



Victorian Certificate of Education 2006

SUPERVISOR TO ATTACH PROCESSING LABEL HERE

STUDENT NUMBER

Letter

Figures

Words

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ENVIRONMENTAL SCIENCE

Written examination 2

Friday 17 November 2006

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 23 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 is an example of a diffuse source of pollution?

- A. highway carrying heavy traffic
- B. chimney stack
- C. sewerage pipe
- D. pipe discharging waste from a manufacturing plant

Question 2

Which one of the following best accounts for mercury's significant harm to the environment?

- A. persistence
- B. degradability
- C. specificity
- D. synergism

Question 3

Oleander is a popular garden plant, which is toxic.

Although human deaths from oleander are rare, increased toxicity may occur if leaves from this plant are ingested together with some commonly prescribed antibiotics.

This is an example of

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

Question 4

A common measure of the toxicity of chemicals is LD50. The term LD50 refers to the dosage of a chemical that is lethal to half (50%) of a test population.

The following table provides LD50 values for different chemicals.

Chemical	LD50
I	220 mg/kg
II	154 mg/kg
III	72 mg/kg
IV	8 mg/kg

The most acutely toxic chemical is

- A. I
- B. II
- C. III
- D. IV

Question 5

Hospitals set a maximum permissible dosage of radiation therapy per person in any 12-month period.

This is to prevent toxicity due to

- A. acute exposure.
- B. bioaccumulation.
- C. chronic exposure.
- D. diffuse source pollution.

Question 6

Allergies are caused by substances that

- A. prevent oxygen uptake.
- B. repress the immune system.
- C. activate the immune system.
- D. leave excessive carbon dioxide in blood.

The following information relates to Questions 7–10.

In the early 1950s a chemical plant in Minamata, Japan, used mercury in the production of acetaldehyde. Discharges into Minamata Bay resulted in high levels of methyl mercury in the water of the bay, but it was not detected in the air above the bay.

Question 7

Methyl mercury can best be described as a

- A. solid form of mercury.
- B. nontoxic form of mercury.
- C. compound of mercury more soluble in water than metallic mercury.
- D. compound having the same toxicity as mercury but not actually containing mercury.

Question 8

The discharge pipe at the factory can best be described as

- A. a point source.
- B. a diffuse source.
- C. a transport mechanism.
- D. synergistic action with the bay.

Question 9

The most likely transport mechanism for the methyl mercury would be

- A. airborne.
- B. parasitic.
- C. waterborne.
- D. carried by birds.

Question 10

Although the levels of methyl mercury in the water of the bay were lower than dangerous levels, nevertheless high toxic levels were found in humans.

This is an example of

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

Question 11

Burning sulfur in dry air can produce

- A. oxygen.
- B. sulfuric acid.
- C. sulfur dioxide.
- D. carbon dioxide.

The following information relates to Questions 12–13.

Scientists monitored concentrations of mercury in Lake Pedder in Tasmania. They measured mercury concentrations in the water and in sediments at the bottom of the lake at each of five locations. The table below presents results from the measurements. Mercury concentrations are given as nanograms (10^{-9} g) per litre (ng/l).

sample number	mercury concentrations in water (ng/l)	mercury concentrations in sediment (ng/l)
1	2.2	30.4
2	2.2	16.9
3	3.1	23.1
4	2.7	41.5
5	1.4	8.4

Question 12

The scientists first calculated the average concentration of mercury in water and in sediment, and then determined the ratio of mercury concentration in the water to that in the sediment.

The best estimate of this ratio is

- A. 10:1
- B. 5:1
- C. 1:5
- D. 1:10

Question 13

The most likely natural sink for mercury is

- A. absorption by trees.
- B. evaporation.
- C. sediment at the bottom of the lake.
- D. upper atmosphere (carried up by winds).

Question 14

Melbourne Airport's Environmental Management System (EMS) complies with the appropriate regulatory framework, ISO 14001.

The main purpose of the EMS is to enable the airport to

- A. identify and evaluate the environmental risks of implementing policies.
- B. implement environmental policy and assess the ongoing effectiveness of its environmental practices.
- C. implement a 'whole life time' analysis of its processes and products to increase the efficiency of resource use.
- D. identify and evaluate the environmental effects of proposed developments prior to major decisions being made.

