NSW Education Standards Authority

2020 **HIGHER SCHOOL CERTIFICATE EXAMINATION**

Earth and Environmental Science

General Instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Write using black pen
- Draw diagrams using pencil
- Calculators approved by NESA may be used
- A Geological Time Scale is provided at the back of this paper

Total marks: 100

Section I – 20 marks (pages 2–9)

- Attempt Questions 1–20
- Allow about 35 minutes for this section

Section II – 80 marks (pages 13–32)

- Attempt Questions 21–36
- Allow about 2 hours and 25 minutes for this section

Section I

20 marks
Attempt Questions 1–20
Allow about 35 minutes for this section

Use the multiple-choice answer sheet for Questions 1–20.

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1 Which era in the Geological Time Scale covers the greatest duration of time?

A. Cenozoic

B. Mesozoic

C. Neoproterozoic

D. Palaeozoic

2 Which of the following is correctly ordered from oldest to youngest?

A. Silurian, Paleogene, Cambrian, Jurassic

B. Ordovician, Devonian, Triassic, Cretaceous

C. Archaean, Hadean, Proterozoic, Phanerozoic

D. Cenozoic, Mesozoic, Palaeozoic, Neoproterozoic

3 Significant increases in oxygen in the atmosphere occurred during the Precambrian.

Which sphere was largely responsible for this increase in the production of oxygen?

A. Atmosphere

B. Biosphere

C. Geosphere

D. Hydrosphere

4 Which of the following is made from a renewable resource?

A. Cardboard

B. Glass

C. Petrol

D. Steel

5 The principle of uniformitarianism states that geological processes acted

A. in an unexplained manner in the past.

B. randomly in the past as they do in the present.

C. in the same manner and with the same intensity in the past as they do at present.

D. in a different manner and with a different intensity in the past as they do at present.

6 Which of the following is most likely to account for the origin of life on Earth?

A. Panspermia

B. Superposition

C. Continental drift

D. Anthropogenesis

7 At which of the following tectonic boundaries do most earthquakes of high magnitude occur?

A. Oceanic–oceanic divergent

B. Continental–oceanic convergent

C. Continental–continental divergent

D. Continental–continental convergent

8 Which of the following is the best technique that could be used to project how Earth's climate will change in the future?

A. Analysing ice cores

B. Forecasting daily weather

C. Extrapolating past climate data

D. Using computers to model climate processes

9 Which of the following identifies the potential *immediate* hazards caused by explosive volcanic eruptions such as those associated with Mount Pinatubo?

