



BOARD OF STUDIES
NEW SOUTH WALES

2001

HIGHER SCHOOL CERTIFICATE
EXAMINATION

Earth and Environmental Science

General Instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Write using black or blue pen
- Draw diagrams using pencil
- Board-approved calculators may be used
- A Geological Time Scale is provided at the back of this paper
- Write your Centre Number and Student Number at the top of pages 13, 17, 19 and 23

Total marks – 100

Section I Pages 2–24

75 marks

This section has two parts, Part A and Part B

Part A – 15 marks

- Attempt Questions 1–15
- Allow about 30 minutes for this part

Part B – 60 marks

- Attempt Questions 16–26
- Allow about 1 hour and 45 minutes for this part

Section II Pages 25–34

25 marks

- Attempt ONE question from Questions 27–30
- Allow about 45 minutes for this section

Section I
75 marks

Part A – 15 marks

Attempt Questions 1–15

Allow about 30 minutes for this part

Use the multiple-choice answer sheet.

Select the alternative A, B, C or D that best answers the question. Fill in the response oval completely.

Sample: $2 + 4 =$ (A) 2 (B) 6 (C) 8 (D) 9
A B C D

If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

A B C D

If you change your mind and have crossed out what you consider to be the correct answer, then indicate the correct answer by writing the word *correct* and drawing an arrow as follows.

A B C D
correct ↙

1



At which of the locations *A*, *B*, *C* or *D* are mountains presently forming as a result of folding and faulting at a convergent plate boundary?

- (A) *A*
- (B) *B*
- (C) *C*
- (D) *D*

- 2** In the year 2525, an Earth-like planet is identified in a nearby solar system. Planetary scientists have identified a linear mountain chain that is 33 000 km long.

Which of the following would be likely to be present if the mountain chain is forming at a divergent margin?

- (A) Andesite and granite
 - (B) Explosive volcanoes and basalt
 - (C) Thickened crust and normal faults
 - (D) High heat flow and volcanic activity
- 3** In which of the following general locations would the inhabitants be most likely to experience tsunamis, destructive earthquakes and volcanic poisonous gas emissions?
- (A) An island chain in the middle of an ocean plate
 - (B) The edge of a continent located in the middle of a plate
 - (C) A coastal location adjacent to a large transform fault
 - (D) The trench side of an island arc

- 4 The map shows the epicentres (●) of earthquakes of magnitude 7.0 and above on the Richter scale that occurred from 1991 to 1997.



The table shows the frequency of earthquakes for each of the years.

<i>Year</i>	<i>Frequency</i>
1991	14
1992	13
1993	13
1994	13
1995	13
1996	17
1997	10

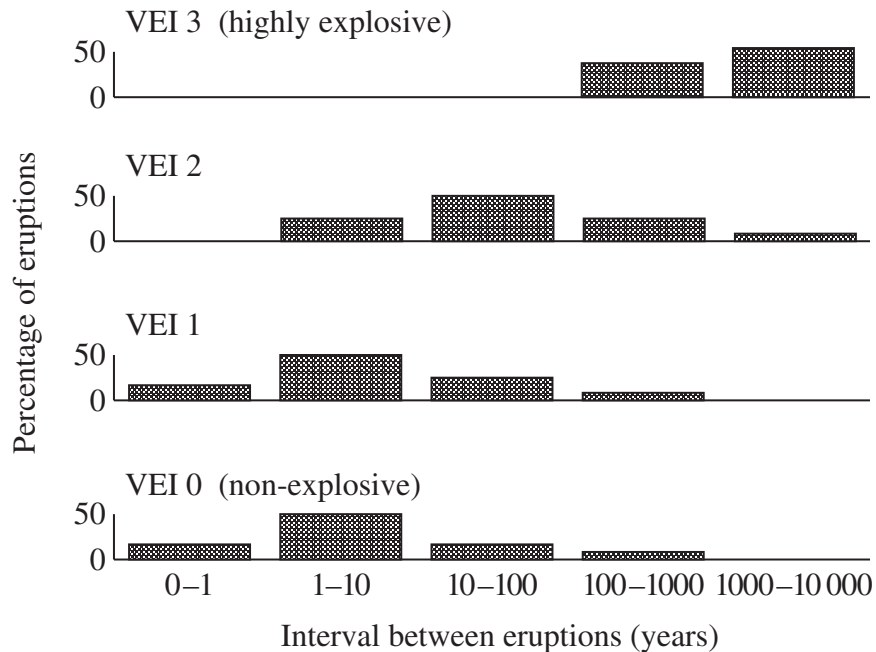
What does this information indicate?

- (A) Plate movement has continued throughout this period.
- (B) The damage caused as a result of earthquakes has decreased.
- (C) The rate of plate movement has decreased during the time period recorded.
- (D) Earthquakes are unrelated to plate boundaries.

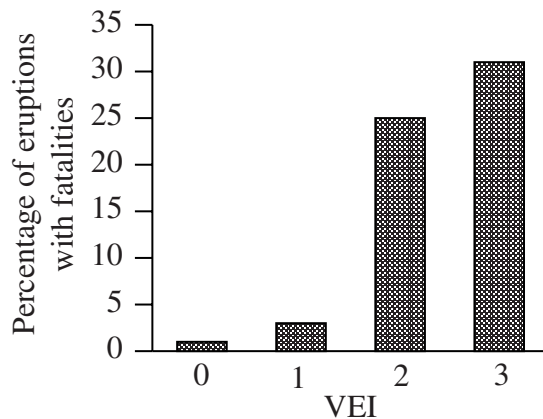
- 5 Graph 1 shows the percentage of eruptions at different time intervals for volcanoes with a volcanic explosivity index (VEI) between 0 and 3.

Graph 2 shows the relationship between VEI and the percentage of eruptions that had known fatalities.

