

Trial Examination 2023

## VCE Environmental Science Units 3&4

Written Examination

### Question and Answer Booklet

Reading time: 15 minutes

Writing time: 2 hours

Student's Name: \_\_\_\_\_

Teacher's Name: \_\_\_\_\_

#### Structure of booklet

| <i>Section</i> | <i>Number of questions</i> | <i>Number of questions to be answered</i> | <i>Number of marks</i> |
|----------------|----------------------------|---|------------------------|
| A              | 30                         | 30  | 30                     |
| B              | 8                          | 8   | 90                     |
|                |                            |   | Total 120              |

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 correction fluid/tape.

#### Materials supplied

Question and answer booklet of 27 pages

Answer sheet for multiple-choice questions

#### Instructions

Write your **name** and your **teacher's name** in the space provided above on this page, and on the answer sheet for multiple-choice questions.

Unless otherwise indicated, the diagrams in this booklet are **not** drawn to scale.

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 booklet.

**Students are NOT permitted to bring mobile phones and/or any other unauthorised electronic devices into the examination room.**

Students are advised that this is a trial examination only and cannot in any way guarantee the content or the format of the 2023 VCE Environmental Science Units 3&4 Written Examination.

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**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.

Unless otherwise indicated, the diagrams in this book are **not** drawn to scale.

*Use the following information to answer Questions 1–3.*

Arnhem Land is a large wilderness region in the north-east of the Northern Territory that is under the care of the traditional owners, the Yolngu peoples. The Glyde River runs through Arnhem Land and flows into the Arafura Sea. Traditionally, fish traps were used to catch fish, such as barramundi (*Lates calcarifer*), in the Glyde River. Seed-dispersing bird species, such as the hooded parrot (*Psephotellus dissimilis*), are also found in the region.

**Question 1**

Which one of the following describes a provisioning service provided by the Glyde River?

- A. the Glyde River's contribution to the global water cycle
- B. the consumption of barramundi caught in fish traps
- C. the hooded parrot's dispersal of fruit seeds
- D. the sense of place felt by the Yolngu peoples living on Arnhem Land

**Question 2**

Which one of the following statements refers to the ecosystem diversity of Arnhem Land?

- A. Tropical grasslands, coastal mangroves, flood plains and open woodlands are a few of the vast natural landscapes found in Arnhem Land.
- B. Arnhem Land is home to many endemic animal species.
- C. Arnhem leaf-nosed bats (*Hipposideros inornatus*) are likely to lose genes from their gene pool due to their declining population.
- D. At least 160 plant species that are found in Arnhem Land are exclusive to this region of the world.

**Question 3**

The hooded parrot is endemic to the Northern Territory.

This means that

- A. the hooded parrot is found nowhere else in the world.
- B. the hooded parrot is susceptible to inbreeding.
- C. the hooded parrot requires immediate protection from the IUCN.
- D. cultural burning puts the hooded parrot's nests in danger.

**Question 4**

Which one of the following best describes the El Niño–Southern Oscillation?

- A. a long-term natural change caused by below-average land temperatures in South America
- B. a long-term natural change caused by the movement of Earth’s tectonic plates
- C. a medium-term natural change caused by above-average sea surface temperatures in the tropical Pacific Ocean
- D. a short-term natural change caused by volcanic activity

**Question 5**

Populations with high genetic diversity are

- A. susceptible to inbreeding, which can result in potential genetic disorders.
- B. likely to experience genetic swamping.
- C. less resistant to bushfires.
- D. resistant to rapid environmental changes.

*Use the following information to answer Questions 6 and 7.*

The Wellington Caves are a complex cave system located approximately 350 km north-west of Sydney. This cave system is protected under the National Heritage List due to its diverse range of fossil material. The fossil record of Australian vertebrates found in the Wellington Caves has allowed scientists to study long-term changes in the biodiversity of the area. Fossil evidence of the Tasmanian tiger (*Thylacinus cynocephalus*) has been found in the Wellington Caves.

**Question 6**

Which one of the following is the most likely reason for fossil evidence of the Tasmanian tiger being found in the Wellington Caves?

- A. A domesticated Tasmanian tiger was brought to Sydney by a human.
- B. Tasmanian tigers became extinct during the Late Devonian extinction.
- C. Tasmanian tigers were once present on the Australian mainland.
- D. The last remaining Tasmanian tiger was in captivity in Sydney.

**Question 7**

What type of fossil evidence of the Tasmanian tiger was most likely found in the Wellington Caves?

- A. bones
- B. fur
- C. DNA
- D. footprints

*Use the following information to answer Questions 8–11.*

A recycling project in Victoria aims to reduce the amount of organic waste going into landfill. The project involves collecting organic waste from local households and businesses, which will be processed by a new technology called biomass carbonisation and converted to an agricultural-grade soil enhancer. The methane produced in the process will be captured and used to run a water recycling facility. The project will allow the local water provider to increase their revenue by selling the soil enhancer to local farmers; they will then pass this benefit to their customers via reduced water bills.