A. Pyroclastic flows, lahars, acid rain, typhoons

B. Earthquakes, typhoons, lava bombs, ash emissions

C. Lahars, poisonous gas emissions, lava bombs, ash emissions

D. Poisonous gas emissions, global warming, lava bombs, ash emissions

10 Australia may be susceptible to a tsunami because it

A. is on a convergent plate boundary.

B. is near active plate boundaries in New Zealand.

C. has a divergent boundary to the south of Tasmania.

D. has large tidal movements around the north of the continent.

11 Which human activity has the most immediate and direct effect on natural habitats?

A. Over-harvesting fish for human consumption

B. Combustion of fossil fuels producing carbon dioxide

C. Urban expansion requiring infrastructure development

D. Coal fired power stations producing thermal pollution in artificial lakes

12 Which of the following contributes most to the enhanced greenhouse effect?

A. Carbon

B. Methane

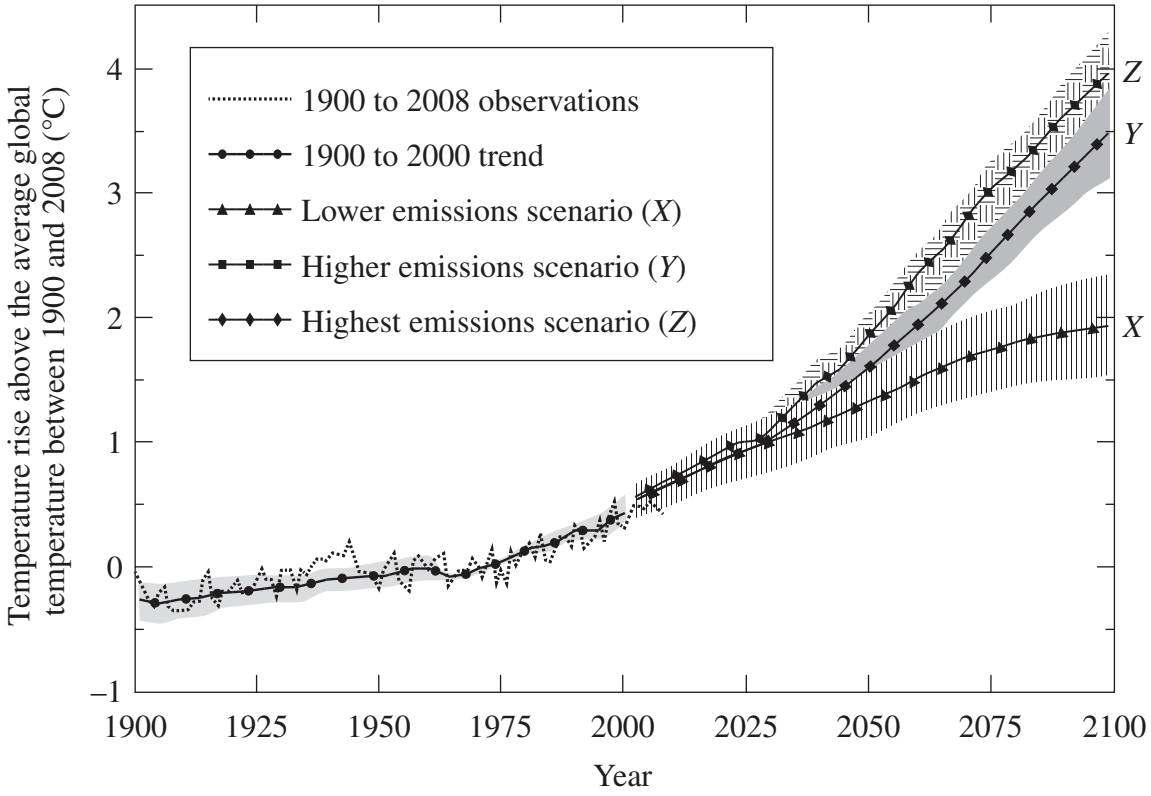
C. Nitrogen

D. Oxygen

Refer to the following graph to answer Questions 13 and 14.

The graph shows the changes in Earth's global temperature from 1900–2008 followed by three different climate change projections to the year 2100.

The projections are derived from different greenhouse gas emission scenarios.



13 Earth's average global temperature between 1900 and 2008 was approximately 15°C. If the world follows a lower emissions scenario (*X*), what would the average global temperature in 2100 be closest to?

A. 2°C

B. 4°C

C. 16°C

D. 17°C

14 Which aspect of the graph shows the scientific uncertainty associated with each projection?

A. The shading around each line

B. The time scale shown in 25 year intervals

C. Showing both observations and a trend line

D. Many data points shown on the same graph

15 An Earth scientist collected the following data.

Volcano	*Volcano type*	*Tectonic setting*	*Average flow rate of lava* (km/hour)
W	Cinder cone	Subduction zone	20
X	Fissure	Divergent ocean–ocean	25
Y	Shield	Hot spot	30
Z	Composite	Subduction zone	4

Based on the data provided, which volcano has the greatest capacity to affect global climate?