Graph 1



Graph 2

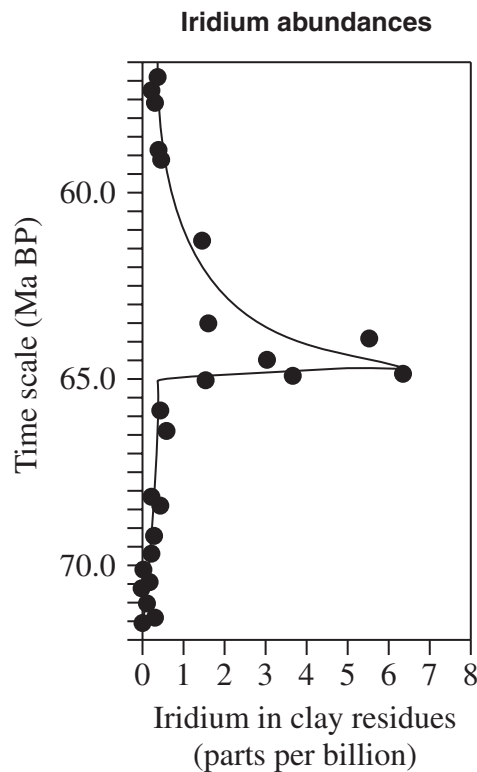


Using the graphs, determine which of these statements is correct.

- (A) Volcanoes with a VEI of 3 erupt only every 100–10 000 years but are most likely to lead to fatalities.
- (B) 50% of eruptions with a VEI of 0 occur every 10–100 years and lead to fatalities in 1% of cases.
- (C) As the VEI increases, the interval between eruptions decreases.
- (D) 32% of the population living near a volcano with a VEI of 3 will die in an eruption every 100–10 000 years.

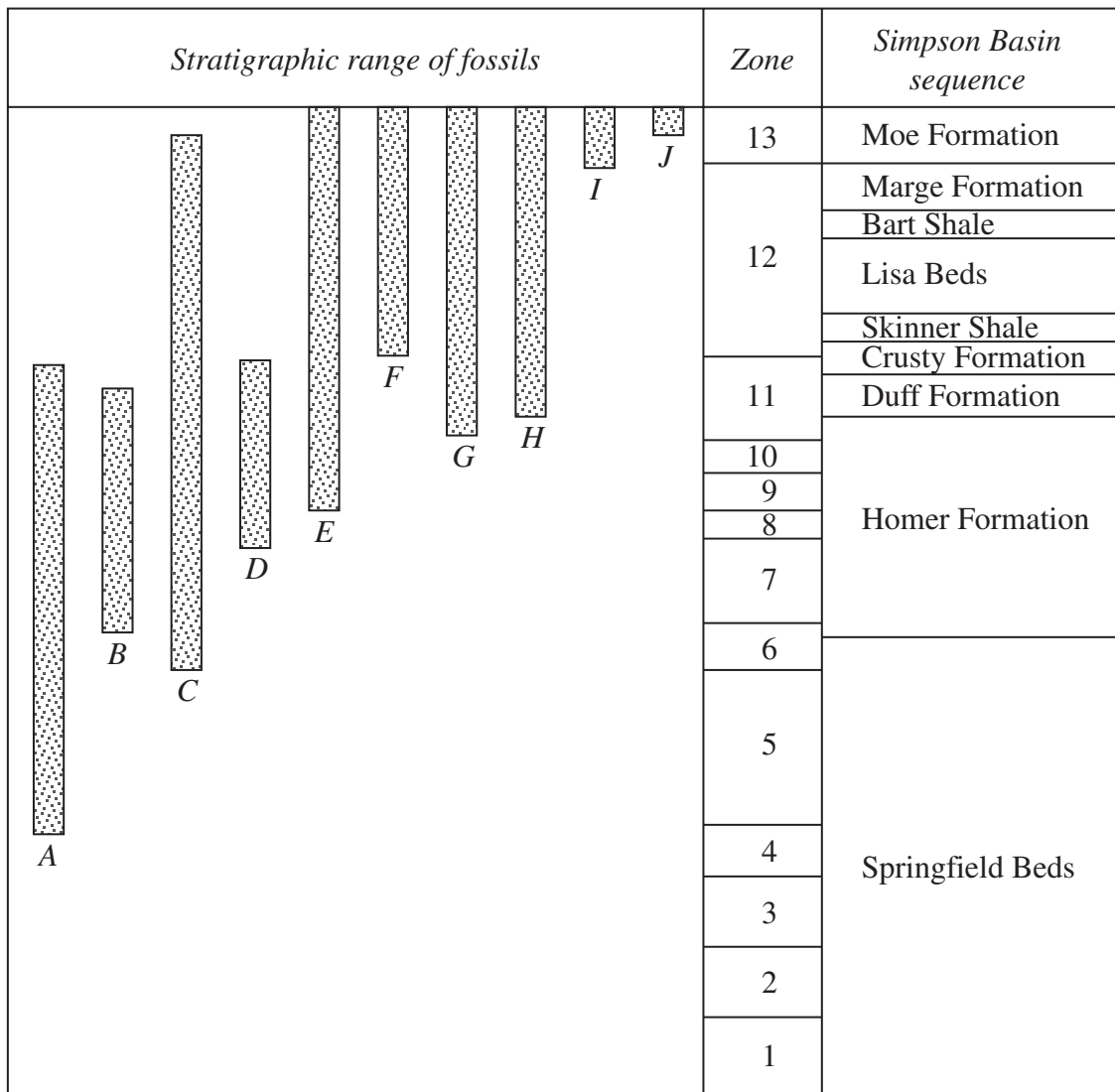
- 6 Relative dating is based on which of the following?
- (A) Measuring radioactive isotopes
 - (B) Using carbon-14
 - (C) Establishing the complexity of fossils
 - (D) Determining stratigraphic sequence
- 7 A comparison of the Cambrian fossil record with that of the Late Proterozoic has resulted in the use of the term *explosion* when referring to the Cambrian Event.
- Why is this expression used?
- (A) Most genera were destroyed by a bolide impact in the Cambrian.
 - (B) There was an apparent increase in the diversity of animal life forms.
 - (C) The first land-based vertebrate species appeared in the Cambrian.
 - (D) An increase in volcanic activity led to rapid evolution.
- 8 In which part of the Phanerozoic fossil record do mammals first appear?
- (A) The Proterozoic
 - (B) The Palaeozoic
 - (C) The Mesozoic
 - (D) The Cenozoic

- 9 The graph shows the abundance of the element iridium in clay residues from pelagic (oceanic) limestones.