### **Question 8**

Which one of the following outlines the project's application of intergenerational equity?

- A. The current generation will benefit from water bills that are lower in cost.
- B. The current generation will need to pay for their organic waste to be collected, while the future generation will benefit from reduced methane emissions.
- C. The current generation will benefit from water bills that are lower in cost, while the future generation will benefit from the reduction in landfill waste.
- D. Future generations will need to consider ways to revegetate the site where the current water recycling facility is located.

### **Question 9**

This project is an example of

- A. a regulatory framework.
- B. a project that focuses solely on the lithosphere.
- C. a project that ignores the precautionary principle.
- D. circular economy thinking.

### **Question 10**

Which value system does this project demonstrate?

- A. anthropocentrism
- B. technocentrism
- C. biocentrism
- D. ecocentrism

### **Question 11**

Using methane to run the water recycling facility is environmentally responsible because

- A. it reduces the amount of fossil fuels being consumed.
- B. it is a response to a regulatory framework being imposed by the local council.
- C. fewer local residents will have health issues.
- D. current data shows that methane has a lower global warming potential than coal.

*Use the following information to answer Questions 12 and 13.*

The local council of a coastal region is planning to upgrade a series of hiking trails. Both coastal cliff and forest trails will be widened and resurfaced, and facilities such as car parks and toilet blocks will be upgraded. A qualitative risk analysis is required for the planning of this project.

**Question 12**

Which one of the following statements about the risk analysis is correct?

- A. The risk analysis is one part of the environmental management plan for this project.
- B. Local residents will have input on ways to manage the risks outlined in the risk analysis.
- C. The risk analysis is purely quantitative.
- D. The risk analysis outlines the costs and benefits of taking each risk during the project.

**Question 13**

The project should consider the impacts on Earth's

- A. lithosphere resulting from carbon monoxide and particulate matter emitted by earth-moving machinery.
- B. hydrosphere resulting from the potential loss of small ground-dwelling orchids along some of the forest-based hiking trails.
- C. atmosphere resulting from the runoff from the work site entering local waterways.
- D. biosphere resulting from the disruption of habitats when the hiking trails are widened.

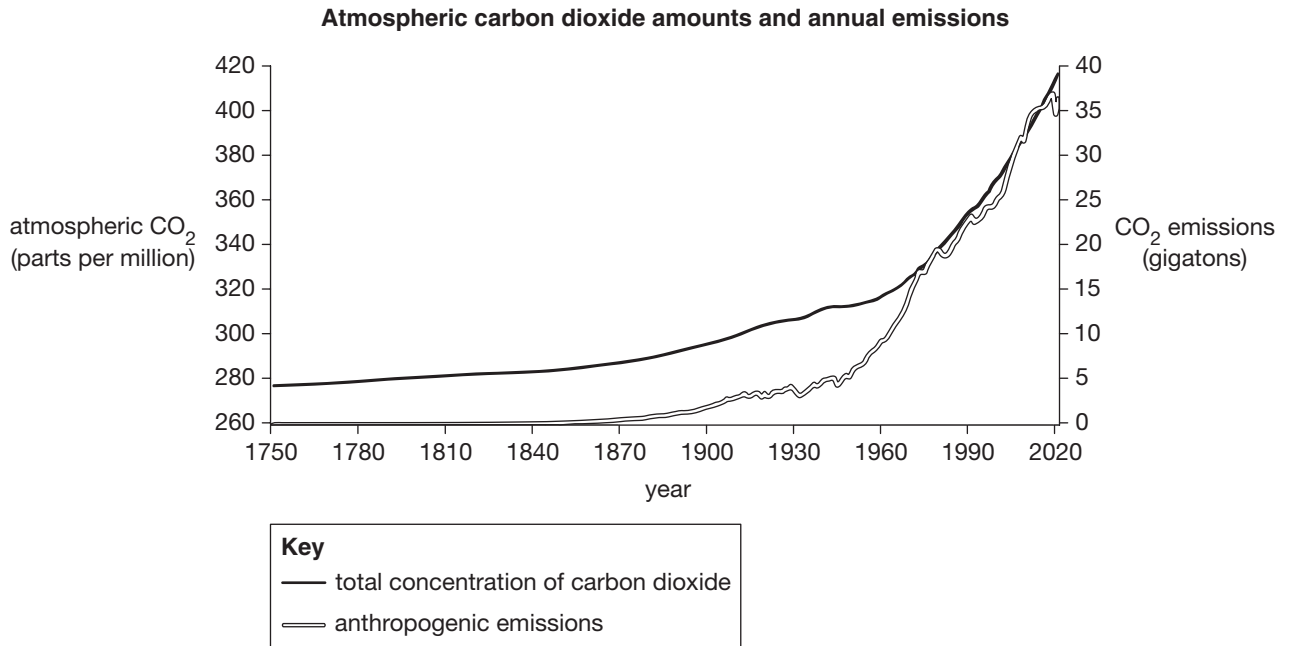
**Question 14**

Which one of the following statements about the natural greenhouse effect is correct?