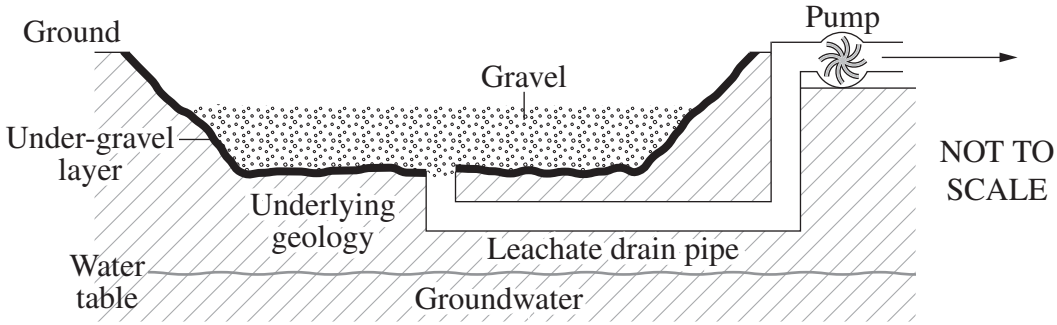
A. Volcano *W*

B. Volcano *X*

C. Volcano *Y*

D. Volcano *Z*

16 The diagram shows a cross-section of a landfill site. The gravel allows leachate (liquid produced or contaminated by the decomposition of solid waste) to flow down to a collection point, where it can be pumped out of the landfill site for treatment.



Based on the diagram, which of the following would be most suitable for use as the under-gravel layer?

A. Limestone

B. Methane capture pipes

C. Clay and welded plastic

D. Sand spread over natural soils

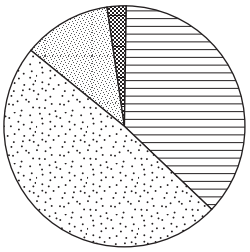
17 The table shows the percentage composition of gas emitted from two sites on Kilauea.

Volcano	*Gas composition* (%)						
	H_2O	H_2	CO_2	CO	SO_2	H_2S	S_2
Kilauea summit	37.1	0.5	48.9	1.5	11.84	0.04	0.02
Kilauea rift zone	79.8	0.9	3.15	0.1	14.9	0.622	0.309

Adapted from https://volcano.oregonstate.edu/gas-compositions-and-tectonic-setting

Which pie chart represents the composition of gas emitted at the Kilauea summit?

A.



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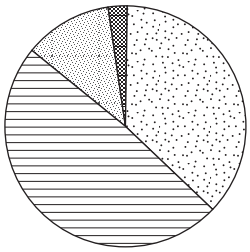

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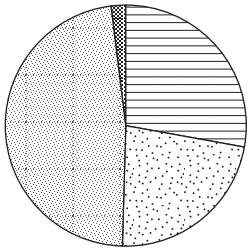

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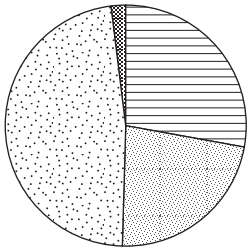
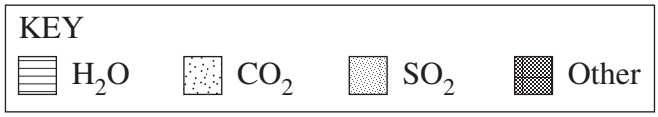




18 Which of the following is the best source of evidence for variations in global temperature during the Miocene epoch?

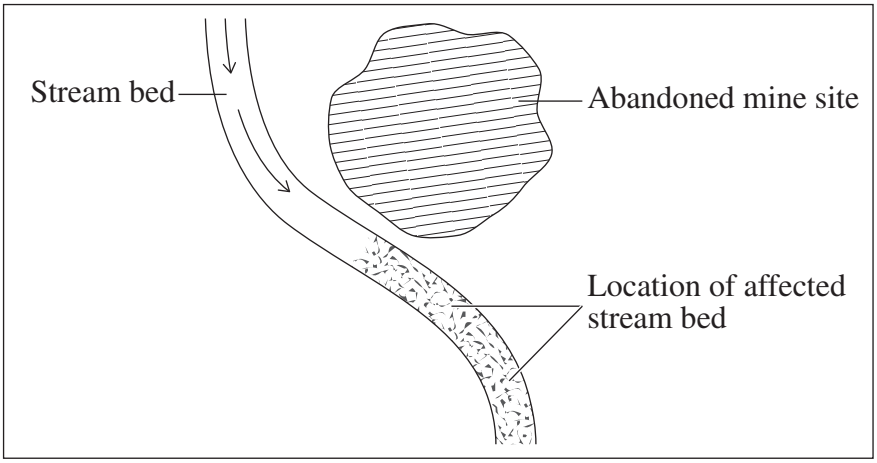
A. Dendrochronology

B. Pollen grains in sedimentary rocks

C. Aboriginal rock art sites showing now-extinct species

D. Ice cores containing gas bubbles and oxygen isotopes

19 The diagram shows a stream bed near an abandoned mine. A process known as acid mine drainage has lowered the pH of the sediment in the stream to a point where vegetation cannot grow.