- What is the most likely reason for the sudden increase in iridium at 65 million years before present (Ma BP)?
- (A) There was an increase in marine organisms producing iridium as a waste product.
 - (B) An extra-terrestrial object that was rich in iridium collided with Earth.
 - (C) Most of the iridium older than 65 Ma BP has radioactively decayed into a stable product.
 - (D) A massive flood caused iridium to be washed from the land into the oceans, and deposited in the limestone.
- 10 How can mass extinction events be distinguished from smaller extinction events?
- (A) Mass extinction events involve a wide range of organisms and habitats, whereas smaller extinction events do not.
 - (B) Mass extinction events are caused by bolide impacts, whereas smaller extinction events are caused by volcanic activity.
 - (C) Mass extinction events are caused by episodes of marked global cooling, whereas smaller extinction events are caused by global warming.
 - (D) Mass extinction events affect both marine and terrestrial organisms, whereas smaller extinction events affect only marine organisms.

- 11 The diagram shows the stratigraphic range of fossils (A to J) in the Simpson Basin sequence.



A sedimentary rock sample contains fossils *B*, *D* and *H*.

From which zone and Simpson Basin sequence was the sample taken?

- (A) 11 and Crusty Formation
- (B) 11 and Duff Formation
- (C) 10 and Duff Formation
- (D) 10 and Homer Formation

- 12** Which of the following has resulted in the majority of Australian soils being relatively low in fertility?
- (A) The excessive use of fertilisers and pesticides over the last two hundred years in Australia.
 - (B) The lower rainfall experienced in Australia since it started moving towards the equator after the break-up of Gondwana.
 - (C) The depletion of the majority of nutrients by dense forest that covered the whole Australian continent during the Carboniferous Period.
 - (D) The great age, low topographic relief and geological stability of Australia.

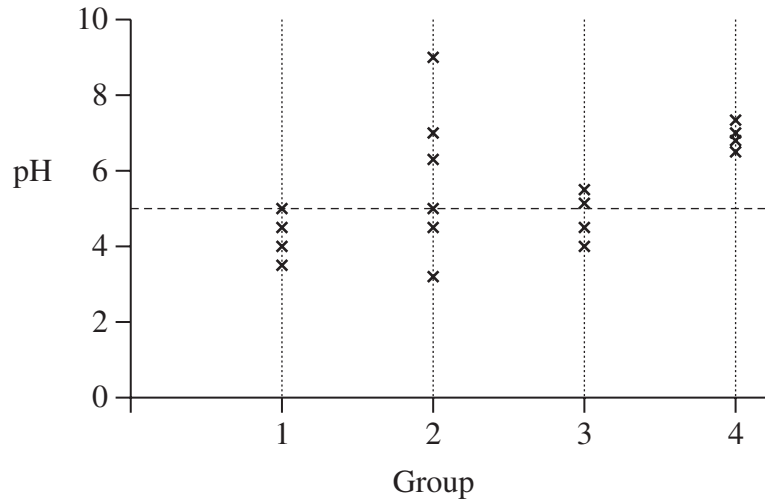
- 13** The excessive use of pesticides can result in accumulation and magnification in living organisms.

Which of the following statements is true?

- (A) Accumulation only occurs at the lowest level of a food chain.
 - (B) Accumulation only occurs in animals.
 - (C) Magnification only occurs at higher levels of a food chain.
 - (D) Magnification only occurs in plants.
- 14** How do chlorofluorocarbons (CFCs) reduce the concentration of ozone in the atmosphere?
- (A) The CFCs combine with ozone to produce oxidised molecules.
 - (B) In dark and cold conditions, CFCs combine with carbon dioxide to decrease ozone production.
 - (C) CFCs split in the troposphere and oxidise, preventing the creation of ozone.
 - (D) Radiation causes CFCs to release atoms that convert ozone to oxygen.

- 15 A class was divided into four groups to measure the pH of ground water seeping out of a landfill. Each group took multiple readings of the ground water pH. A sample was also submitted to the Environmental Protection Authority (EPA) for an accurate reading. The pH was determined by the EPA to be 5.0.

The results of the four groups are shown in the graph.



Based on the EPA reading, which group's results are the most accurate?

- (A) Group 1
- (B) Group 2
- (C) Group 3
- (D) Group 4

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Earth and Environmental Science

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Centre Number

Section I (continued)

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Student Number

Part B – 60 marks

Attempt Questions 16–26

Allow about 1 hour and 45 minutes for this part

Answer the questions in the spaces provided.

Marks

Question 16 (6 marks)

- (a) Name the most common igneous rock formed at ocean–ocean convergent plate margins. 1