- A. Ultraviolet radiation is completely absorbed in the troposphere before it reaches Earth.
- B. Visible light is trapped by greenhouse gases before it reaches Earth.
- C. Infrared radiation is absorbed by greenhouse gases in the troposphere.
- D. Visible light can increase the albedo effect in the stratosphere.

Use the following information to answer Questions 15 and 16.

The following graph shows a comparison of the total concentration of global carbon dioxide (CO<sub>2</sub>) and annual anthropogenic emissions of carbon dioxide between 1750 and 2021.



Source: Adapted from National Oceanic and Atmospheric Administration (NOAA) 'Climate Change: Atmospheric Carbon Dioxide'. Accessed November 2022. <https://www.climate.gov/news-features/understanding-climate/climate-change-atmospheric-carbon-dioxide>.

### Question 15

The stable level of atmospheric carbon dioxide between 1750 and 1860 is due to

- A. the carbon cycle.
- B. a volcanic eruption.
- C. the albedo effect.
- D. circulating oceanic currents.

### Question 16

Which one of the following is closest to the percentage increase of carbon dioxide emissions between 1960 and 2020?

- A. 152%
- B. 220%
- C. 350%
- D. 440%

**Question 17**

Which one of the following statements about industrial agriculture is correct?

- A. The greatest contributor to greenhouse gas emissions is carbon dioxide emitted when clearing forests for industrial agriculture.
- B. The greatest contributor to greenhouse gas emissions is methane emitted by the flatulence of livestock on industrial farms.
- C. The greatest contributor to greenhouse gas emissions is water vapour emitted from large-scale irrigation on industrial farms.
- D. Industrial agriculture does not contribute to greenhouse gas emissions, but it should be stopped due to animal welfare issues.

**Question 18**

*Dendrobium toressae* is a species of miniature orchid that is endemic to rainforests in a small area of northern Queensland. The orchid is pollinated in late spring by a native bee known as the sugarbag bee (*Tetragonula carbonaria*). Recently, studies have been conducted into the impacts of climate change on the relationship between these two species.

Which one of the following is a likely impact of climate change on the interactions of these two species?

- A. The orchid will flower later to avoid the warmer springs and the sugarbag bee will become more active during the hotter summers, leading to the orchid having an increased seed set.
- B. The orchid will flower earlier due to warmer springs but the sugarbag bee will not change its behaviour, leading to the orchid having a reduced seed set.
- C. The orchid and the sugarbag bee will both migrate to lower altitudes to avoid heat stress, so their interactions and populations will remain the same.
- D. Tropical rainforest biomes will increase in size due to increased amounts of rain, which will cause the orchid's habitat to increase.

**Question 19**

A state government has introduced a financial incentive program for residents who purchase electric vehicles, rather than traditional fuel-combusting vehicles.

This program is

- A. an adaptation strategy that aims to build resilience to climate change for residents in that state.
- B. an adaptation strategy that aims to reduce greenhouse gas emissions in that particular state only.
- C. a mitigation strategy that aims to reduce global greenhouse gas emissions.
- D. a mitigation strategy that aims to build resilience to climate change for Australians living close to the sea.

**Question 20**

Sea surface temperature monitoring can be used to measure past and present changes in global climate. Which one of the following is an important consideration when analysing sea surface temperature data?

- A. Sea surface temperature naturally fluctuates due to seasonal changes in solar activity.
- B. Sea surface temperature can increase as the albedo effect increases.
- C. Sea surface temperature is only collected from the poles as these are the most reliable locations.
- D. Sea surface temperature cannot give information on global climate as air and water temperatures are measured using different scales.

**Question 21**

Which energy source is extracted through fracking?

- A. oil
- B. uranium
- C. natural gas
- D. coal seam gas

*Use the following information to answer Questions 22 and 23.*

In January 2021, the Ranger uranium mine in Kakadu National Park was closed after 40 years of operation. Rehabilitation of the mine site is underway and, upon completion, the site will be closed so that the traditional owners, the Mirarr people, can return to Country.

**Question 22**

Which one of the following is a mechanical rehabilitation strategy that is likely to be used on the site of the Ranger uranium mine?

- A. removing invasive species from the area
- B. using anaerobic bacteria to assist with waste removal
- C. dredging mud and sludge from water storage areas
- D. adding fertiliser to new topsoil to improve fertility

**Question 23**

Which one of the following describes the energy source provided by uranium?