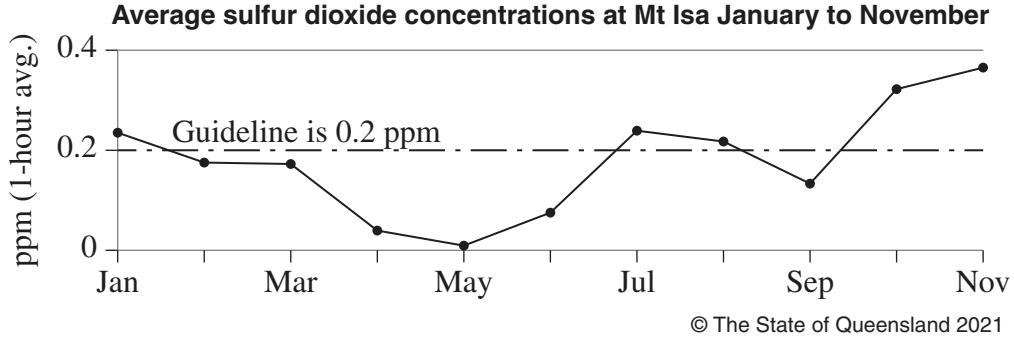
An environmental scientist wanted to investigate the relationship between distance from the mine and the severity of this problem caused by acid mine drainage.

Which row of the table best describes the variables in this investigation?

	Independent variable	*Dependent variable*	*Controlled variables*	
A.	pH of sediment	Distance from the mine	Rainfall in the past month	Time since mining ceased
B.	Time since mining ceased	pH of sediment	Rainfall in the past month	% plant cover
C.	Distance from the mine	Time since mining ceased	pH of sediment	% plant cover
D.	Distance from the mine	pH of sediment	Time since mining ceased	Rainfall in the past month

20 A table showing climate data and a graph showing sulfur dioxide emissions in Mount Isa are provided.

Mt Isa long-term averages													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Mean max (°C)	36.4	35.4	34.4	32.0	28.0	24.9	24.8	27.4	31.3	34.7	36.6	37.1	31.9
Mean min (°C)	23.7	23.3	21.8	18.5	13.8	10.0	8.7	10.2	14.2	18.4	21.5	23.1	17.3
Mean rain (mm)	118.1	101.3	63.6	14.3	12.7	6.5	6.0	3.6	8.7	17.9	38.6	76.0	470.8
Median rain (mm)	72.8	85.6	38.0	1.8	3.7	0.0	0.0	0.4	0.4	8.6	25.2	49.4	421.2
Mean rain days	9.9	9.0	5.7	2.2	1.7	1.1	0.9	1.0	1.7	3.2	5.4	8.0	48.6



In which month would you expect the greatest decrease in local soil pH?

A. January

B. May

C. September

D. December

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2020 HIGHER SCHOOL CERTIFICATE EXAMINATION

Centre Number

Student Number

Earth and Environmental Science

Section II Answer Booklet

80 marks
Attempt Questions 21–36
Allow about 2 hours and 25 minutes for this section

Instructions

- Write your Centre Number and Student Number at the top of this page.
- Answer the questions in the spaces provided. These spaces provide guidance for the expected length of response.
- Show all relevant working in questions involving calculations.
- Extra writing space is provided at the back of this booklet. If you use this space, clearly indicate which question you are answering.

Please turn over

Question 21 (3 marks)

Describe the use of index fossils in the development of a Geological Time Scale. **3**

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Question 22 (4 marks)

Explain TWO effects that a volcanic eruption had on the atmosphere or the biosphere. **4**

Name of volcanic eruption: .....

