

STUDENT NAME	
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## Victorian Certificate of Education 2009

### ENVIRONMENTAL SCIENCE

#### Trial Written Examination 2

October 2009

Time allowed 1.5 hours [90 minutes]

## SUGGESTED SOLUTIONS

### Structure of book

Section	Number of questions	Number of questions to be answered	Number of marks
A	20	20	20
B	5	5	70
			<b>Total 90</b>

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Please note this is a practice exam only and its degree of difficulty and content is different to the end of year Unit 4 exam. VAEE takes no responsibility for your success in completing the actual VCE Environmental Science Unit 4 exam.

### SECTION A - Multiple-choice questions

#### Question 1

These substances are defined as pollutants because:

- C. they cause deleterious health effects and are released by human action

#### Question 2

The best description of the toxic mechanism of these pollutants is:

- D. they are inhaled and their combined effect is greater than the sum of their individual effects

#### Question 3

These insecticides

- A. have low mobility

#### Question 4

- B. it increases the likelihood of insects undergoing chronic exposure

#### Question 5

It is most likely that

**C. the LD50 of an organochlorine insecticide is lower for insects than humans**

#### Question 6

The smelting plant is most likely

**B. a point source of sulfur dioxide**

#### Question 7

If  $2 \times 10^{24}$  particles of nickel sulfide were used up in the reaction, how many particles of nickel oxide would be produced?

**C.  $2 \times 10^{24}$  particles of NiO**

#### Question 8

If 195g of nickel is produced, and nickel is 79% of the mass of nickel oxide, what mass of nickel oxide is produced?

**D. 0.247kg**

#### Question 9

The LD40 for nicotine is

**D. 2.0 mg/kg**

#### Question 10

The threshold for nicotine is closest to

**B. 0.1mg/kg**

#### Question 11

The human LD50 for arsenic oxide is 10mg/kg. The U.S. EPA recommended maximum concentration of this pollutant in water is 50mg/L. The volume of 50mg/L arsenic oxide contaminated water a 60kg man would need to ingest to reach the LD50 is

**A. 12L**

#### Question 12

The “four R’s” help to achieve

**B. waste minimisation**

#### Question 13

Arguments for reusing products incorporate the benefit that new raw materials will not be used up, allowing them to be used in the future. This supports the principle of

**A. sustainability**

#### Question 14

Debate as to whether recycling is a worthwhile process continues, with the argument that the labour, energy and pollution costs associated with collecting materials, sorting them and transporting them back to facilities where they can be reused may be too great to justify the benefits. A cost benefit analysis of the recycling process would best include

**D. life-cycle analysis of the recycled products**

#### Question 15

Local governments in Victoria have introduced legislation to ensure that recycling projects meet acceptable standards. This is an example of

**B. a regulatory framework**

**Question 16**

Which of the following could best be described as “ecotourism”?

**C. a bushwalk in a national park along designated paths with interpretative signs every 10m**

**Question 17**

In which month was the highest average acid concentration recorded?

**A. January**

**Question 18**

In addition to the monitoring process, the management plan would have likely incorporated

**D. mitigation strategies and evaluation methods**

**Question 19**

What was the purpose of taking samples every 3 months?

**A. to account for seasonal weather variation**

**Question 20**

The data shows

**A. significant seasonal variation**

**SECTION B - Short answer questions**

**Question 1 (Total 14 marks)**

Name a substance, other than sulfur dioxide and mercury, you have studied this year.

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- a. Describe the chemical or physical properties of the pollutant that contribute to its i. source and ii. transport mechanism.

**i. at least one property described and reasonably linked to diffuse or point source<sup>1</sup>**

**ii. one property (may be same as above) reasonably linked to transport mechanism<sup>1</sup>**

**2 marks**

- b. State a location where the pollutant has or could effect human health or the health of the environment and describe these detrimental effects

**Specific location stated<sup>1</sup>**

**Detrimental effects described<sup>1</sup>**

**2 marks**

- c. Describe the chemical or physical properties that contribute to the persistence of the pollutant in this location.