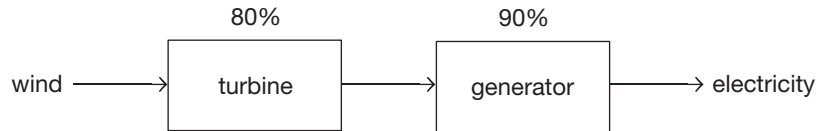
- A. renewable and fossil fuel
- B. renewable and non-fossil fuel
- C. non-renewable and fossil fuel
- D. non-renewable and non-fossil fuel



Use the following information to answer Questions 24–27.

The council of a town on the south-west coast of Victoria is considering the construction of a large-scale wind farm to provide electricity to its residents. By implementing this strategy, the council intends to stop relying on coal and other fossil fuels for electricity.

The following diagram shows the conversion of wind to electricity that will occur in the turbines that will be constructed at the wind farm. The percentage efficiency of each step in the conversion is shown.



#### Question 24

Which one of the following lists the types of energy involved in the conversion of wind into electricity?

- A. kinetic → potential → electrical
- B. kinetic → mechanical → electrical
- C. potential → heat → electrical
- D. thermal → mechanical → kinetic

#### Question 25

What is the approximate overall energy efficiency of this wind turbine?

- A. 72%
- B. 80%
- C. 85%
- D. 112%

#### Question 26

What is the most likely environmental reason for the council's decision to use wind energy instead of coal energy?

- A. Building the wind farm will increase the availability of construction jobs in the town.
- B. Pest species will decrease when the land is cleared for the wind farm due to loss of habitat.
- C. The wind farm will reduce the town's greenhouse gas emissions, which will in turn reduce their contribution to the enhanced greenhouse effect.
- D. The wind farm will reduce the town's greenhouse gas emissions, which will reduce their contribution to the natural greenhouse effect.

#### Question 27

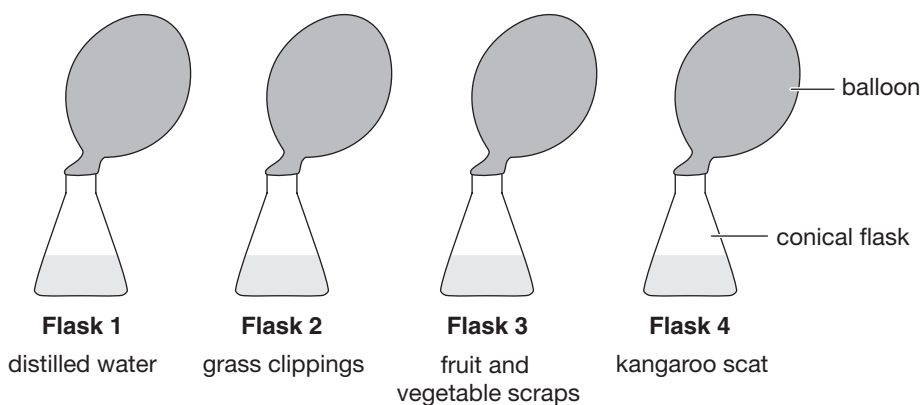
Which one of the following is a disadvantage of wind power when compared to other renewable sources of energy?

- A. Wind power is more energy efficient than solar energy.
- B. Wind power disrupts more natural water flow than hydroelectric power.
- C. Wind power is a more intermittent energy supply than solar energy.
- D. Wind power is more readily available to homeowners in Australia than geothermal power.

Use the following information to answer Questions 28–30.

An Environmental Science student conducted an experiment to compare the biogas emissions from different types of waste.

The student set up four conical flasks. In flask 1, they placed 300 mL of distilled water. In flasks 2, 3 and 4, they placed 300 mL of different pureed organic materials. All four flasks were topped with balloons of equal mass. The student measured the width of the balloons each day for seven days with a 15 cm ruler and took photographs. After seven days, the change in the mass of the balloons was measured with an electronic balance. The diagram below shows the set-up of the experiment.



### Question 28

Another student suggested that three flasks should be set up for each type of organic matter, resulting in a total of 12 flasks being measured.

This suggestion would reduce the chance of

- A. random errors.
- B. systematic errors.
- C. personal errors.
- D. outliers.

### Question 29

Which one of the following is the dependent variable of this experiment?

- A. the type of organic matter
- B. the mass of the balloons
- C. the mass of the organic matter
- D. the species of kangaroo

### Question 30

Which one of the following identifies the gases emitted from flasks 2, 3 and 4?

- A. carbon dioxide and methane
- B. carbon dioxide and oxygen
- C. methane and chlorofluorocarbons
- D. methane and oxygen

**END OF SECTION A**

**SECTION B****Instructions for Section B**

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

Unless otherwise indicated, the diagrams in this book are **not** drawn to scale.