The following information relates to Questions 15–17.

A commercial tourism company plans to set up a resort on an island a long distance from the mainland. The project is strongly promoted as ‘ecotourism’ in the company’s planning application and literature.

The resort will use solar power and recycled water.

The activities listed in the planning application are swimming, sailing, motor trail bike riding, rowing boats, water-skiing and jet-skiing.

Question 15

Which one of the following aspects of the project would support its description as ‘ecotourism’?

- A. It is located on an island.
- B. It will attract ecotourists.
- C. It uses renewable power and water.
- D. It is isolated, away from population centres.

Question 16

Which one of the following activities proposed for the development can best be described as ‘environmentally sustainable’ in terms of energy usage?

- A. jet-skiing
- B. water-skiing
- C. rowing boats
- D. motor trail bike riding

Question 17

Which one of the following is an essential component of an ecotourism activity?

The activity must

- A. be commercially profitable.
- B. have an educational focus.
- C. increase biodiversity.
- D. involve a threatened native species.

The following information relates to Questions 18–20.

The Victorian State Government recently released the Yarra River Action Plan.

This was partly in response to media reports that pollution in the Yarra was approaching or exceeding unacceptable health limits, as measured by *E.coli* readings.

The Yarra River Action Plan outlines remediation measures to be funded and undertaken, including the commitment to funding of \$250 million over twenty years.

Question 18

The Yarra River Action Plan is an example of

- A. ecotourism.
- B. Life Cycle Analysis.
- C. waste minimisation.
- D. an Environmental Management System.

Question 19

As part of the action plan, the government commissions an Environmental Risk Assessment (ERA).

The aim of an ERA should be to

- A. minimise the cost of the project.
- B. eliminate all damage to the environment during the project.
- C. avoid the risk of later legal action against the government.
- D. identify any disadvantages of proposed actions under the plan, so that they can be balanced against the advantages.

As part of the Environmental Risk Assessment, Melbourne Water takes samples from several points along the Yarra River and measures the number of *E.coli* organisms per 10 ml of water. Samples are taken once a week over a six-month period at 20 sites along the Yarra River.

Question 20

The reason for taking samples at 20 different sites is to

- A. allow for variation in the *E.coli* count over time.
- B. provide a large number of samples to store for future testing.
- C. allow for temperature variations affecting the test equipment.
- D. identify the most polluted sites, and therefore sources of pollution.

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 to answer **parts a.–d.**

Pollutant _____

- a. Explain why this material is considered a pollutant. Your answer should refer to factors that define a material as a pollutant, and how these factors apply to your nominated material.

[illegible]

3 marks

- [illegible]

SECTION B – Question 1 – continued
TURN OVER

- c. If there were no human intervention to remove it, describe how this pollutant would leave the immediate environment. You should include reference to its persistence.

3 marks

- [illegible]

SECTION B – continued
TURN OVER

Question 2

A team of environmental scientists is studying emissions of sulfur dioxide from a coal-burning power station. They are taking measurements and designing experiments to determine the distribution of sulfur dioxide and its impacts.

The power station burns coal that contains high quantities of sulfur. The power station is located near the ocean.