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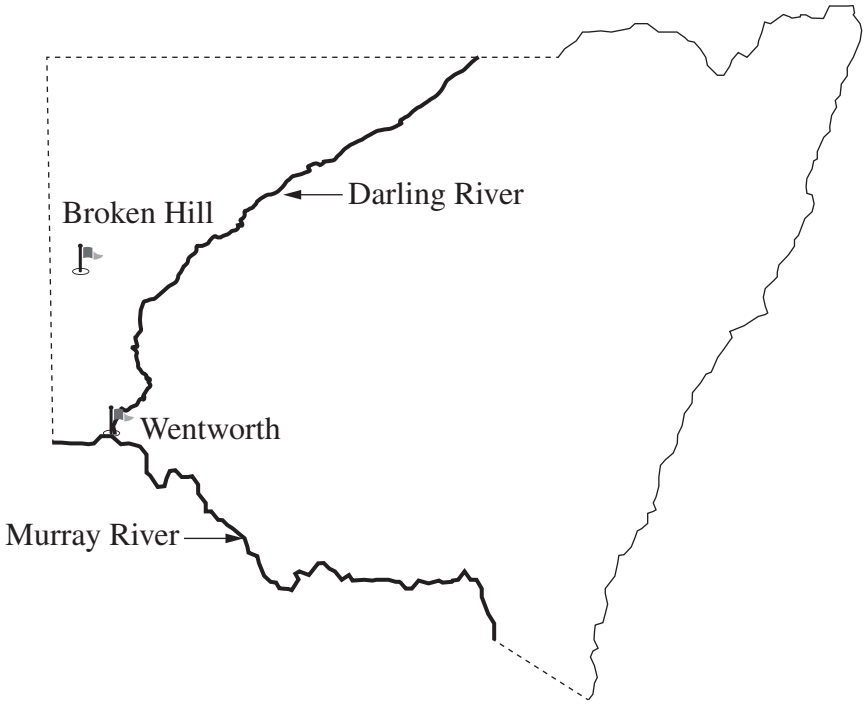
Question 23 (3 marks)

In January 2019, a 270 km pipeline was completed to supply water to the City of Broken Hill from the Murray River. The pipeline started at the town of Wentworth. The locations of Wentworth and Broken Hill are shown on the map below. **3**



Discuss possible impacts of this water management strategy.

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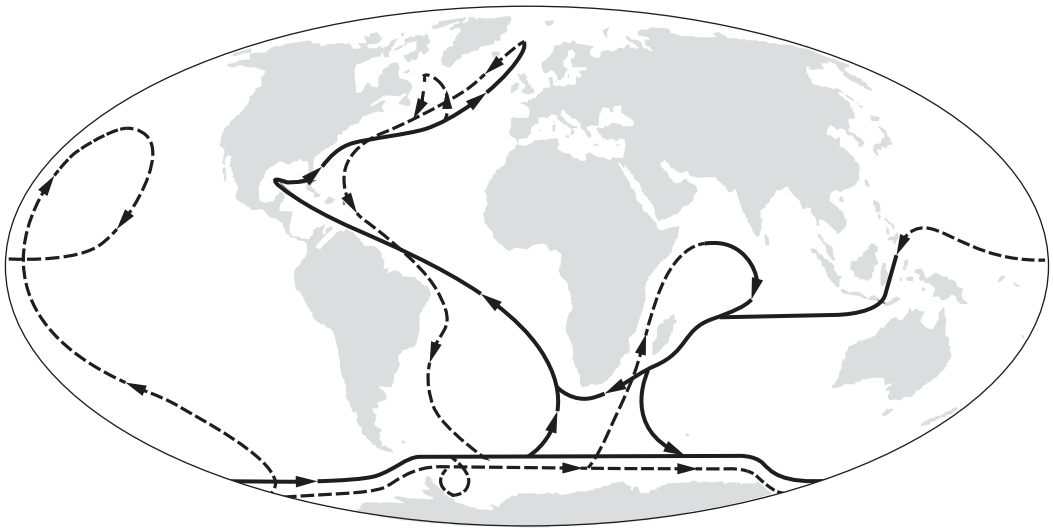
Question 24 (5 marks)

The image shows the global conveyor belt and the movement of water through the ocean basins.