**Question 1** (11 marks)

The two largest biomes in Brazil are the Amazon Rainforest and the Cerrado savanna. The Amazon Rainforest is over 500 million hectares and the Cerrado savanna is approximately 200 million hectares.

The data below shows the estimated number of species found within the Amazon Rainforest and the Cerrado savanna.

|                 | <b>Amazon Rainforest</b> | <b>Cerrado savanna</b> |
|-----------------|--------------------------|------------------------|
| <b>Trees</b>    | 2500                     | 800                    |
| <b>Birds</b>    | 1300                     | 860                    |
| <b>Mammals</b>  | 427                      | 200                    |
| <b>Reptiles</b> | 370                      | 180                    |

- a. Compare the species richness of the Amazon Rainforest and the Cerrado savanna. 2 marks

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- b. Identify **two** factors that may have led to the difference in the species richness of the Amazon Rainforest and the Cerrado savanna. 2 marks

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- c. An Environmental Science student wants to compare the Simpson's Index of Diversity (SID) for both biomes.

Identify what data the student would need to calculate the SID for each biome. 2 marks

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- d.** Name and outline a sampling method that may have been used to estimate the number of mammal species in the Amazon Rainforest. 3 marks

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- e.** Satellite data showed that in the first six months of 2022, almost 4000 square kilometres of the Amazon Rainforest was cleared.  
Describe **two** impacts that this rate of land clearing has had on the Amazon Rainforest's biome. 2 marks

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**Question 2** (12 marks)

The helmeted honeyeater (*Lichenostomus melanops cassidix*) is a critically endangered bird that is endemic to a small region of lowland eucalypt woodlands in southern central Victoria.

The helmeted honeyeater acts as a pollinator for various eucalypt species when it feeds on the nectar of the flowers. On average, they nest between one and four metres off the ground in densely packed, interlocking foliage and their chicks start leaving the nest 13 days after hatching.

The main threat to the helmeted honeyeater is the destruction of its habitat for agricultural purposes. A more recent threat to the bird is the introduction of various herbivorous deer species into its habitat.

- a.** Explain why the introduction of deer species is a threat to the helmeted honeyeater. 2 marks

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- b.** Describe **one** way that climate change may be a threat to the helmeted honeyeater. 3 marks

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- c.** The helmeted honeyeater is legally protected from harm in Victoria.

- i.** Name the regulatory framework responsible for the protection of the helmeted honeyeater in Victoria. 1 mark

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- ii.** Identify **one** way that this framework provides protection for the helmeted honeyeater. 1 mark

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- d.** A strategy for the conservation of the helmeted honeyeater includes revegetation, habitat reconstruction and connection of the eucalypt woodlands.

Explain how this conservation strategy may increase the population of the helmeted honeyeater.

2 marks

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- e.** Since 1989, Melbourne Zoo has been conducting a captive breeding program for the helmeted honeyeater.

Explain how captive breeding programs can be used to support the helmeted honeyeater.

2 marks

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- f.** ‘The helmeted honeyeater is critically endangered.’

Explain what is meant by this statement.

1 mark

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**Question 3** (12 marks)

Monica has recently purchased five hectares of land near the Otway National Park in south-west Victoria. The land has a small stream running through the north-west corner. The eastern half of the land is open eucalypt woodland, which is home to a variety of marsupials, including the endemic tiger quoll (*Dasyurus maculatus*). The western half of the land is mostly grassy woodland with a small portion of cleared space for a two-bedroom tiny house, three large vegetable gardens and a chicken coop.

Monica is deliberating between the following two options for using the land.

- Option A involves clearing the open eucalypt woodland (approximately 2.5 hectares) and building a dairy farm. Monica has estimated the annual profit of a dairy farm to be approximately \$250 000. In this option, Monica could potentially employ two to three individuals who will live and work on the farm full time. Timber from the felled trees can be used to build fencing and milking sheds. However, Monica’s brother has expressed concern about the welfare of the livestock living in dairy farms.
- Option B involves harvesting leaves from the eucalypt trees to begin producing eucalyptus oil, expanding the vegetable patches and extending the chicken coop. Monica has sourced a potential regular buyer for eucalyptus oil, and has researched a number of weekly farmers’ markets where eggs and organic, seasonal vegetables can be sold. In this option, Monica can employ one local resident part-time to assist with the harvesting of eucalyptus leaves; Monica will complete all other daily tasks involved with maintaining the chicken coop and vegetable gardens. The annual profit from this option has been calculated as approximately \$90 000.

