



Victorian Certificate of Education 2009

SUPERVISOR TO ATTACH PROCESSING LABEL HERE

STUDENT NUMBER

Letter

Figures

Words

ENVIRONMENTAL SCIENCE

Written examination 2

Thursday 19 November 2009

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 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 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 characteristics causes sulfur dioxide's significant harm to the environment?

- A. specificity
- B. solubility in fat
- C. synergistic action
- D. solubility in water

The following information relates to Questions 2–5.

Exposure to concentrations of 20 ppm (parts per million) in air of gas A for an hour generally leads to hospitalisation of 10% of people.

Exposure to concentrations of 100 ppm in air of gas B for an hour generally leads to hospitalisation of 5% of people.

Question 2

The dosage of gas A is best described as

- A. the mass absorbed per unit of body weight.
- B. the minimum amount that will cause harm.
- C. the atmospheric concentration of the gas.
- D. the volume of the gas breathed in.

Question 3

The toxicity of gas A is best described as

- A. a measure of the ability of the gas to harm people.
- B. the actual harmful atmospheric concentration of the gas.
- C. the minimum harmful atmospheric concentration of the gas.
- D. the total amount of the gas breathed by a person in a given time.

Question 4

The effects of gas A and gas B combined could be termed 'synergistic' if exposure to 20 ppm in air of gas A and 100 ppm in air of gas B for an hour leads to hospitalisation of

- A. no people.
- B. fewer than 5% of people.
- C. between 5% and 10% of people.
- D. more than 15% of people.

Question 5

The long-term effects on people of exposure to gas A are described as

- A. acute.
 - B. chronic.
 - C. specificity.
 - D. bioaccumulation.
-

Question 6

The vapour of elemental (metallic) mercury demonstrates **acute** toxicity for humans.

This means that it

- A. causes immediate harmful effects.
- B. causes only minor harm for humans.
- C. builds up slowly in fat tissue to cause long-term health effects.
- D. is quickly absorbed into the bloodstream to cause long-term health effects.

Question 7

Coal-fired power plants are a major source of mercury.

The chimney stack of one of these plants can best be described as

- A. a point source.
- B. a diffuse source.
- C. a mobile source.
- D. a transport mechanism.

Question 8

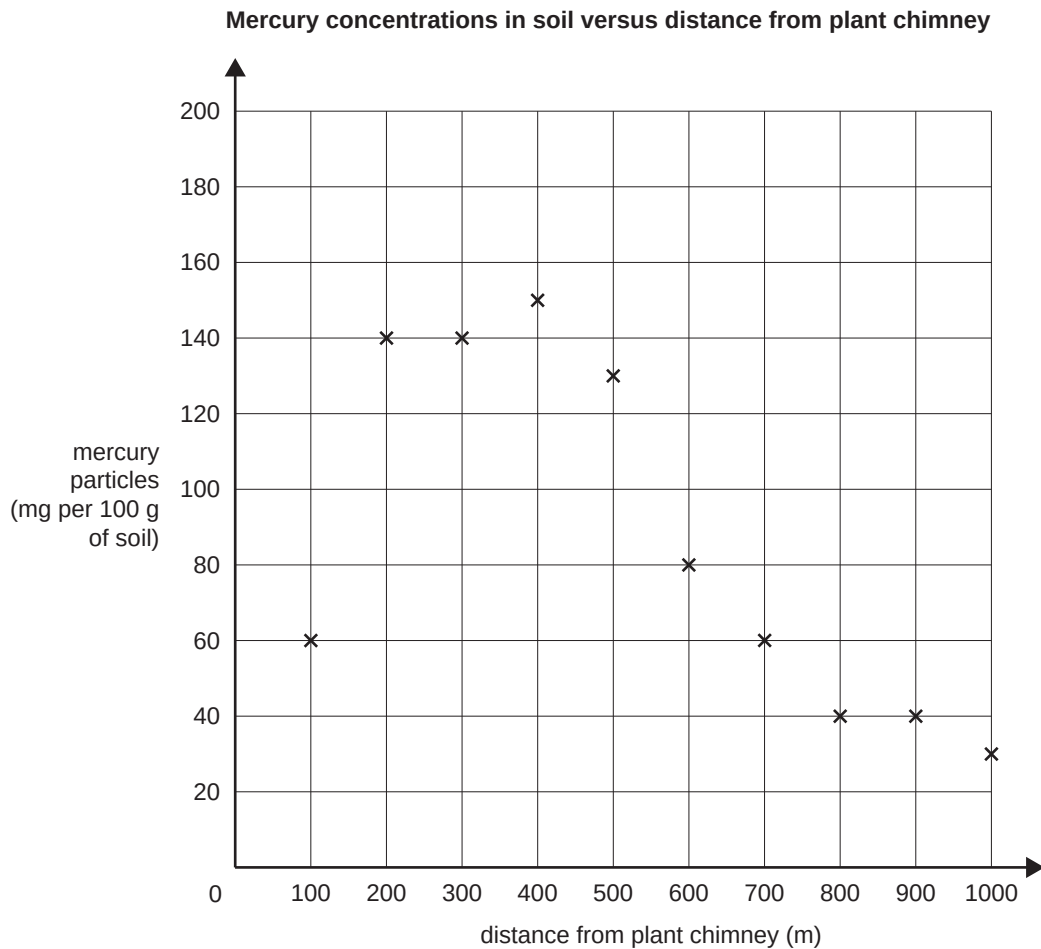
Scrubbers commonly used in the chimney stacks of coal-fired power plants can prevent emission of 45% of the heavy metal particulates released from combusted coal. One tonne of coal (1000 kg) releases on average 500 mg of mercury particulates when burned without scrubbers.