KEY

Surface current Deep current

(a) Explain how a change in ocean circulation may affect Earth's climate. **3**

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(b) Describe a possible flow-on effect of a change in ocean circulation on Earth's weather. **2**

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Question 25 (3 marks)

Explain TWO factors which allowed animals to move from an aquatic environment onto land. **3**

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Please turn over

Question 26 (6 marks)

A council is encouraging residents to sort their waste into separate bins. The image below describes the use of an organic waste bin.

Reproduced by permission of the Shellharbour City Council

(a) Assess the effectiveness of this image in terms of its ability to communicate scientific information to the general public. **3**

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(b) Explain TWO ways that the use of organic waste bins supports sustainability. **3**

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Question 27 (6 marks)

Students are planning a practical investigation into the composition of household or organisational waste.

(a) Outline a safety precaution needed for this investigation. **2**

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(b) Justify steps required to ensure both the accuracy and reliability of the data collected. **4**

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Question 28 (4 marks)

For a mine that you have investigated, describe the involvement of traditional owners in the mining and the restoration of the land after mining has ceased. **4**

Name of mine: .....

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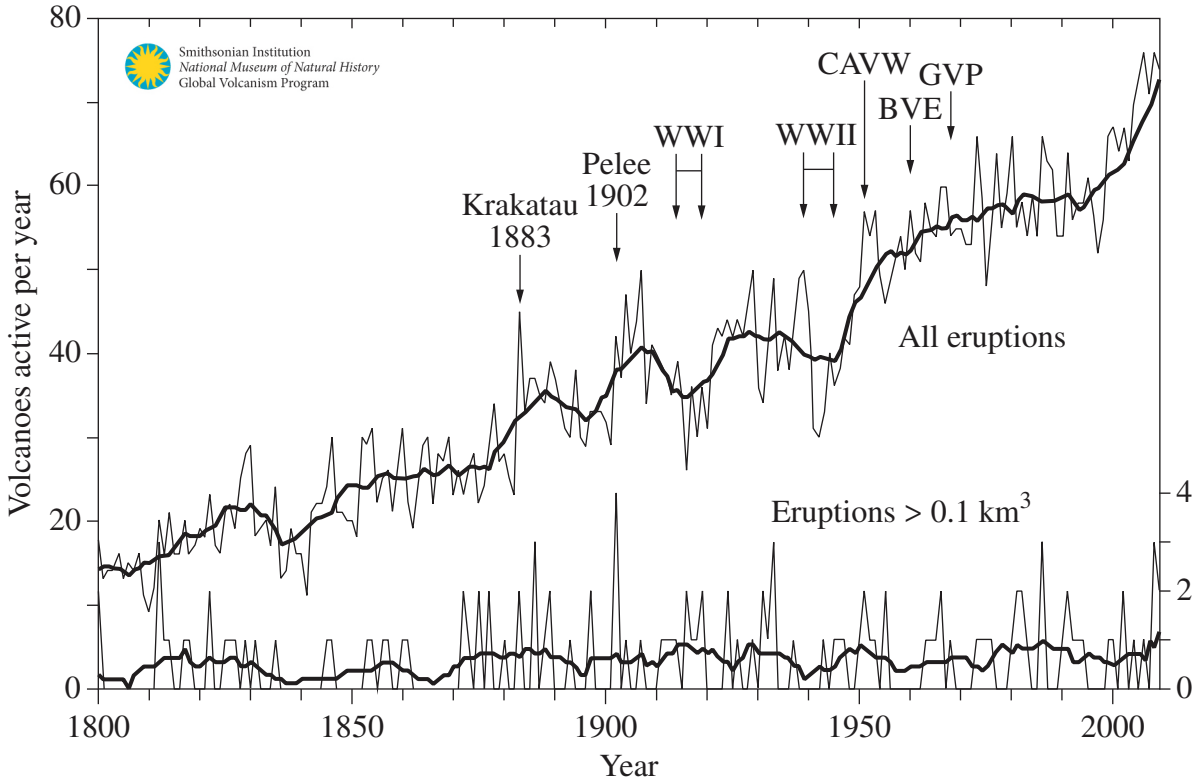
Question 29 (5 marks)

The graph shows data on all reported volcanic eruptions since 1800 CE and the frequency of large eruptions (> 0.1 km^3).