- a.** Using a cost-benefit analysis and referring to the ecological, economic and sociocultural dimensions of sustainable development, justify which option Monica should choose. 6 marks

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- b.** Define the principle of efficiency of resource use, and explain how Monica could consider this principle when making her decision. 2 marks

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- c.** Name **one** stakeholder that may be involved in Monica’s decision and describe how their values and priorities may influence her decision. Do not refer to any stakeholders already identified in the scenario. 2 marks

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- d.** Describe **one** negative impact that option A may have on the hydrosphere. 2 marks

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**Question 4** (11 marks)

Compressed, liquified hydrogen is created by splitting hydrogen and oxygen atoms in water. When the energy used in this process is derived from wind or solar power, the product is green hydrogen. Liquified green hydrogen can be used as an alternative energy source for powering vehicles or generating electricity in fuel cells. Unlike fossil fuels, the combustion of hydrogen does not release carbon dioxide.

The construction of a green hydrogen production facility on disused livestock grazing land in Western Australia has recently been approved. As part of the project, a solar farm and 140 wind turbines will be constructed to power the facility. Groundwater from the site will be used in the reaction, and the resulting hydrogen will be stored in high-pressure steel tanks and transported through hydrogen-powered road trains to the communities purchasing it.

- a.** From the perspective of extraction and storage, describe **one** environmental concern related to this project. 2 marks

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- b.** Explain how this project upholds the theory of circular economy thinking. 3 marks

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- c.** Explain why a community may choose to produce electricity using hydrogen fuel cells instead of the combustion of coal. 2 marks

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- d.** Outline the steps of developing an environmental management plan for the site of the green hydrogen production facility.

4 marks

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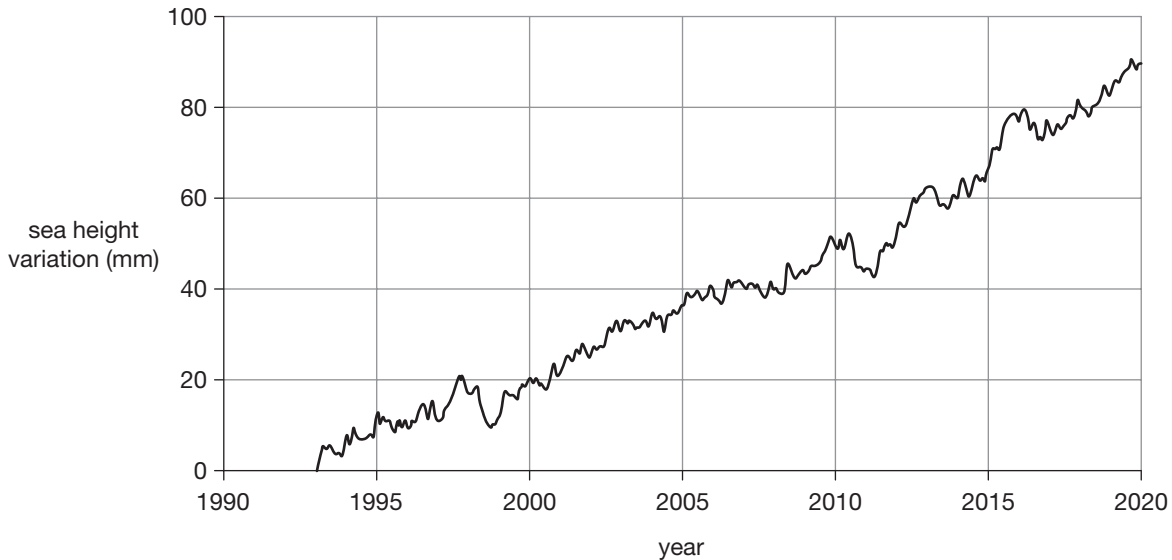
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**Question 5** (12 marks)

Kiribati is a nation composed of 33 atoll islands that are located in the Pacific Ocean. The majority of the population inhabits the capital city of Tarawa. This city is less than three metres above sea level. Climate modelling predicts that the sea level will rise up to 0.76 metres by 2100. The following graph shows the average change in global sea levels between 1993 and 2020.



Source: Adapted from National Aeronautics and Space Administration (NASA).  
‘Vital Signs: Sea Level’. Accessed May 2023. <https://climate.nasa.gov/vital-signs/sea-level/>.

- a. Describe the trend shown in the graph and identify **one** reason for this trend. 3 marks

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- b. Suggest **one** anthropocentric and **one** environmental impact of the predicted rise in sea levels. 2 marks

Anthropocentric \_\_\_\_\_

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Environmental \_\_\_\_\_

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- c.** Describe an adaptation strategy that the government of Kiribati could use to help local communities build resilience against rising sea levels. 2 marks

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The water supply in Tarawa comes from groundwater aquifers that are fed by infiltration. This water supply is also threatened by the predicted rise in sea levels; as such, water scarcity is another issue faced by the population of Kiribati. Construction has begun on a desalination plant and solar energy system that will power the new plant and its connected water supply network.