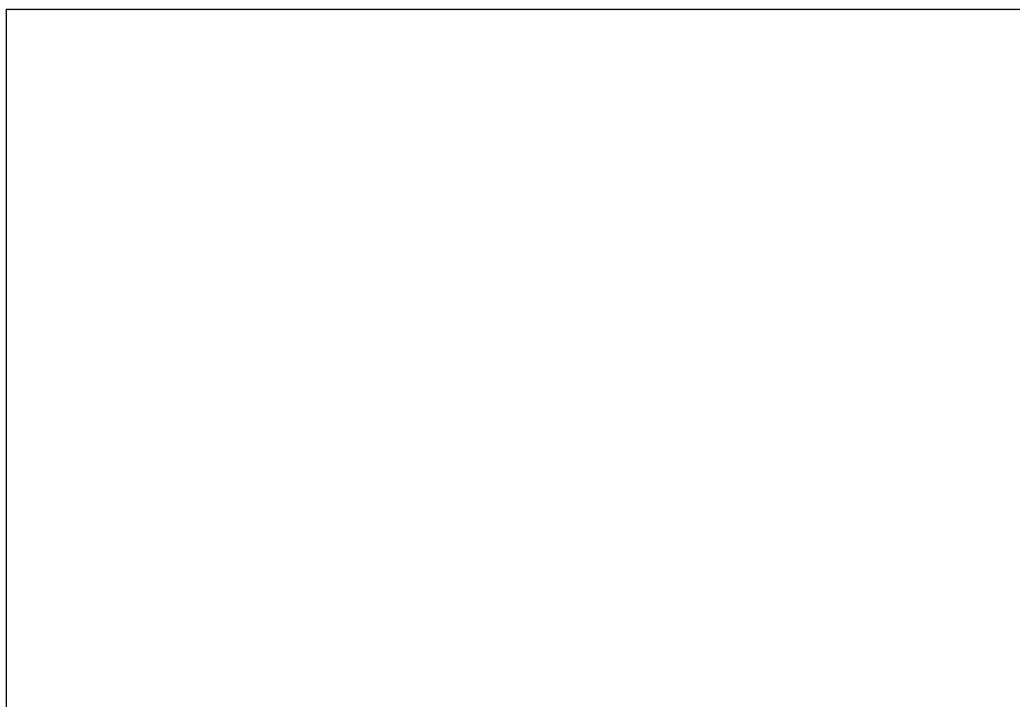
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- (b) Define the term *lithospheric plate*. 2

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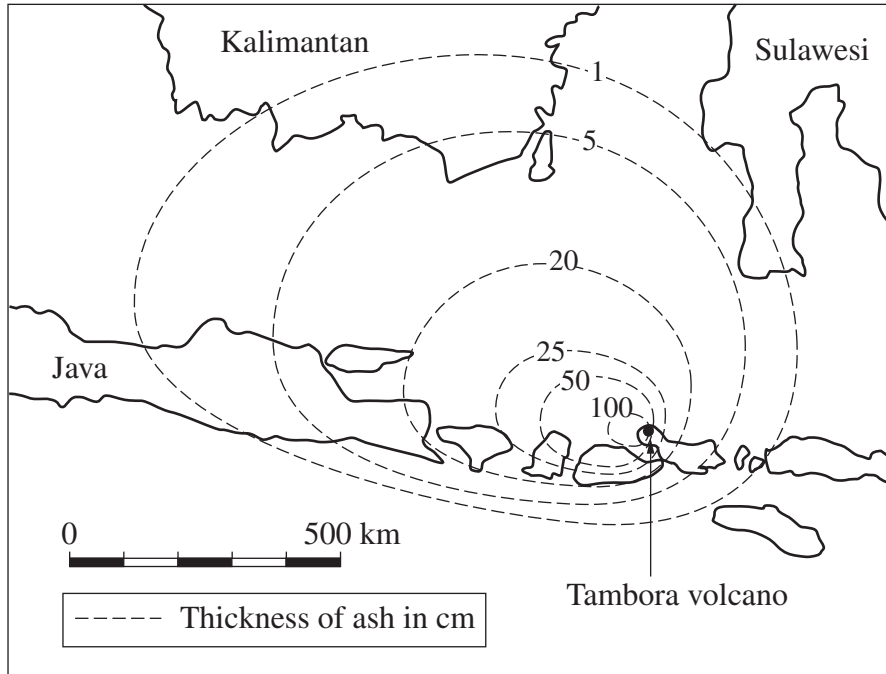
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- (c) Draw and label a diagram of an ocean–ocean convergent boundary to show the plate motion and a resulting landform feature or environment. 3

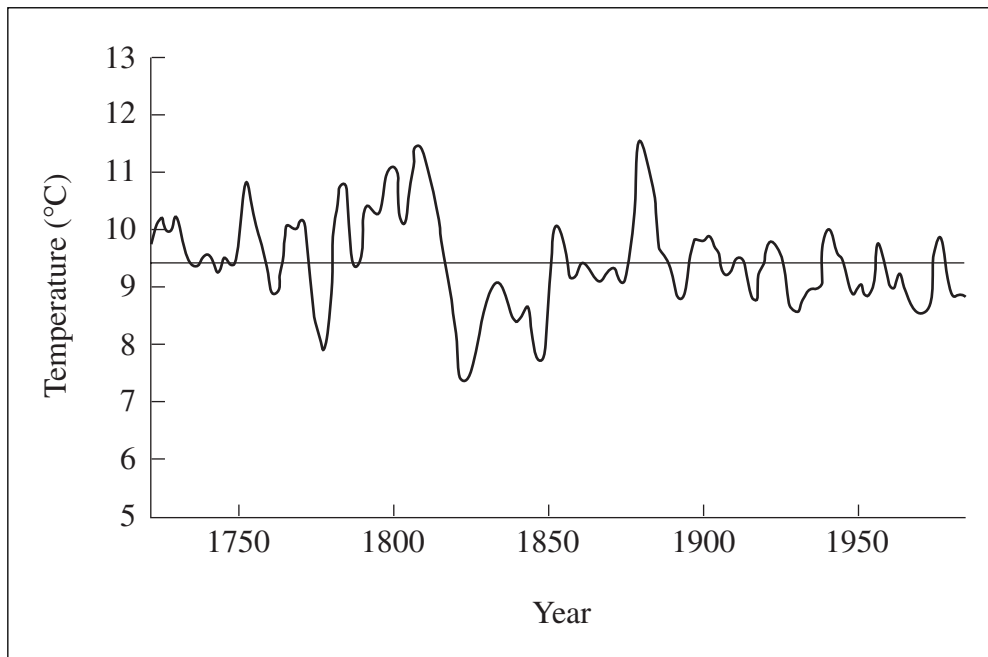


Question 17 (6 marks)

The diagram shows the location of the Tambora volcano in Indonesia, and the depth of ash fall following the 1816 eruption.



