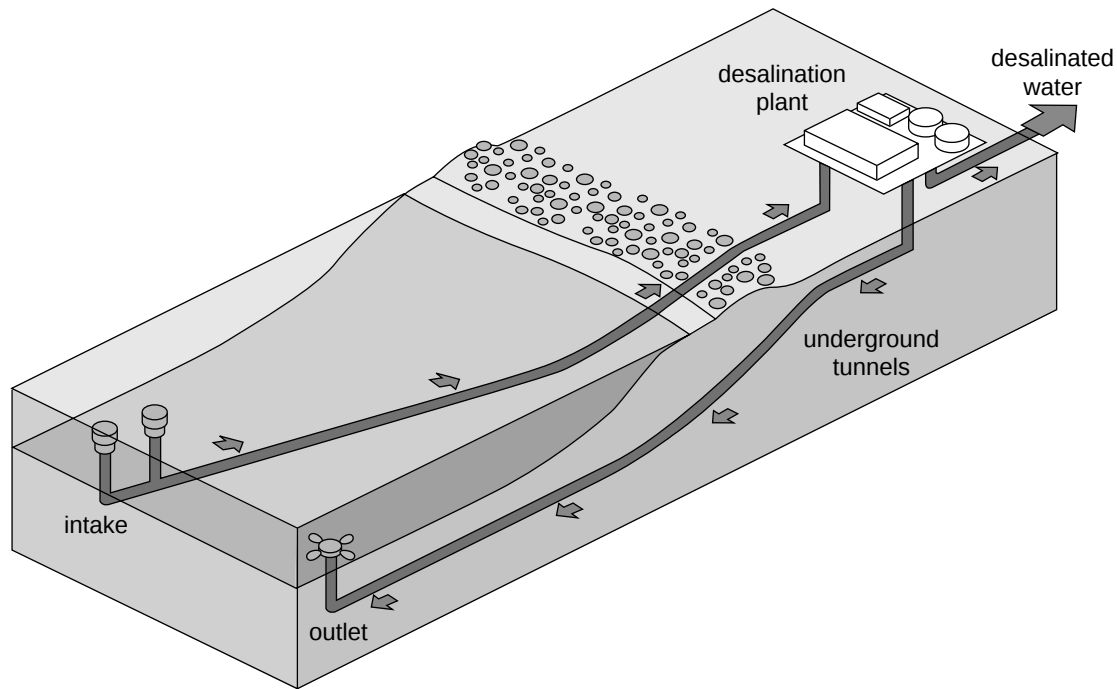
4 marks

- c. Define the term bioaccumulation. Comment on the possibility of harmful effects on aquatic species from the bioaccumulation of copper salts. Refer to the measurements provided above.

3 marks

Total 11 marks

Question 3



To increase Melbourne's water supply, the state government has proposed a desalination plant on the Bass coast (ocean coast southeast of Melbourne). Each year, the proposed plant would provide approximately one third of Melbourne's annual fresh water. The cost is approximately \$3 billion, including connection to the existing water supply and electrical grid. The plant would use approximately 100 megawatts of electricity. The government hopes to offset the impact of this extra electricity requirement by building new renewable energy sources (not necessarily adjacent to the plant); for example, wind power.

The plant would be constructed approximately 500 metres inland from the beach and linked to the ocean by underground pipelines for inlet and outfall.

The plant operates by taking in sea water (salt water), removing some as fresh water and returning the more salty water to the ocean.

The alternative proposed by some people involves building a new dam, possibly on the Mitchell River, at a cost of approximately \$1 billion.

Several community groups, including the *Australian Conservation Foundation* and *Your Water Your Say* (a local community group) have presented arguments against the desalination plant proposal.

- a. Describe three steps that should be taken in reaching a decision on whether to build the desalination plant.

1. _____

2. _____

3. _____

2 + 2 + 2 = 6 marks

Alan is an environmental engineer with the state government. Bridget is a member of a community group opposed to the desalination plant.

Alan argues

- Melbourne's population has increased and will continue to increase, and so a larger and more reliable water supply is required. No amount of realistic water restrictions will allow the present supply to be adequate, especially as the state government favours increasing Melbourne's population.
- The most economic way to provide for this increased population is with a major desalination plant.
- The desalination plant is also the most ecologically sustainable method, since a new dam would involve taking a major area of national park.
- Because the plant can operate at any time of day, sustainable renewable energy sources such as wind or solar power, which are not suitable for base load electricity generation, can be used to power the plant.
- Many desalination plants operate in other parts of the world and in Australia (for example, in Perth), and these plants have had little impact on marine life or the environment. Returning brine (higher concentration of salt in the water) to the ocean, where it is open ocean, has not affected the environment in Perth.
- Provision of recycled (grey) water or individual water tanks would be far too expensive compared to a desalination plant.

Bridget argues

- The 100 megawatts of power required will produce large amounts of greenhouse gases.
- Brine (higher concentration of salt in the water returned to the ocean) will affect marine life. No long-term studies of impacts on marine ecology have been done.
- The site being considered is on a beautiful coastline, and any development will affect tourism.
- A desalination plant is interfering with nature – it makes water a commodity that can be traded and sold.
- Lower water consumption is the answer.

- [illegible]

Total 12 marks

Question 4

Name an environmental project you have studied this year.

Project _____

- a.** Describe the project, including its location and time frame.

4 marks

- b. i.** Outline the aim(s) of this project.

- ii.** At the start of the project, key performance indicators should be identified to measure the success of the project. Describe **two** key performance indicators that could be identified for this project.

2 + 2 = 4 marks

- c. Describe the environmental management plan developed to either ensure the success of the project **or** to avoid environmental damage during the lifetime of the project.

4 marks

- d. Evaluate the success of the project in terms of its aim(s). Include relevant data as evidence of the aim(s) being met.

5 marks

Total 17 marks

SECTION B – continued
TURN OVER

Question 5

- a.** Name and describe a specific ecotourism activity or business.

2 marks

- b.** State two criteria that characterise an activity as ecotourism, and explain how the specific activity you have described in part **a.** meets or does not meet these criteria.

- i.** Criterion 1

Explanation

- ii.** Criterion 2

Explanation

(1 + 2) + (1 + 2) = 6 marks

SECTION B – Question 5 – continued

- c. Describe any likely negative impacts of your nominated ecotourism activity.

2 marks

Total 10 marks