- d.** Explain how this project meets the sustainability principle of intragenerational equity. 2 marks

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- e.** Explain why the construction of the solar energy system can be considered a climate change mitigation strategy. 3 marks

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**Question 6** (5 marks)

The Intergovernmental Panel on Climate Change (IPCC) is an international body of the United Nations. The IPCC provides governments with assessments and measurements related to climate change, and future predictions about the enhanced greenhouse effect and climate change.

- a.** Describe the confidence levels used by the IPCC when predicting future changes in climate. 2 marks

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- b.** One of the assessments provided by the IPCC relates to the loss of glacial mass in polar regions.  
Explain why measurements of glacial mass can be used to monitor changes in climate. 2 mark

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- c.** Name the natural process that will be disrupted by a loss of glacial mass. 1 mark

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**Question 7** (12 marks)

In 2022, the Australian Government released permits to survey approximately 47 000 square kilometres of the ocean surrounding Australia for oil and gas deposits.

The most common process used to survey marine sites for oil or gas is seismic blasting, which involves using an extremely strong airgun to send high-powered soundwaves to the sea floor. The echoes measured can help to uncover oil or gas reserves, but this process also disturbs the feeding, breeding and communication of marine mammal and fish species.

The council of a small city in Western Australia is considering whether to invest in the exploration of natural gas off the coast. The city's population and subsequent demand for energy has increased over recent years. Most of the energy used in heating and cooking comes from natural gas, and the council wants to ensure they can continue to access natural gas in the years to come.

A proposal has been made to the council to invest in building a solar farm instead.

- a.** Explain how the use of natural gas as an energy source can impact the enhanced greenhouse effect. 3 marks

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- b.** Explain how seismic blasting could impact the sustainability principle of conservation of biodiversity and ecological integrity. 2 marks

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- c. Outline the requirements for creating a solar farm in or around a city. 2 marks

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- d. There is some concern from key stakeholders that if the town chooses to invest in the solar farm, the city's energy demands will not be met during peak demand times.

- i. What is peak demand? 1 mark

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- ii. Do you agree with the stakeholders' concerns? Justify your response. 2 marks

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- e. Describe **one** environmental reason for using solar energy instead of sourcing new natural gas resources. 2 marks

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**Question 8** (15 marks)

The stormwater drains have been upgraded in a new housing estate in a small, coastal city. Environmental Science students at a local school were concerned that a new stormwater outlet pipe will impact a temperate reef area, as the reef is a habitat for a variety of endemic fish and invertebrate species.

The students designed an experiment to measure the physical, chemical and biological indicators of the intertidal zone at three locations along the reef. The students took measurements every Monday morning over an eight-week period. The following diagram shows the three locations at which the students took measurements.

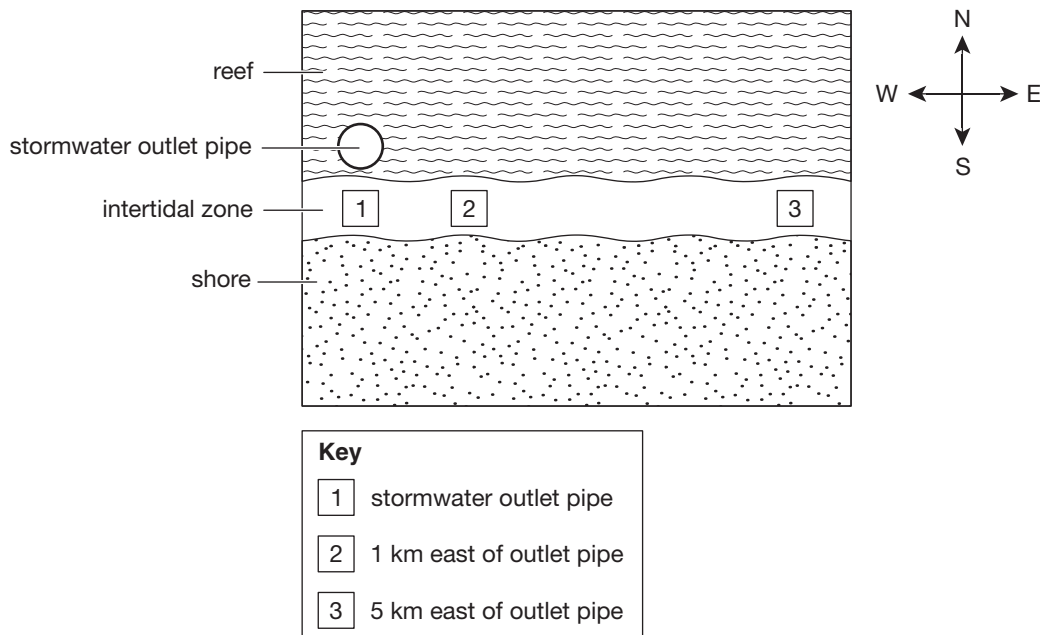


Table 1 details the measuring equipment used by the students, and Table 2 shows the results of the experiment at the end of the eight-week period.