(a) Account for the trends in the data. **3**

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(b) Identify TWO modifications to the graph that would aid in the interpretation of the data. **2**

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Question 30 (6 marks)

Using an example, explain a change in the geosphere that resulted from a development of the biosphere. **6**

Question 31 (4 marks)

Assess the effectiveness of a method used to minimise the impact of a natural disaster. **4**

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Question 32 (5 marks)

Since human settlement, Australia's land use has changed the natural land cover across the country. The table shows current land use categories. **5**

Australia's Current Land Use

Land use	*Percentage*	*Area* (km^2)
Grazing (native vegetation)	45%	3 448 896
Conservation	23%	1 768 347
Grazing (modified pastures)	9%	716 313
Croplands and horticulture	4%	290 988
Forestry	2%	129 246
Urban	< 1%	17 632
Other	17%	1 315 301

Courtesy of Climate Works Centre

Explain how changes in land use since human settlement have contributed to the enhanced greenhouse effect. Refer to the data provided.

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Question 33 (5 marks)

Explain ONE effect that an aspect of the plate tectonic supercycle has had on the evolution of life on Earth. Use an annotated diagram to support your answer. **5**

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Question 34 (7 marks)

It has been suggested that practices used by Aboriginal and Torres Strait Islander Peoples be adopted or adapted when preparing environmental management plans. **7**

Analyse the environmental impacts of incorporating such practices.

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Question 35 (6 marks)

Two tectonic plate boundaries run in a north–south direction. A geologist measured the depth of earthquakes, and the distance each occurred from the plate margin. The results are shown.

Boundary *A*

Distance from the plate margin (degrees of longitude)	−4.5	−3.5	−2.9	−2.5	−1.6	0	+0.6	+1.8
Focus depth of earthquake (km)	430	390	300	200	70	5	3	2

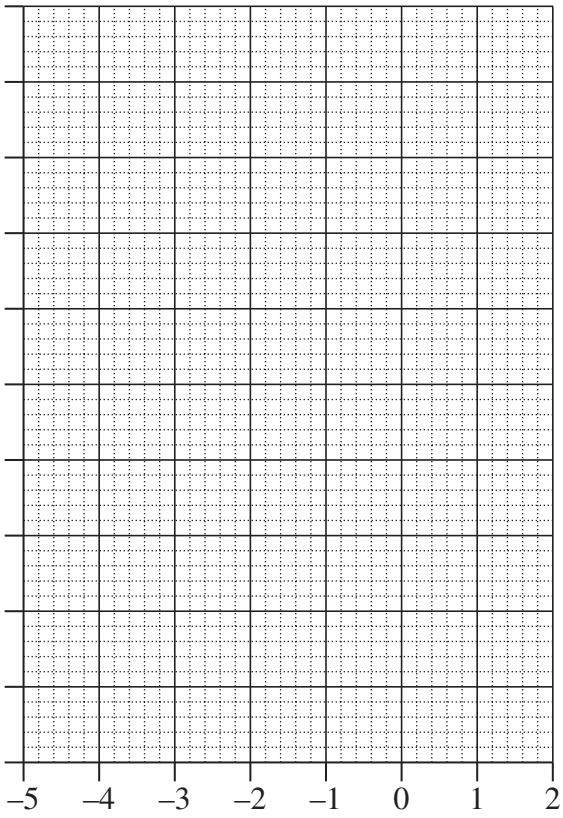
Boundary *B*

Distance from the plate margin (degrees of longitude)	−1.8	−0.7	−0.4	0.0	+0.4	+0.9	+1.6	+1.8
Focus depth of earthquake (km)	10	10	10	10	10	10	10	10

Distance from the plate margin and focus depth of the earthquake. Courtesy of the U.S. Geological Survey

(a) Using the grid provided, graph the relationship between the distance from the plate margin and the focus depth of earthquakes at Boundary *A* and Boundary *B*. **3**

Title: .....