The year 1816 was globally known as the *year without summer*. The graph shows temperatures in North America and Europe from 1720 to 1980.



Question 17 continues on page 15

Question 17 (continued)

- (a) Describe the impact of the Tambora eruption on global temperature. **2**

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- (b) Explain the likely impact of the Tambora eruption on local and global agriculture. **4**

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End of Question 17

Please turn over

Question 18 (8 marks)

The shaded area of Australia indicates the location of the oldest rocks of the continent.

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Outline how the Australian continent has grown over geological time as a result of plate tectonic processes.

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Earth and Environmental Science

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Centre Number

Section I – Part B (continued)

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Student Number

Marks

Question 19 (4 marks)

- (a) Identify ONE effect that cyanobacteria had on Earth’s primitive atmosphere. **1**

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- (b) State the environment in which stromatolites typically form. **1**

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- (c) Explain why stromatolites were more widely distributed in the Proterozoic Eon than they are in the modern environment. **2**

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Question 20 (4 marks)

Summarise the major adaptations that allowed the exploitation of terrestrial environments by animals.

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Question 21 (5 marks)

Compare TWO hypotheses proposed to explain the extinction of the megafauna in Australia.

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Earth and Environmental Science

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Centre Number

Section I – Part B (continued)

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Student Number

Marks

Question 22 (3 marks)

- (a) Identify the source of ONE named greenhouse gas whose atmospheric concentration has increased since the Industrial Revolution. **1**

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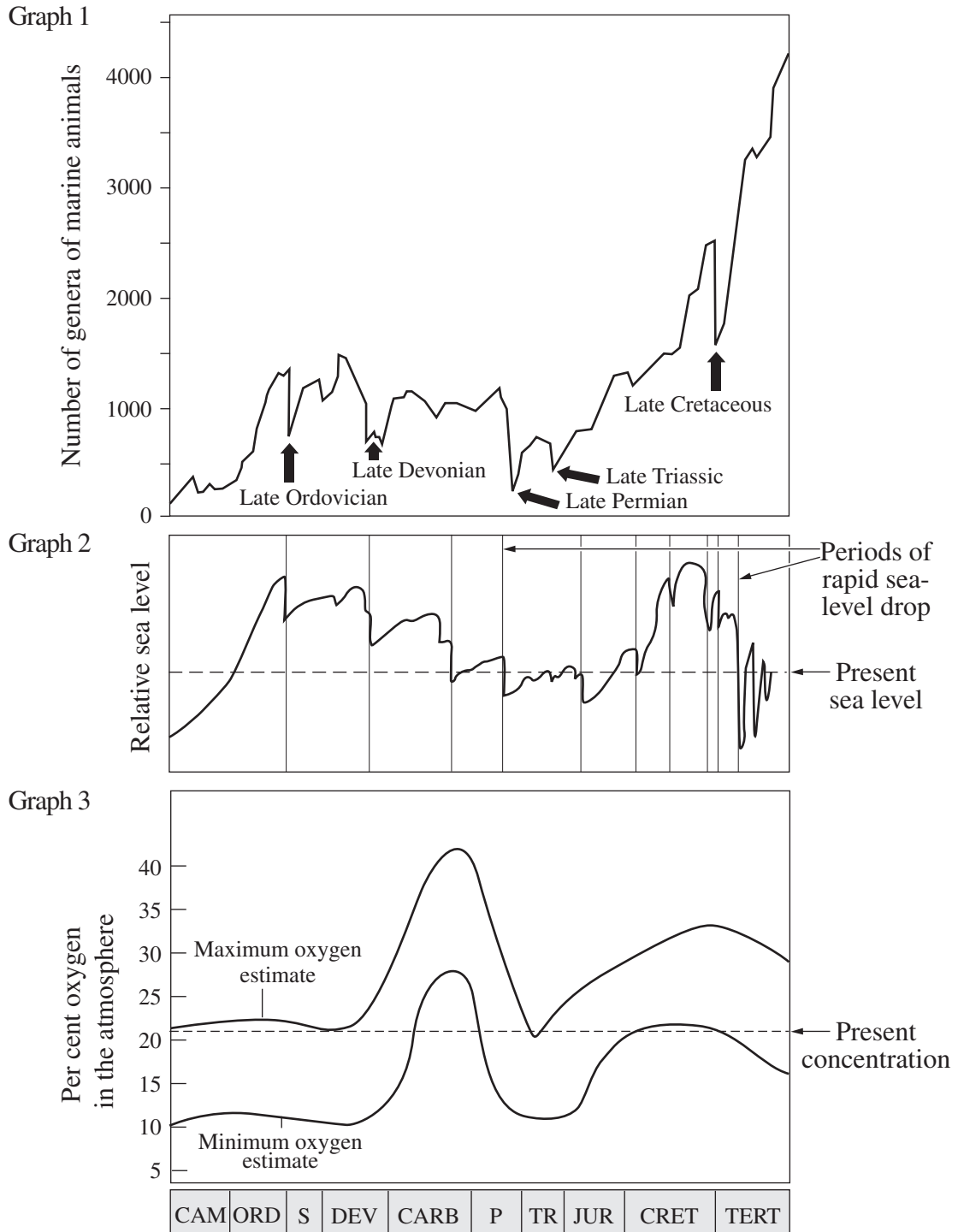
- (b) Explain why a proposed or actual strategy would result in decreasing emissions of this gas. **2**

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Question 23 (7 marks)

Graph 1 shows the diversity of marine animals, expressed in terms of the number of known genera, and the five major mass extinction episodes in the Phanerozoic Eon. Graphs 2 and 3 show variation in sea level and atmospheric oxygen concentration respectively, over this same time period.



Question 23 continues on page 21

Question 23 (continued)

Analyse the relationships between marine animal diversity in the Phanerozoic Eon and atmospheric oxygen content, sea-level variation and related climate variation.

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End of Question 23

Please turn over

Question 24 (5 marks)

In your Earth and Environmental Science course you have undertaken first-hand investigations to determine the effect of compaction or tracking on a soil. Assess how the results of your investigations have contributed to your understanding of soil management.