**At least 1 property described<sup>1</sup> and linked to persistence at the location<sup>1</sup>**

**2 marks**

- d. Describe a strategy that has been introduced to minimise the impact of this pollutant, ensuring you refer to the sink of the pollutant in your answer.

2 aspects of strategy that can reasonably minimise impact of pollutant described<sup>2</sup>

Reference to pollutant sink<sup>1</sup>

3 marks

- e. “Not all pollution can be eliminated... What is absolutely crucial, however, is to recognise that pollution prevention should be the first choice and the option against which all other options are judged<sup>1</sup>”. Discuss this statement in an evaluation of the pollutant management strategy outlined in part d.

Reference to the quote<sup>1</sup>

Reference to the strategies in d. <sup>1</sup>

Quantitative data to support evaluation<sup>1</sup>

Opinion/evaluation given in a cohesive manner<sup>1</sup>

4 marks

### Question 2 (Total 16 marks)

a. State the properties of elemental mercury and sulfur dioxide in the table below:

Property	Mercury (Hg)	Sulfur dioxide (SO <sub>2</sub> )
State at room temperature	Liquid	Gas
Colour	Silver/grey	Colourless
Specificity	Nervous system	Respiratory system
Symptoms of toxicity	Paralysis, ataxia	Respiratory disease, choking, coughing
Transport mechanism	Can be carried by moving water, but not soluble, Vapour airborne at high temperature	Airborne due to gaseous state
Density in comparison to atmospheric gases	Much more dense than air	More dense than air
Source - diffuse or point?	Point when emitted from industrial plant, Diffuse when from landfill	Point when from coal burning or metal smelting
Natural sink	Sediment (wetlands)	Water, ocean

8 marks

b. Compare the negative environmental consequences of elemental mercury and sulfur dioxide if each were released in medium concentration into a small lake.

Sulfur dioxide would be converted to sulfuric acid in the lake<sup>1</sup>

<sup>1</sup> Joel Hirschorn, in G. Tyler Miller, Jr. *Living in the Environment*, 8<sup>th</sup> Ed. 1994 Belmont, California: International Thomson Publishing

Sulfuric acid could cause immediate damage to fish fry, inhibit nutrient uptake of aquatic plants and animals and cause direct damage to living tissues (at least one negative consequence stated)<sup>1</sup>

Whereas the negative effects of mercury contamination would take a longer time to realise as the mercury would initially fall into the sediment in the lake (answers could also discuss immediate effects of elemental mercury ingestion)<sup>1</sup>

This mercury could then be converted to methyl mercury by bacteria in the sediment. The methyl mercury then has the capacity to be absorbed into living tissues and bioaccumulate in the food chain, causing damage to the nervous system of higher-order feeders. (a more simplified answer is acceptable here)<sup>1</sup> Similarities would also be rewarded here, eg. Both pollutants would cause significant harm to aquatic life via disruption of the food chain.

4 marks

c. A manufacturing plant releases elemental mercury vapour and sulfur dioxide at a very high temperature from a 40m high chimney stack on a calm, dry day. Predict the relative concentration of each pollutant at the following locations, considering the properties of each:

i) 30cm from the chimney stack, at 40m height, 2 minutes after release:

The concentration of mercury would be low, as its low boiling temperature and high density<sup>1</sup> would cause it to form a liquid and to fall to the ground soon after release. The concentration of sulfur dioxide would be higher than mercury because it would remain as a gas and travel by an airborne mechanism into the area<sup>1</sup>.

2 marks

ii) 30cm from the chimney stack, at ground level, 10 minutes after release:

The concentration of mercury would be higher than sulfur dioxide, due to its high density causing it to fall quickly to the ground<sup>1</sup>. The gaseous state of sulfur dioxide would cause it to stay airborne for longer than 10 minutes<sup>1</sup>.