The mass of mercury emitted from 25 tonnes of coal when combusted in the presence of scrubbers is closest to

- A. 6 300 mg
 - B. 6 900 mg
 - C. 8 600 mg
 - D. 12 500 mg
-

The following information relates to Questions 9 and 10.

The following graph shows the average distribution of mercury in soil at various distances around a coal-fired power plant.



Question 9

This distribution pattern shows that mercury is most likely to be

- A. hazardous.
- B. liquid.
- C. dense.
- D. toxic.

Question 10

The mass of mercury contained in a 350 g sample of soil collected from a distance of 600 m from the plant chimney would be closest to

- A. 80 mg
- B. 280 mg
- C. 350 mg
- D. 600 mg

The following information relates to Questions 11–13.

Mercury can be particularly hazardous to human and animal health because of bioaccumulation.

Question 11

Bioaccumulation

- A. is caused by excessive exposure to mercury in the air.
- B. occurs because the person or animal is allergic to mercury.
- C. is due to synergism between mercury and another pollutant in the ecosystem.
- D. occurs because the rate of intake exceeds the rate at which the body can remove it.

Question 12

Bioaccumulation of mercury is most likely to occur in

- A. aquatic organisms.
- B. animals high up the food chain.
- C. sediment in lakes containing mercury.
- D. animals that are low in fat, and so are unable to store the mercury, which is fat soluble.

Question 13

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

- A. Methyl mercury, as it is soluble in fat.
 - B. Elemental mercury, as it is persistent.
 - C. Methyl mercury, as it is soluble in water.
 - D. Oxides of mercury, as they are soluble in water.
-

Question 14

Allergies are caused by substances that

- A. produce excessive levels of carbon dioxide in the blood.
- B. prevent uptake of oxygen into the blood.
- C. affect the immune system.
- D. bioaccumulate.

Question 15

A mining company wishes to develop a large-scale open-cut mine to extract iron ore for the production of steel. The site for this new development is within two kilometres of a wetland which provides habitat for migratory water birds.

Before development of the mine can take place an Environmental Impact Assessment should be conducted. This is required because

- A. it is important to find the cheapest way to develop the mine.
 - B. information needs to be collected about the project for use by the mining company.
 - C. no developments are allowed to occur that could cause any disruption or damage to the environment.
 - D. both the positive outcomes of the activity, as well as the negative impacts on the environment, need to be evaluated and overall approval by the government given.
-

The following information relates to Questions 16–20.