KEY

Question 35 continues on page 28

Question 35 (continued)

(b) Name the types of plate boundary at Boundary *A* and Boundary *B*. Justify your response. **3**

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End of Question 35

Question 36 (8 marks)

Assess the effects of both climatic phenomena and human activities on the frequency and magnitude of bushfires in Australia. **8**

Question 36 continues on page 30

Question 36 (continued)

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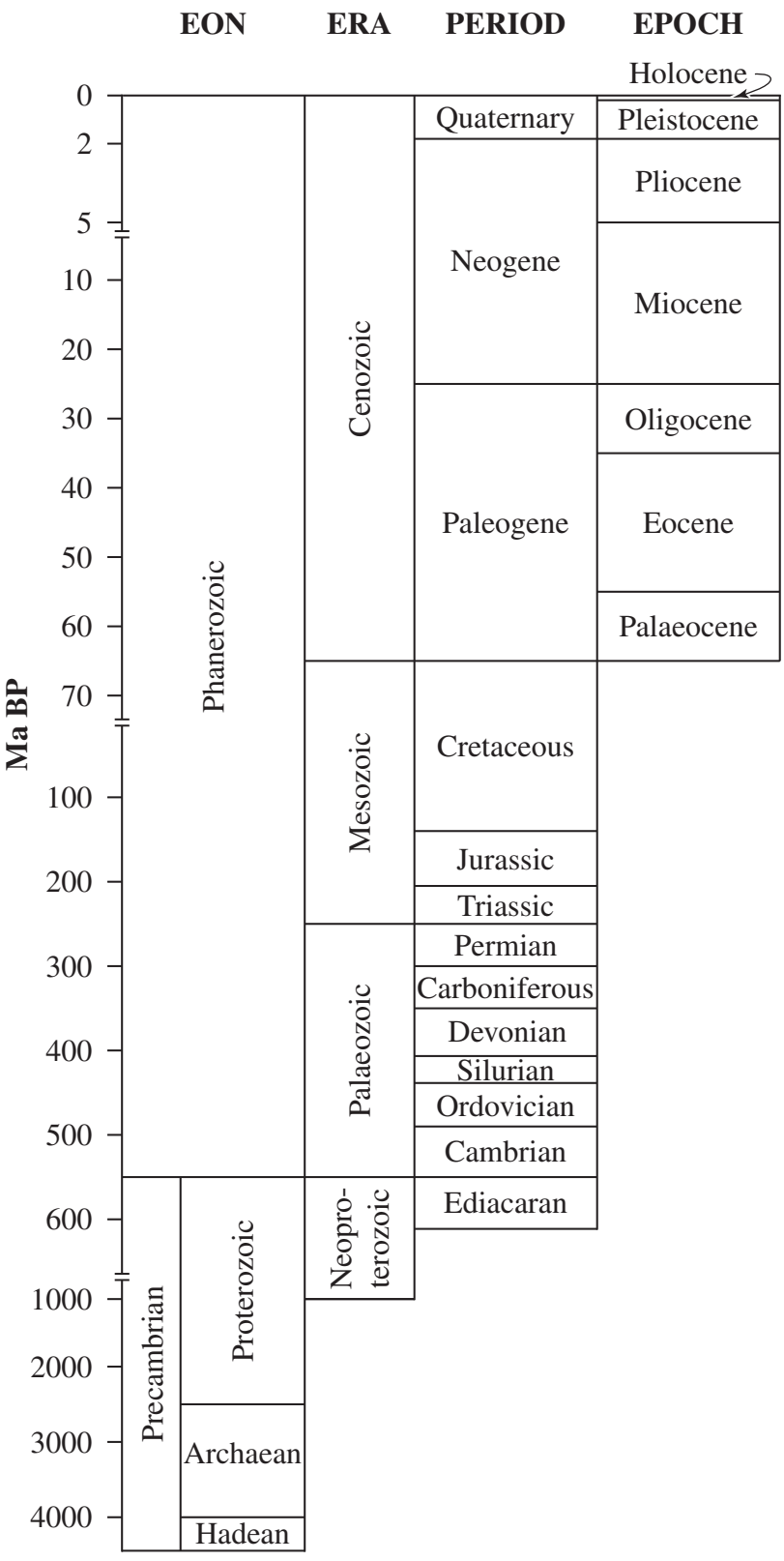
Earth and Environmental Science

Geological Time Scale



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