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Earth and Environmental Science

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Centre Number

Section I – Part B (continued)

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Student Number

Marks

Question 25 (8 marks)

During the Earth and Environmental Science course, you have carried out a case study of a rehabilitation program in an area affected by salinity.

- (a) Name the area you studied, and identify ONE cause of the salinity problem. **1**

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- (b) Describe the impact of this salinity problem. **3**

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- (c) Evaluate the effectiveness of the rehabilitation strategy used at this site. **4**

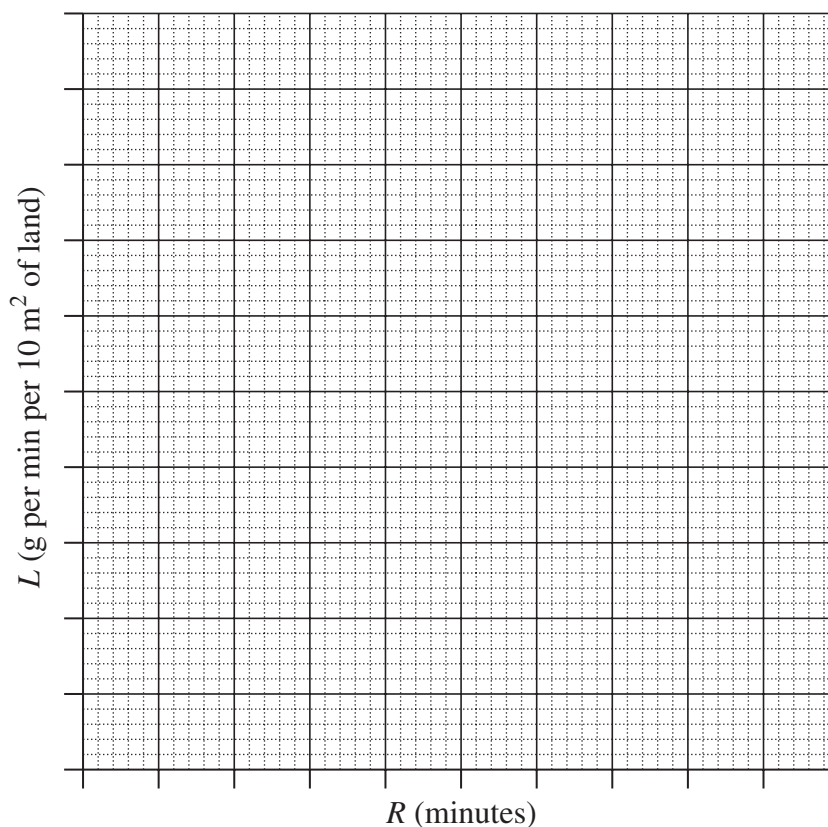
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Question 26 (4 marks)

The table shows the duration of rainfall (R) and the rate of soil loss due to erosion (L) at a test site in an agricultural area.

<i>Duration of rainfall (R)</i> (minutes)	<i>Rate of soil loss (L)</i> (g per min per 10 m ² of land)
0	0.0
2	0.0
5	0.1
6	0.6
10	1.6
15	2.1
25	2.5

- (a) Using the grid provided, draw a graph of L versus R , with a line through the data points. 2



- (b) Describe the relationship between L and R . 2

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Earth and Environmental Science

Section II

25 marks

Attempt ONE question from Questions 27–30

Allow about 45 minutes for this section

Answer the question in a writing booklet. Extra writing booklets are available.

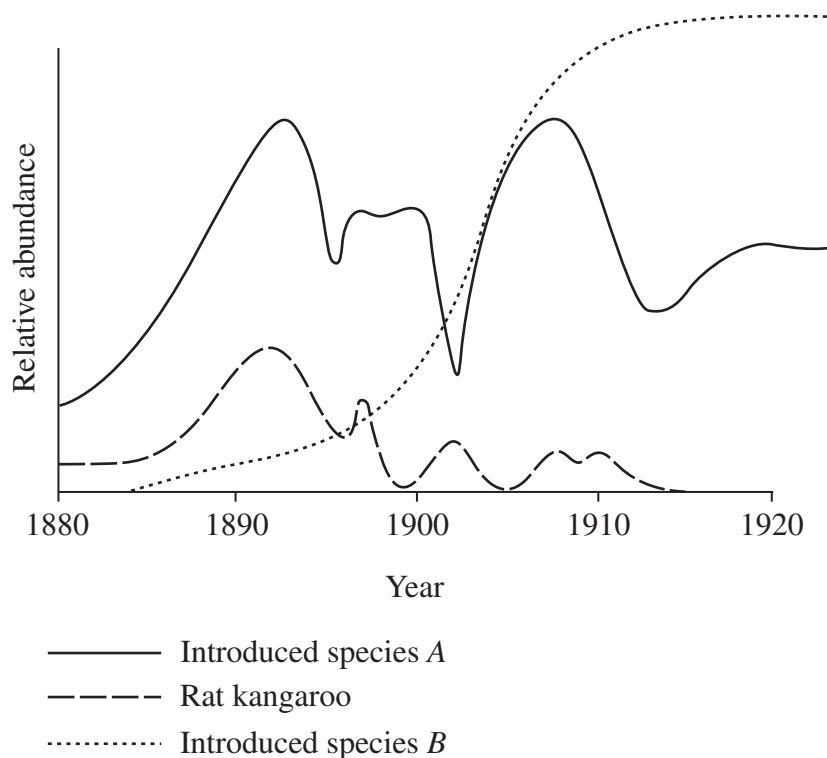
	Pages
Question 27 Introduced Species and the Australian Environment	26–27
Question 28 Organic Geology – A Non-renewable Resource	28–29
Question 29 Mining and the Australian Environment	30–32
Question 30 Oceanography	33–34

		Marks
Question 27 — Introduced Species and the Australian Environment (25 marks)		
(a)	(i) Identify ONE criterion that has been used to recognise an organism as being an introduced species.	1
	(ii) Describe the mode and reason for the introduction of a named species to Australia.	2
(b)	In your study of Introduced Species and the Australian Environment, you performed a first-hand investigation of an environment that has been affected by an introduced species.	
	(i) Name the introduced species and the environment, and explain how ONE aspect of this environment made it vulnerable to the introduced species.	2
	(ii) Explain ONE effect of the introduced species on this environment.	2
(c)	Analyse the effectiveness of TWO quarantine methods or procedures used in Australia to prevent the introduction of new species.	4

Question 27 continues on page 27

Question 27 (continued)

- (d) The graph shows the relative abundance of one native and two introduced mammals on the New England tablelands from 1880 to 1920.