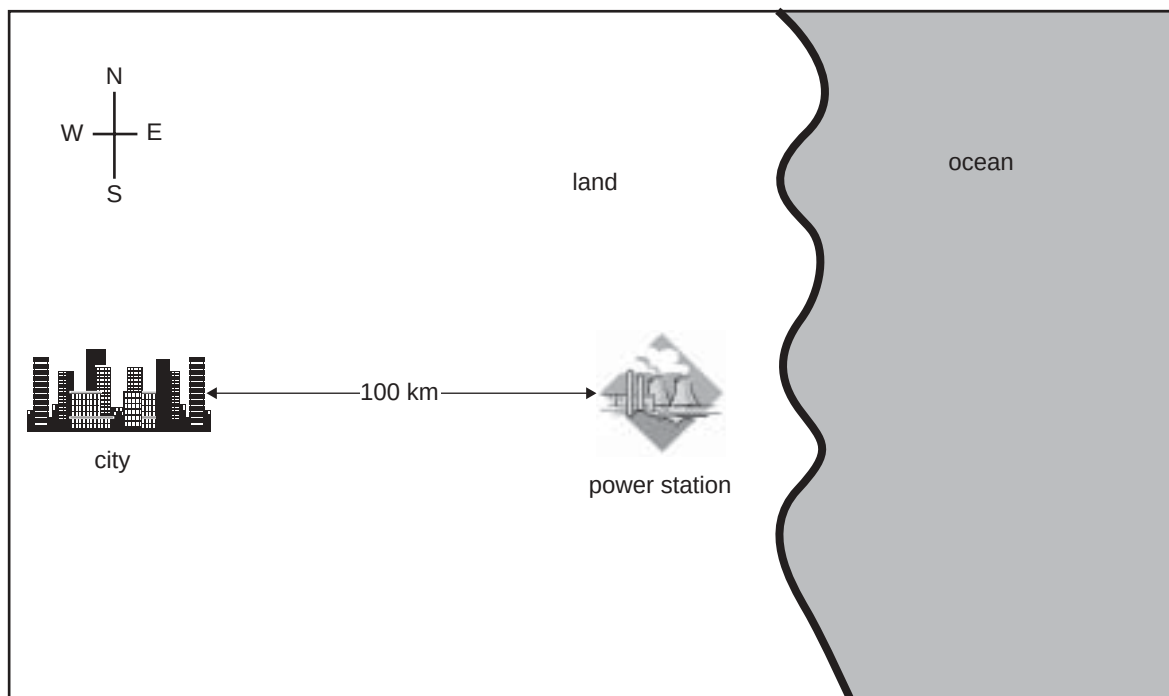


Figure 1 Map of region

The scientists monitor the atmospheric concentration of sulfur dioxide at a city 100 km inland from the power station. They also record the weather conditions. Their results are presented in the following table.

Table 1

date	atmospheric concentration of sulfur dioxide (parts per million)	wind from	wind speed (kilometres per hour)	weather conditions
16 March	0.1	west	18	clear
17 March	0.2	south	10	rain
18 March	2.4	east	36	clear
19 March	0.3	east	28	rain

(Note that 'wind from' indicates the direction from which the wind comes. Wind from north, for example, blows from north to south.)

- a. Describe the impact of high concentrations of sulfur dioxide on human health.

2 marks

- b.** Use the information in Table 1 to describe the transport mechanism for sulfur dioxide.

2 marks

- c.** Use the information in Table 1 to describe a pollutant sink for sulfur dioxide.