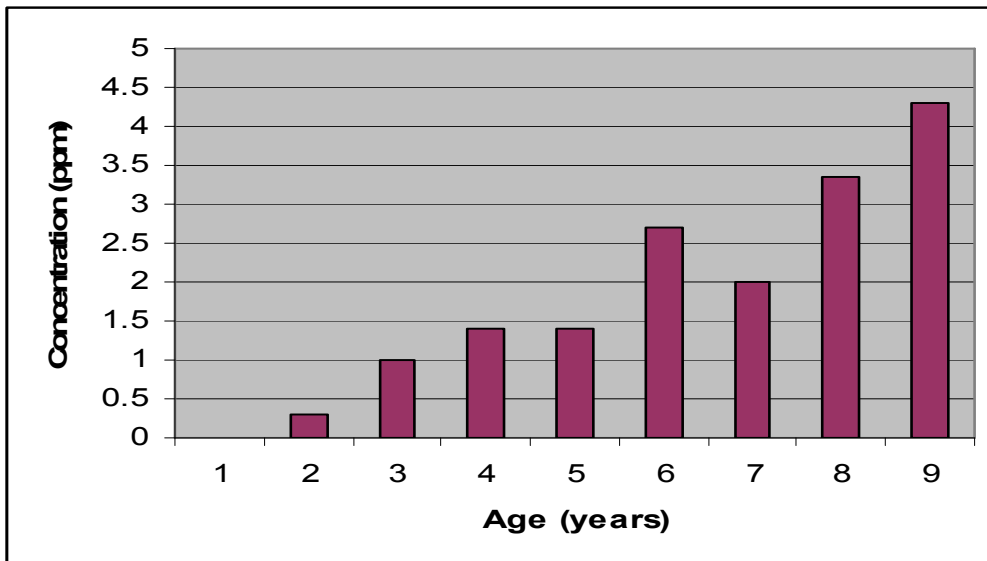
2 marks

### Question 3 (Total 14 marks)

a. The cormorant and the lake trout have identical food sources. In which animal, the cormorant or the lake trout, would you expect the higher concentration of DDT? Explain: The cormorant will have the higher concentration of DDT<sup>1</sup>, as it must eat much more of the DDT contaminated food sources to maintain its body weight<sup>1</sup>, causing increased bioaccumulation of the toxin.

2 marks

The following graph shows the variation with age of the average DDT concentration in Lake Ontario trout<sup>2</sup>:



b. Calculate the average percentage increase in DDT concentration from the age of 2 to 9:

$$(4.3-0.25)/0.25 = 16.2$$

$$16.2 \times 100 = 1620\% \quad 1 \text{ mark}$$

c. Circle the correct answer, the increase in concentration is due to:

Bioaccumulation 1 mark

d. State one age where the data is anomalous. Suggest one improvement to the data gathering method that could be undertaken to correct this.

5 or 7 years<sup>1</sup>. Any reasonable improvement that includes few assumptions accepted.<sup>1</sup>  
 E.g. As many trout as possible should be tested in order to reduce the effect of: random fluctuations in tissue concentration; or human error in the testing process.

2 marks

e. Using the table above, describe the relationship between solubility in water and bioconcentration factor:

Answers must state trend<sup>1</sup> and refer to data in the table<sup>1</sup>.  
 As the solubility in water decreases, the bioconcentration factor increases. This can be seen in the example of Mirex, where the solubility in water is a low 0.20 and the bioconcentration factor is a high 7.3.

2 marks

f. Explain this relationship in terms of mobility:

Substances with low water solubility are not mobile in water<sup>1</sup> and are fat-soluble. These substances will accumulate in fatty tissues and will not be flushed out through water based systems<sup>1</sup>.