- (i) Describe the general trends for Introduced species A and the Rat kangaroo shown in the graph. **2**
- (ii) Explain how characteristics of Introduced species B may have contributed to its success in Australia. **4**
- (e) Critically evaluate ONE strategy that has been used to rehabilitate an ecosystem that has been impacted upon by introduced species. **8**

End of Question 27

Question 28 — Organic Geology – A Non-renewable Resource (25 marks)

- (a) (i) Identify ONE property of coal that changes with increasing coal rank. **1**
- (ii) Coal mined from a coal seam contains mineral matter and organic material. Describe how the organic material is extracted from the coal. **2**
- (b) In your study of Organic Geology – A Non-renewable Resource, you have undertaken first-hand investigations of the combustion of fossil fuels.
- (i) Outline a procedure that could be used to distinguish between the products of complete and incomplete combustion of a fossil fuel. **2**
- (ii) Explain ONE effect on the environment resulting from the incomplete combustion of fossil fuels. **2**
- (c) The table provides data on different sources of electricity generation for a country, and the price per megawatt-hour (MWh). **4**

Amount of power commercially generated (MW)					
<i>Year</i>	<i>Solar</i>	<i>Hydroelectric</i>	<i>Nuclear</i>	<i>Coal</i>	<i>Total</i>
1970	2	183	125	1890	2200
1980	9	453	415	2223	3100
1990	24	579	709	2651	3963
2000	48	651	450	2871	4020
2010*	331	904	149	2662	4046
Price per MWh (\$) (includes capital costs)					
<i>Year</i>	<i>Solar</i>	<i>Hydroelectric</i>	<i>Nuclear</i>	<i>Coal</i>	
1970	62	32	28	24	
1980	58	32	29	20	
1990	48	32	30	17	
2000	40	31	30	20	
2010*	28	31	32	21	

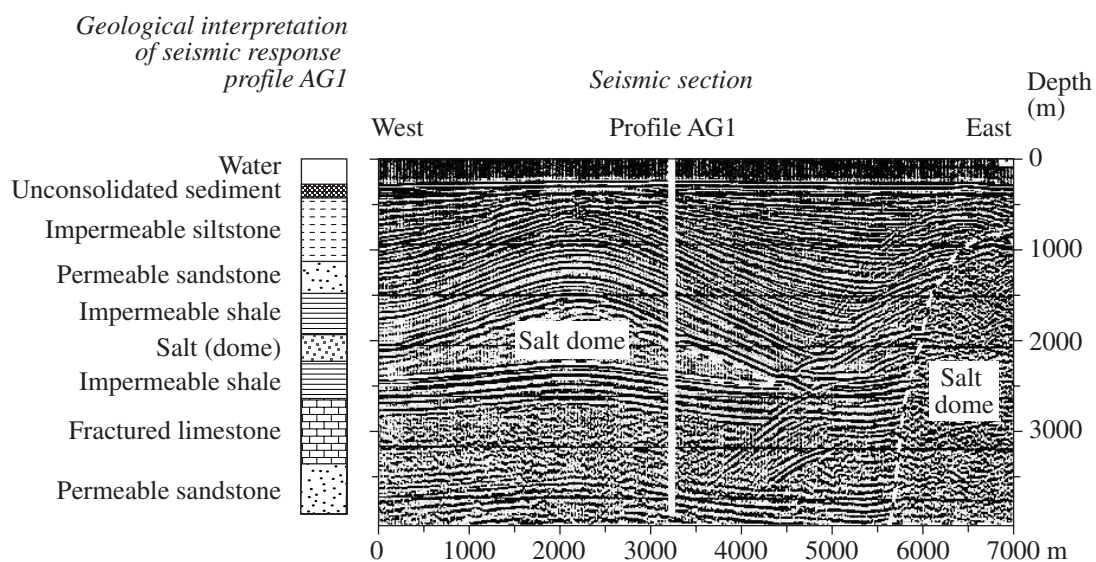
* Projected values

Analyse the main trends shown in the data.

Question 28 continues on page 29

Question 28 (continued)

- (d) As part of an exploration program for petroleum on Australia’s North West Shelf, a series of seismic sections has been collected. One of these sections and a geological interpretation of the vertical profile AG1 are shown.



- (i) Explain why there are dark lines on the section. 2
- (ii) Propose a location for a vertical drill hole that could be used to test geological structures for potential petroleum accumulations. Justify the location of that drill hole. 4
- (e) Analyse the environmental factors that control the accumulation, preservation and maturation of organic material in coal formation. 8