2 marks

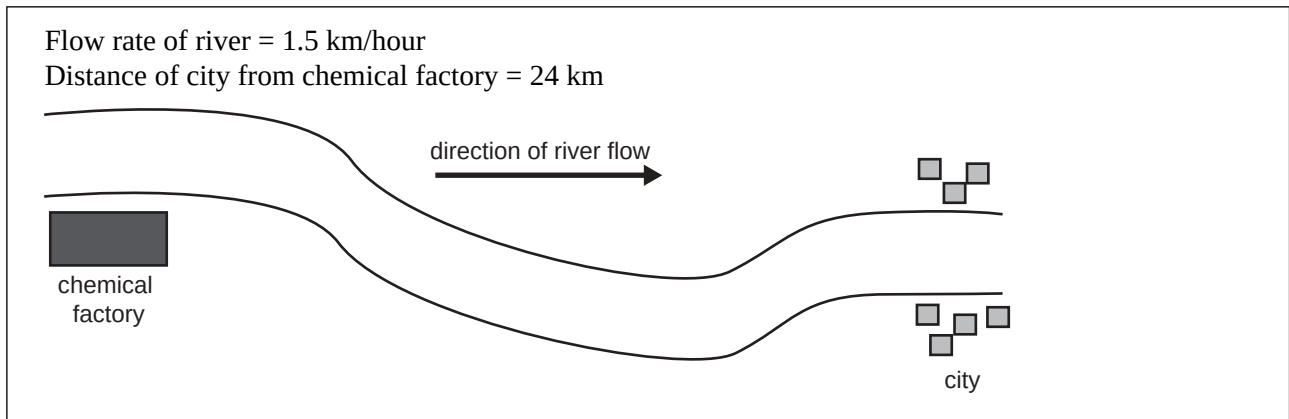
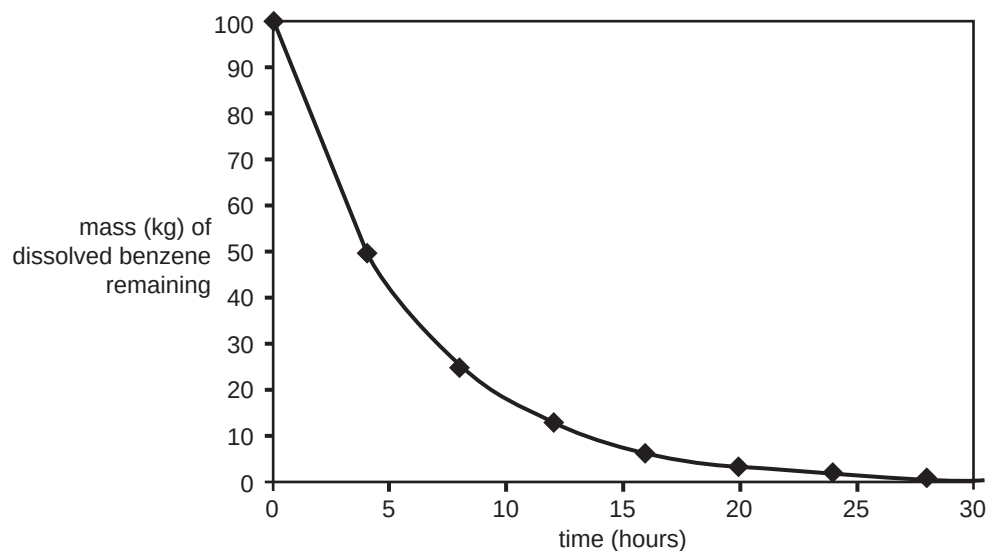
- d.** Health workers are concerned about city residents' exposure to, and dosage of, sulfur dioxide. Explain the difference in meaning of the terms 'exposure' and 'dosage', in this context.

3 marks

Total 9 marks

Question 3

An explosion at a chemical factory releases 100 tonnes of a toxic pollutant, benzene, directly into a nearby river. After the clean-up, which involved removing surface benzene, it was found 100 kg had dissolved in the river water. This benzene travelled down the river as a block. Benzene is a liquid which is much more volatile (evaporates much more easily into air) than water. When ingested or inhaled, benzene is known to cause cancer in humans and aquatic species.

**Figure 2** Map of site**Figure 3** Persistence of benzene in water: Mass of benzene remaining (kg) versus time (hours)

- a. Use the characteristics of benzene to explain why its mass in the water decreases over time, as shown in Figure 3.

3 marks

Various methods of treatment are commonly used to minimise the consequences of benzene spills into the environment.

Two of these are

- adding detergent to the water. Liquid detergent, which itself dissolves in water, is known to increase the solubility of benzene in water, and therefore reduce evaporation.
- adding solid charcoal. Solid charcoal is known to absorb/trap benzene. The charcoal, which is not soluble, needs to be filtered out.

Under safe conditions, a group of students constructed a laboratory model of the chemical spill by dissolving 80 g of benzene in a large, sealed tank containing 50 L of water. The students calculated the initial concentration of benzene and then tried three actions separately, to model possible strategies for managing a real-life spill.

The three actions were

- no action (untreated)
- adding equal mass (80 g) of liquid detergent
- adding solid charcoal.

The mass of benzene remaining in the tank was measured 4 hours and 8 hours after each treatment method.