<sup>2</sup> Ibid

2 marks

- e. The U.S. EPA have carried out a risk assessment analysis on DDT. Outline 3 essential pieces of information required to perform the analysis:
- Hazard analysis/evaluation (**toxicity**<sup>1</sup> data). E.g. What is the type and effect of toxicity?
  - Dosage**<sup>1</sup> data, LD50 or other quantitative information about level of toxicity
  - Likelihood of **exposure**<sup>1</sup> (exposure information)
  - Transport mechanisms**<sup>1</sup>
  - Chemical and physical properties**<sup>1</sup>

3 marks

- f. Describe a likely consequence of this risk assessment analysis:  
An action or management plan for the management of DDT would be implemented<sup>1</sup>

1 mark

#### Question 4 (Total 7 marks)

- a. Jim Callender decided to restore the wetlands although there was not quantitative evidence that wetland species were in decline. State the ecological principle he employed in this case.

Precautionary principle

1 mark

- b. Describe the interest of two stakeholders that were or should have been consulted before reaching a decision on whether to restore the wetlands.

Any two of the following or other reasonable answer:

U.S. Fish and Wildlife Service could have provided funding, labour or advice about the rebuilding of areas important to the survival of the animals in their charge.

Canadian Waterfowl Association provided advice in the rebuilding program in order that more habitat be available to Canadian Waterfowl on their migratory path.

Local Government - a permit may be required when undertaking such extensive changes to the area. Parks protection may be available for the rejuvenated area.

Local residents - a local wetland will increase the number of native animals in the area and of birds overhead. Local residents may wish to visit the area.

Ramsar convention - for the protection of wetland birds, funding and long-term protection could be available

2 marks

- c. Outline three essential components of the environmental management plan for the restored wetlands.

One mark is awarded for each of the following aspects of an EMP:

- \* A statement of the aims or objectives of the project<sup>1</sup>
- \* A clear environment policy in accordance with legislation (eg. EPA)<sup>1</sup>
- \* Continual monitoring<sup>1</sup>
- \* Response procedures when environmental limits are reached<sup>1</sup>
- \* Continual evaluation of performance and improvement<sup>1</sup>

4 marks

#### Question 5 (Total 20 marks)

- a. Describe:

- the location of the project:

Specific location described

1 mark

ii. the timeline of the project:

Specific timeline described

1 mark

iii. the main stakeholder in the project and their interest:

Stakeholder with clearly important interest described

1 mark

iv. the primary aims of the project:

At least one reasonable aim described

1 mark

b. Explain how regulatory frameworks have assisted or informed the environmental management process:

Government legislation stated<sup>1</sup>  
and linked to assisting or informing the EMP<sup>1</sup>

Eg. The Management Plan for the project was written according to the ISO 14001 framework

2 marks

c. Describe an ecotourism activity, including location, activities and how environmental education is achieved:

Specific location stated<sup>1</sup>  
Activities with minimal environmental impact described<sup>1</sup>  
Environmental education process explained<sup>1</sup>

3 marks

d. Evaluate the magnitude of the environmental risks of the nominated environmental science project compared to the environmental risks of the nominated ecotourism activity.

Risks of project outlined<sup>1</sup>  
Risks of ecotourism activity outlined<sup>1</sup>  
Magnitude of both compared<sup>1</sup>  
Judgement made according to magnitude<sup>1</sup>

4 marks

e. Evaluate, using data, the success of the environmental science project in mitigating the risks described in d. above.

Describes at least 2 management strategies that address risks above<sup>2</sup>  
Quantitative data used<sup>1</sup> to make judgement (student's opinion)<sup>1</sup>

4 marks

f. Discuss whether the nominated environmental science project OR ecotourism activity meets the principles of ecologically sustainable development:

Refers to activities undertaken in project or ecotourism<sup>1</sup>  
Discusses (2 reasonable arguments) whether these can be maintained without compromising future generations<sup>2</sup>

3 marks

- END OF EXAM -