Planners are given the task of designing a system to provide electricity for a small isolated town, which is on a coast. The choice is between a wind farm using ten turbines or a small natural gas-powered turbine generator. They decide on the wind farm as more ecologically sustainable development.

Question 16

Which of the following is the best reason for considering the wind farm as ecologically sustainable?

The wind farm

- A. minimises damage to the environment.
- B. provides more income to the local community.
- C. uses more commonly available materials in its construction and so is cheaper for the community and government.
- D. meets the needs of this generation without compromising the ability of future generations to meet their own needs.

Question 17

An Environmental Impact Assessment is prepared for the project.

It deals with

- possible damage to the environment during construction
- pollution, carbon emissions and other material outputs during operation
- the relative benefits for the community compared to disadvantages.

Which of the following factors has been overlooked in the Environmental Impact Assessment?

- A. Life Cycle Analysis
- B. Waste Minimisation
- C. Environmental Risk Assessment
- D. effect of carbon emissions on global warming

Question 18

When the gas-powered turbine generator is operating, the hot exhaust gas will be passed over pipes to heat water for the local heated indoor swimming pool before exiting to the atmosphere.

This is best seen as an example of

- A. reducing gas emissions from the turbine.
- B. reducing sulfur dioxide pollution.
- C. waste minimisation.
- D. noise abatement.

Question 19

The Environment Protection Authority (EPA) has guidelines for the maximum amount of noise that may be heard from the turbines outside the boundaries of the wind farm.

This is best described as an example of

- A. Life Cycle Analysis.
- B. Waste Minimisation.
- C. Regulatory Framework.
- D. Environmental Management System.

Question 20

One of the disadvantages of using wind power is that the wind does not always blow sufficiently to run the turbines. These wind turbines cannot use a wind speed below 10 km/h. Hence the planners also provide a stand-by gas-powered turbine.

The table below gives the average number of hours per day for each season when the wind speed is below 10 km/h.

Summer	Autumn	Winter	Spring
7.2	4.3	2.5	3.3

Assuming that the power demand is the same for each season, which of the following best gives the percentage of power that the gas turbine is required to provide in a year?

- A. 4.3%
- B. 17%
- C. 18%
- D. 82%

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

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

Question 1

Name a pollutant, other than sulfur dioxide or mercury, that you have studied this year. You should use this pollutant in answering **parts a.–e.**

- a.** Describe a specific situation or location in which this pollutant is found.

2 marks

- b.** Describe the properties of this pollutant which make it harmful to humans, animals or the environment.

3 marks

- c. i. Describe a major source of this pollutant. State whether this source is a point or diffuse source. Give a reason for what type of source it is.

- ii. Describe the major transport mechanism for this pollutant.

- iii. Describe a natural sink for this pollutant.

3 + 2 + 2 = 7 marks

- d. Nominate a population of humans or animals that is exposed to this pollutant and describe how the population is exposed.

Your answer should include

- level of exposure of the nominated population
- dosage considered harmful to this population
- supporting data
- clear differentiation between the terms ‘exposure’ and ‘dosage’.

[illegible]

6 marks

Total 22 marks

Question 2

During a study of atmospheric pollution in a large Australian coastal city, researchers measured concentrations of sulfur dioxide at various sites. They also collected and analysed rainwater at these sites.

- a.** Describe **two** properties, chemical or physical, of sulfur dioxide.

3 marks

- b.** Describe **two** impacts of the pollutant sulfur dioxide on human health or on the environment.