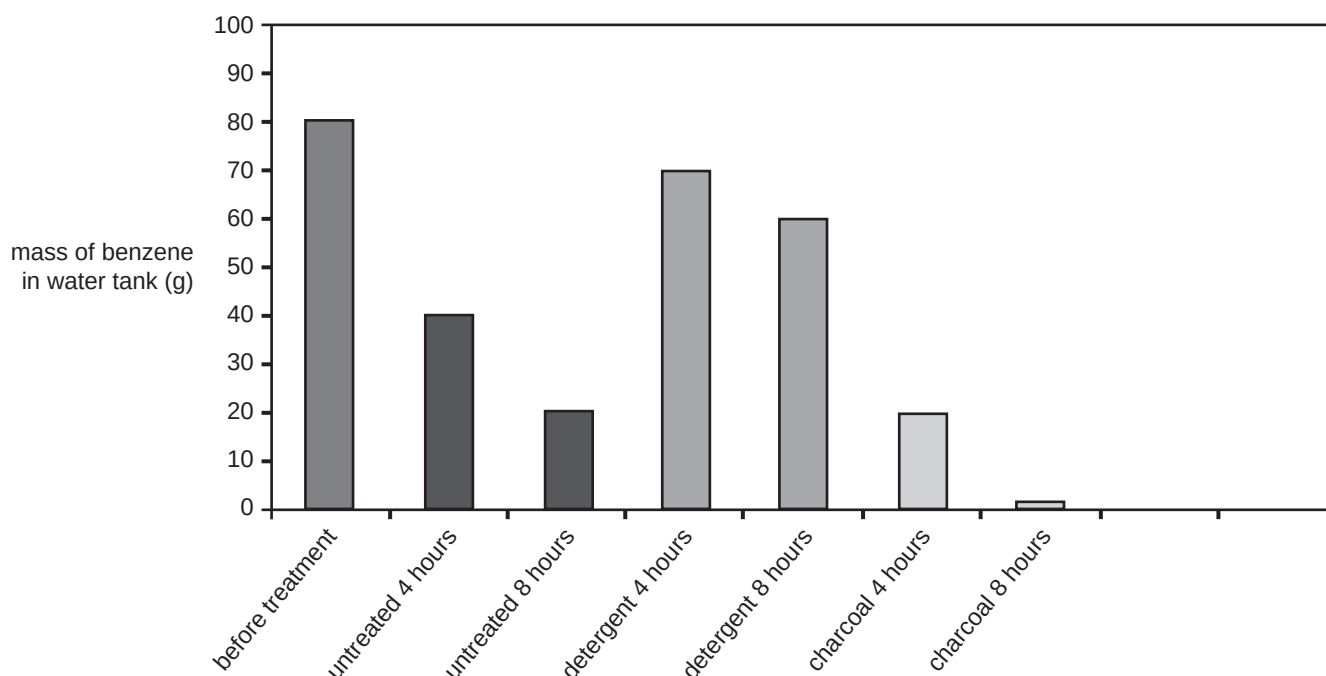


Figure 4 Observed mass of dissolved benzene versus time for different actions

- b. Calculate the initial concentration of benzene in grams per litre.

2 marks

-
-
-
-

d. Compare the results obtained for the untreated tank as shown in Figure 4 to the data in Figure 3. Discuss the validity of this laboratory experiment for modelling the real-life scenario.

[illegible]

SECTION B – Question 3 – continued
TURN OVER

Figures 2, 3 and 4 are repeated here to help answer Question 3e.