**Table 1: Equipment required to collect data on environmental indicators**

| Indicator  | Variable and unit of measurement | Equipment                 |
|------------|----------------------------------|---------------------------|
| physical   | temperature (°C)                 | digital temperature probe |
| chemical   | nitrites (mg/L)                  | digital nitrate ion meter |
| biological | algae coverage of quadrat (%)    | 1 × 1 metre quadrat       |

**Table 2: Temperature, nitrate and algae coverage values at each location**

| Week | Temperature (°C) |      |      | Nitrates (mg/L) |   |   | Algae coverage (%) |    |    |
|------|------------------|------|------|-----------------|---|---|--------------------|----|----|
|      | Location         |      |      | Location        |   |   | Location           |    |    |
|      | 1                | 2    | 3    | 1               | 2 | 3 | 1                  | 2  | 3  |
| 1    | 18.0             | 16.5 | 16.3 | 6               | 5 | 2 | 80                 | 80 | 75 |
| 2    | 18.3             | 16.8 | 16.5 | 6               | 5 | 2 | 80                 | 83 | 75 |
| 3    | 18.3             | 16.9 | 16.3 | 6.5             | 6 | 3 | 85                 | 85 | 60 |
| 4    | 20.4             | 17.0 | 16.8 | 8               | 6 | 3 | 90                 | 70 | 60 |
| 5    | 18.9             | 17.3 | 17.0 | 7               | 4 | 3 | 90                 | 70 | 50 |
| 6    | 19.0             | 17.8 | 17.0 | 7               | 4 | 2 | 95                 | 75 | 50 |
| 7    | 19.5             | 17.8 | 17.1 | 6               | 4 | 2 | 98                 | 70 | 50 |
| 8    | 19.9             | 18   | 16.9 | 6               | 4 | 2 | 98                 | 60 | 45 |



a. On the grid below, draw a line graph for **one** of the indicators. In your graph:

- provide a title that indicates the variables being graphed
- include a label and suitable scale for each axis
- plot all relevant data points
- include a key.

5 marks



|            |
|------------|
| <b>Key</b> |
|------------|

- b.** Based on the data in Table 1 and your graph from **part a.**, describe the impact of the stormwater outlet pipe on the reef. Use evidence to justify your response. 3 marks

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- c.** Explain why the students may have chosen to collect data from such a wide variety of indicators. 2 marks

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- d.** State **one** safety and **one** ethical consideration that should be accounted for in the method for this experiment. 2 marks

Safety \_\_\_\_\_

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Ethical \_\_\_\_\_

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- e.** Identify **one** possible source of error in this experiment and state the type of error you have identified. 2 marks

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- f.** Suggest **one** way to reduce the chance of the error identified in **part e.** occurring. 1 mark

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**END OF QUESTION AND ANSWER BOOKLET**

## VCE Environmental Science Units 3&4

### Written Examination

#### Multiple-choice Answer Sheet

Student's Name: \_\_\_\_\_

Teacher's Name: \_\_\_\_\_

#### Instructions

Use a **pencil** for **all** entries. If you make a mistake, **erase** the incorrect answer – **do not** cross it out. Marks will **not** be deducted for incorrect answers.

**No** mark will be given if more than **one** answer is completed for any question.

All answers must be completed like this example: 

|   |   |   |   |
|---|---|---|---|
| A | B | C | D |
|---|---|---|---|

#### Use pencil only

|    |   |   |   |   |    |   |   |   |   |
|----|---|---|---|---|----|---|---|---|---|
| 1  | A | B | C | D | 16 | A | B | C | D |
| 2  | A | B | C | D | 17 | A | B | C | D |
| 3  | A | B | C | D | 18 | A | B | C | D |
| 4  | A | B | C | D | 19 | A | B | C | D |
| 5  | A | B | C | D | 20 | A | B | C | D |
| 6  | A | B | C | D | 21 | A | B | C | D |
| 7  | A | B | C | D | 22 | A | B | C | D |
| 8  | A | B | C | D | 23 | A | B | C | D |
| 9  | A | B | C | D | 24 | A | B | C | D |
| 10 | A | B | C | D | 25 | A | B | C | D |
| 11 | A | B | C | D | 26 | A | B | C | D |
| 12 | A | B | C | D | 27 | A | B | C | D |
| 13 | A | B | C | D | 28 | A | B | C | D |
| 14 | A | B | C | D | 29 | A | B | C | D |
| 15 | A | B | C | D | 30 | A | B | C | D |