4 marks

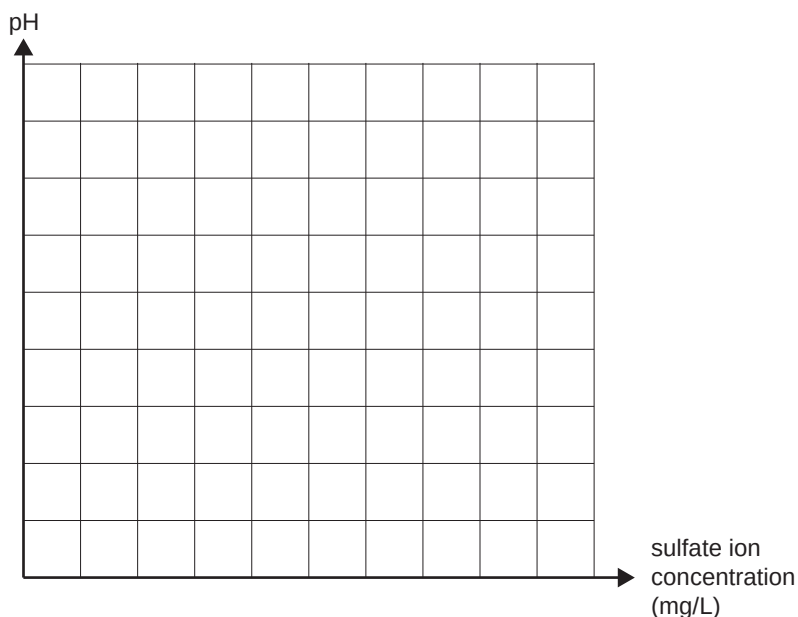
*The following information relates to **parts c. and d.***

At a sampling station in the city, the researchers measured the pH (acidity) of rain and the concentration of sulfate ions in the rainwater for a month. Sulfate ions are formed when sulfur dioxide dissolves in water. Table 1 below presents the data from each of 12 rain events during the month.

Table 1

Rain event	Sulfate ion concentration (mg/L)	pH
1	0.50	5.0
2	0.40	5.0
3	0.30	5.5
4	0.85	4.6
5	0.80	4.4
6	0.20	5.8
7	0.20	5.7
8	0.45	5.1
9	0.30	5.3
10	0.35	5.2
11	0.65	4.8
12	0.40	5.1

- c. On the axes below, draw a plot of sulfate ion concentration versus pH. You should put values (numbers) on each axis.



3 marks

- d. Use your graph to describe the relationship between sulfate ion concentration and pH.

2 marks

Total 12 marks

SECTION B – continued
TURN OVER

Question 3

Name an environmental project which you have studied this year.

- a. Describe this project, including the main aims of the project, its location and time frame.

4 marks

- b. Name a population or environment that has been affected or could have been affected (positively or negatively) by the project you have described.

Describe any consultative process that occurred or should have occurred before the start of this project. Include an evaluation of whether you consider the consultation process to have been adequate.

5 marks

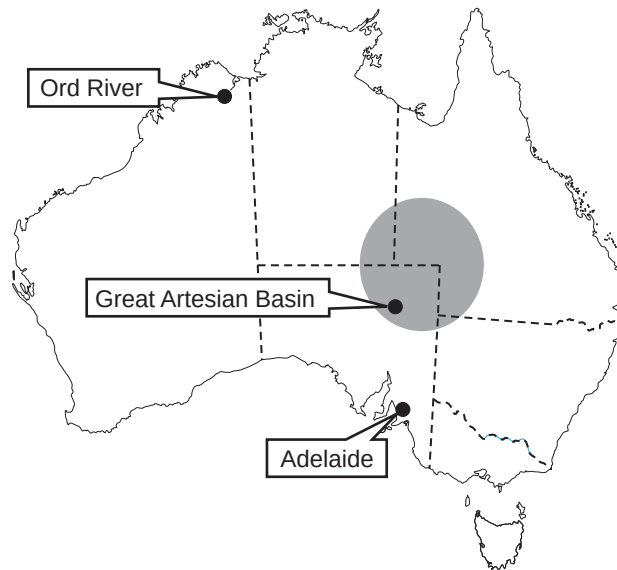
- c. Describe any Environmental Management Plan that resulted from assessment of any risks or impacts.