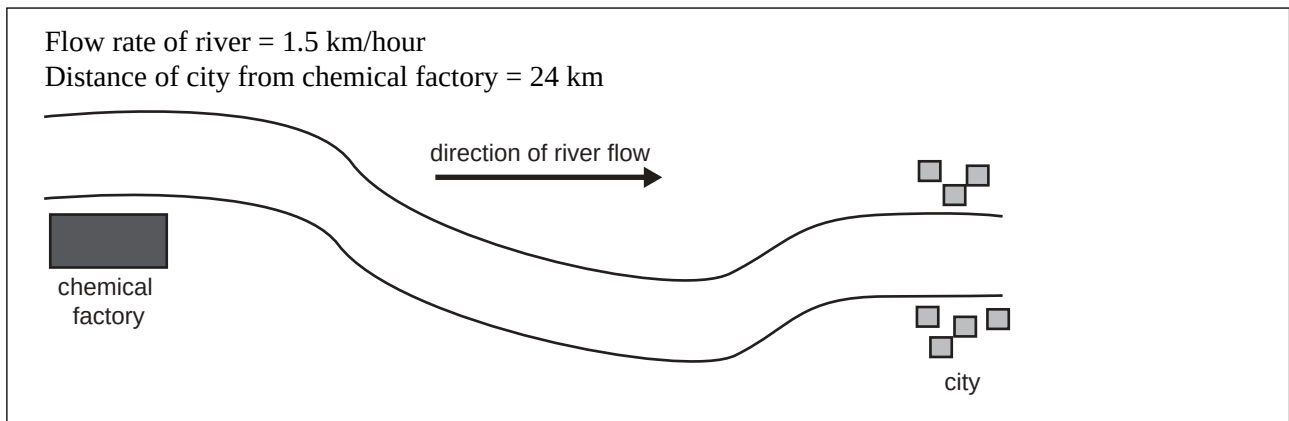


Figure 2 Map of site

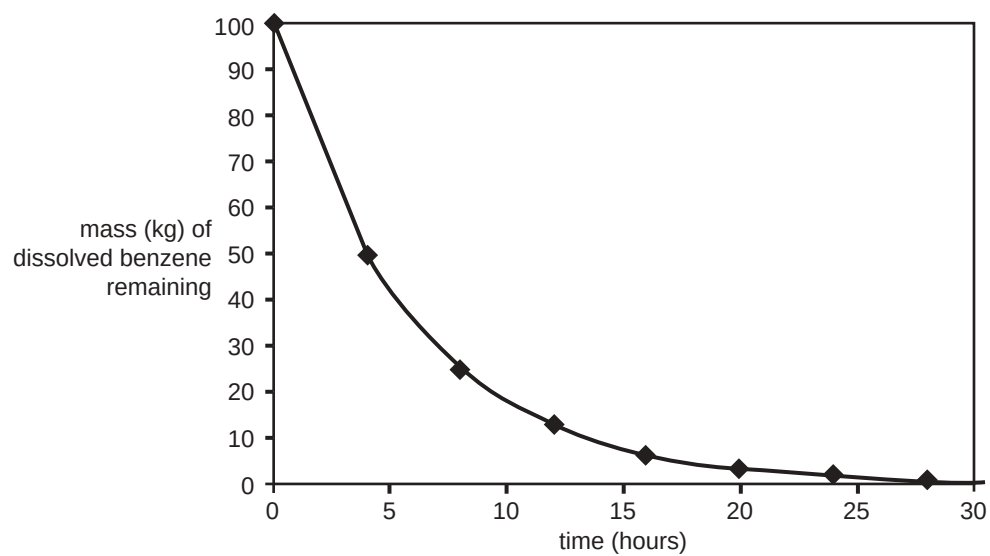


Figure 3 Persistence of benzene in water: Mass of benzene remaining (kg) versus time (hours)