3 marks

- d. Evaluate the success of the Environmental Management Plan or other strategies. Include any relevant data as evidence of the success or failure of the strategy.

4 marks

Total 16 marks

Question 4

There is a need to increase the water supply to Adelaide, which is currently very dependent on water from the Murray River System.

Over the years, a number of large-scale schemes have been proposed to use major water resources across the country to pipe more water to Adelaide.

Two of these are

- Ord River Scheme (from northern Western Australia)
- Great Artesian Basin Scheme (northern South Australia).

The Ord River Scheme

The Ord River dam in northern Western Australia could supply approximately 150 000 million litres (ML) of water per year from the existing catchment and dam, after meeting current commitments. It would transport water approximately 3 000 km (about 30% of distance via pipeline, and 70% in open channels).

Table 2 shows some details of this.

Table 2

Quantity supplied (ML per year)	150 000
Capital cost	\$11 000 000 000
Ongoing costs (per year)	\$400 000 000
Supply cost per 1000 L to Adelaide consumers	\$9.30

The Great Artesian Basin Scheme

The Great Artesian Basin is an underground water table, covering approximately one-fifth of the Australian continent and extending to northern South Australia.

Artesian water could be conveyed by pipeline and open channel to Adelaide, although it would have to be desalinated slightly for drinking water (not for industrial, cleaning and agricultural use).

Table 3 shows some details of the scheme.

Table 3

Quantity supplied (ML per year)	30 000
Capital cost	\$2 000 000 000
Ongoing costs (per year)	\$61 000 000
Supply cost per 1000 L to Adelaide consumers	\$6.60

Both schemes would pass through farmland and populated areas.

Paul favours the Ord River Scheme, while Hayley argues for the Great Artesian Basin Scheme.

Hayley argues that the Great Artesian Basin Scheme is cheaper, both in capital and running expenses and cheaper for the consumers. Since it involves less distance, there will be less loss from evaporation, hence it will be more efficient in terms of water loss. The energy required (electricity for pumping, etc.) will be less, and so will involve less investment in generation infrastructure (a hidden cost not included in the costs of the scheme). The higher cost to consumers of the Ord River Scheme would be an intolerable burden on poor consumers already struggling with the financial downturn and unemployment in Adelaide.

Paul argues that taking water out of the Great Artesian Basin may lower the water table and cause even more major problems with increased salinity. Many animals (both native and feral such as camels) depend on the springs from the Basin for their water. Removing water may also affect wetlands which are used by migratory birds and Australia is required to protect these under the RAMSAR Convention. Water in the Ord is already artificially dammed, so removing some of that will not affect any natural environment. The need to desalinate some of the water from the Basin will require massive amounts of electricity, the generation of which will create greenhouse gases.

- a. Name three groups who should be consulted before choosing between the two proposals.

Give a reason for each choice.

1. _____

2. _____

3. _____

3 marks

b. Summarise the arguments of Paul and Hayley and comment on any differences in their approaches.

This image shows a full page of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page, leaving small margins at the top and bottom. There are no vertical margin lines, and the entire surface is available for writing.

6 marks

- [illegible]

Total 14 marks

Question 5

The Tahune Forest Airwalk was built in Tasmania to allow tourists to experience views of a southern eucalypt forest from the level of the canopy (tops of the trees) from a walkway at treetop height.

The Airwalk was designed to fit into the forest in a way that minimised the number of trees that needed to be disturbed or removed. Other reasons the site was chosen included its accessibility from existing roads and because the forest region had previously undergone logging.

Forestry Tasmania has included within the Tahune Forest Airwalk development a visitor centre, café, toilets, walking tracks, picnic and camping facilities. The visitor centre contains information about the local forest environment, including details about the flora and fauna of the region, as well as material about logging practices and timber production in Tasmania.

- a. The concept of ecological sustainability is an important factor in the development of the Tahune Forest Airwalk. Explain how the Airwalk is an ecologically sustainable development. Include in your answer a definition of the phrase ‘ecologically sustainable development’.

3 marks

- [illegible]

Total 6 marks