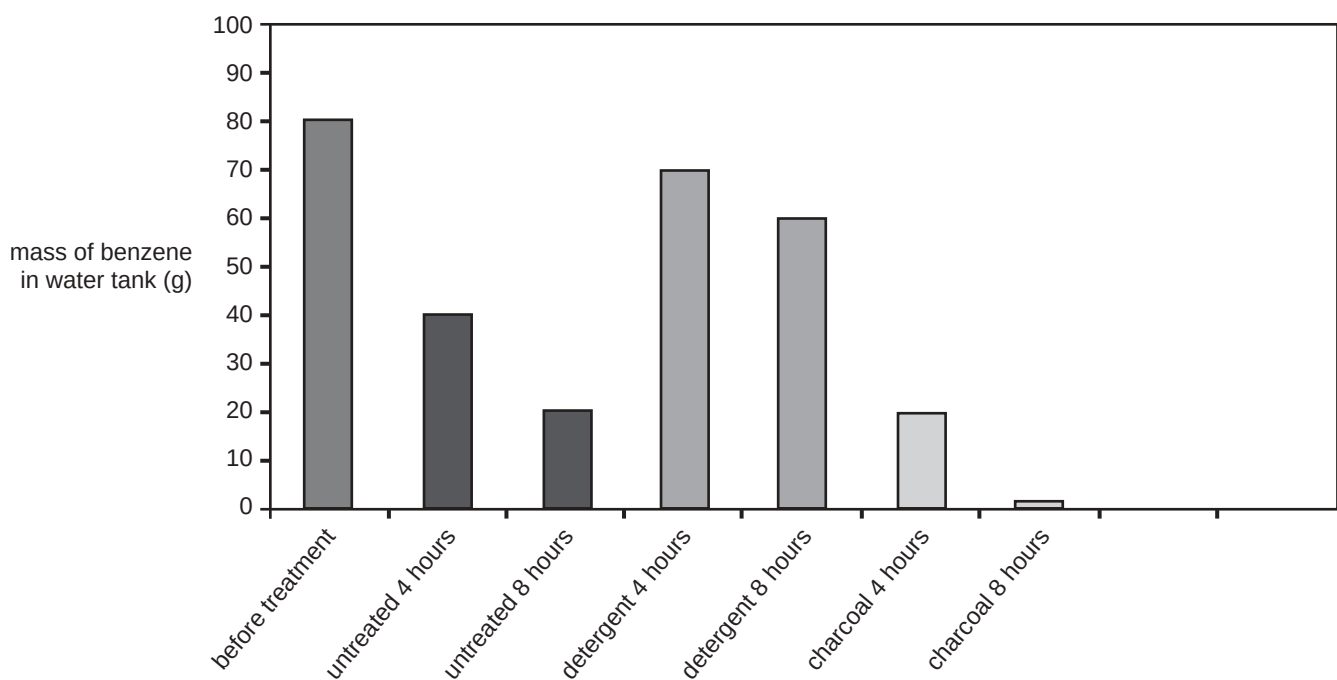


Figure 4 Observed mass of dissolved benzene versus time for different actions

- [illegible]

Total 16 marks

SECTION B – continued
TURN OVER

Question 4

Name an environmental science project you have studied this year.

Project _____

- a. Describe the location and time frame of this project.

2 marks

- b. Outline the aims of this project.

2 marks

- c. Describe any consultative process or regulatory frameworks associated with this project.

2 marks

- d. Describe any strategies that were used to address the environmental aims of this project or to protect against environmental damage during this project.

3 marks

- [illegible]

Total 14 marks

Question 5

A regional electricity authority identifies the need for more electrical generation capacity, approximately 1 000 MW, in addition to its current 5 000 MW capacity.

(For comparison, 1 000 MW represents about 10% of Victoria's current electrical generating capacity.)

Two proposals are put forward by the electricity authority.

Proposal A A coal-fired thermal power station. This would be one station, using a nearby open-cut coal mine with a plentiful supply of coal.

Proposal B Wind power. A series of wind farms (approximately 2 000 wind turbines in total) along a moderately windy coastline.

Two students, Claire and Brad, are debating the advantages and disadvantages of each proposal.

Brad argues for the coal-fired station based on the following points.

- Both initial cost and life cycle costs will be lower.
- It will affect the population less, have less visual impact, and so will not reduce land values in the region.
- Newly developed techniques such as geosequestration (burying carbon dioxide deep underground) can decrease carbon emissions.
- Coal can provide power continuously, but wind only some of the time, so an alternative source will be needed, which is an added cost.

Claire argues for the wind power proposal based on the following points.

- Wind power is less polluting than coal.
- Wind power is renewable, coal is not renewable; therefore wind power is more environmentally friendly.
- Wind power causes less disturbance to the land, and therefore to animals.
- Wind farms will attract tourists to look at them.

- a. Explain the term 'ecologically sustainable' as it relates to the generation of electricity.

3 marks

Environmental Risk Assessment is an essential part of the decision-making process for this project and involves consultation with interested key stakeholders.

- b. List **two** key stakeholders in this project and their interests.

4 marks

c. Explain what is meant by Life Cycle Analysis, and outline **two** factors that should be taken into account in a Life Cycle Analysis for this project.

d. Using **only** the information given, evaluate the arguments Brad and Claire have made for each proposal. You should refer to economic and environmental considerations.

[illegible]

END OF QUESTION AND ANSWER BOOK