End of Question 28

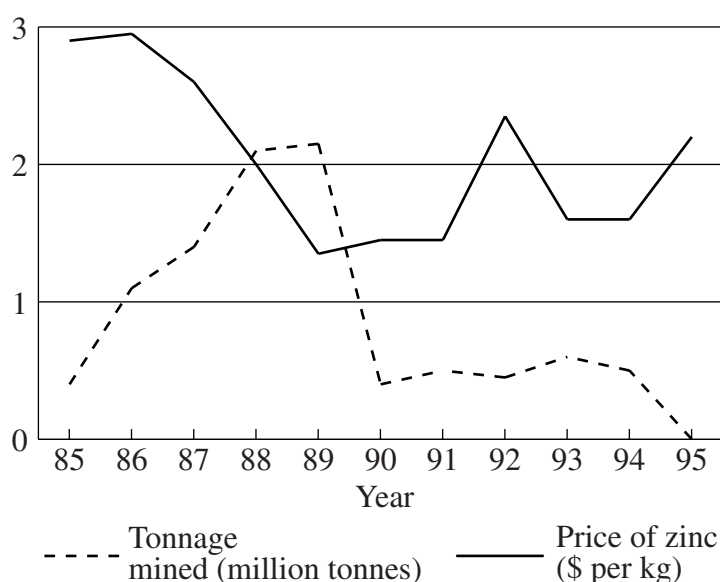
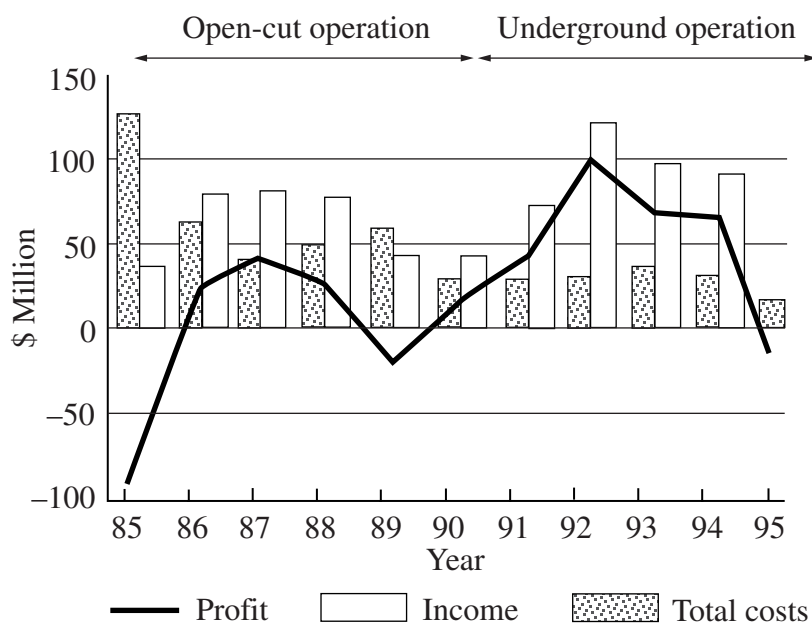
		Marks
Question 29 — Mining and the Australian Environment (25 marks)		
(a)	(i) Identify ONE landmark decision that has affected mining operations in Australia.	1
	(ii) Explain the possible effect of this landmark decision on the exploitation of an ore deposit.	2
(b)	In your study of Mining and the Australian Environment, you have studied a specific mineral deposit.	
	(i) Name the mineral deposit, and state TWO factors considered in determining the feasibility of mining that deposit.	2
	(ii) Explain how ONE government policy may have affected the decision to mine the deposit.	2

Question 29 continues on page 31

Question 29 (continued)

- (c) Production at the Millennium Zinc Mine commenced in 1985. The graphs show data relating to mine production, costs and income. 4

The cost relating to mine development prior to 1985 has been included in the 1985 costs. Costs relating to mine closure and environmental monitoring have been included in the 1995 costs.

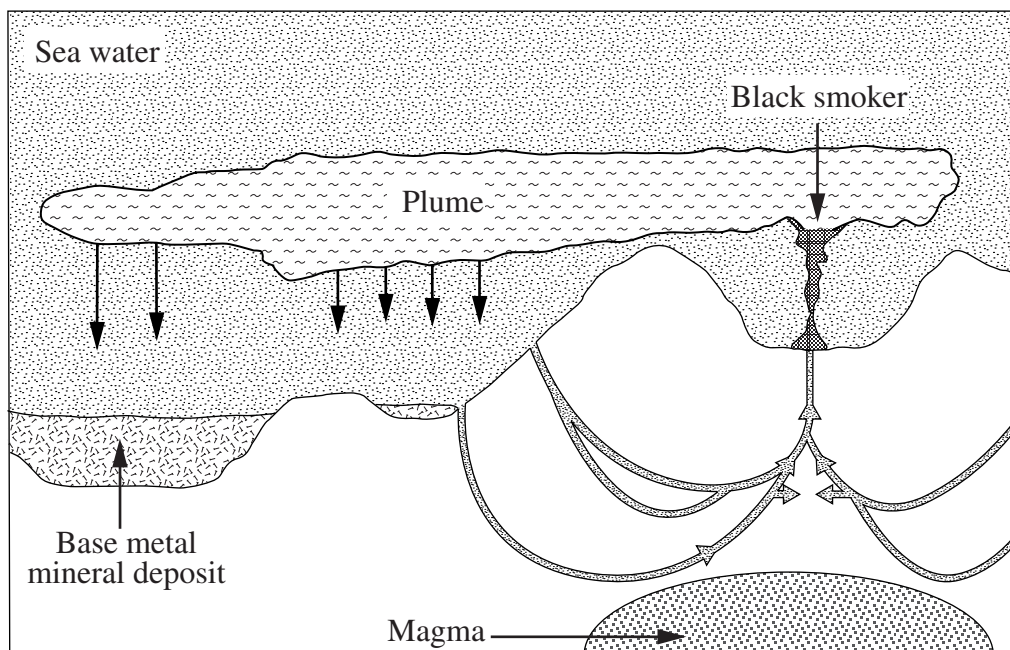


Analyse the data to determine the effect of the main economic components of the mining operation on the profit.

Question 29 continues on page 32

Question 29 (continued)

- (d) The diagram shows the processes leading to the production of a base metal mineral deposit in an island arc setting.



- (i) Describe how the processes shown in the diagram can produce a base metal mineral deposit. 2
- (ii) For ONE exploration method that you have studied, discuss whether the method could be used to locate this type of mineral deposit in an ancient island arc setting. 4
- (e) Evaluate the likely impacts on the environment of exploration, mining and processing methods at ONE deposit that you have studied. 8

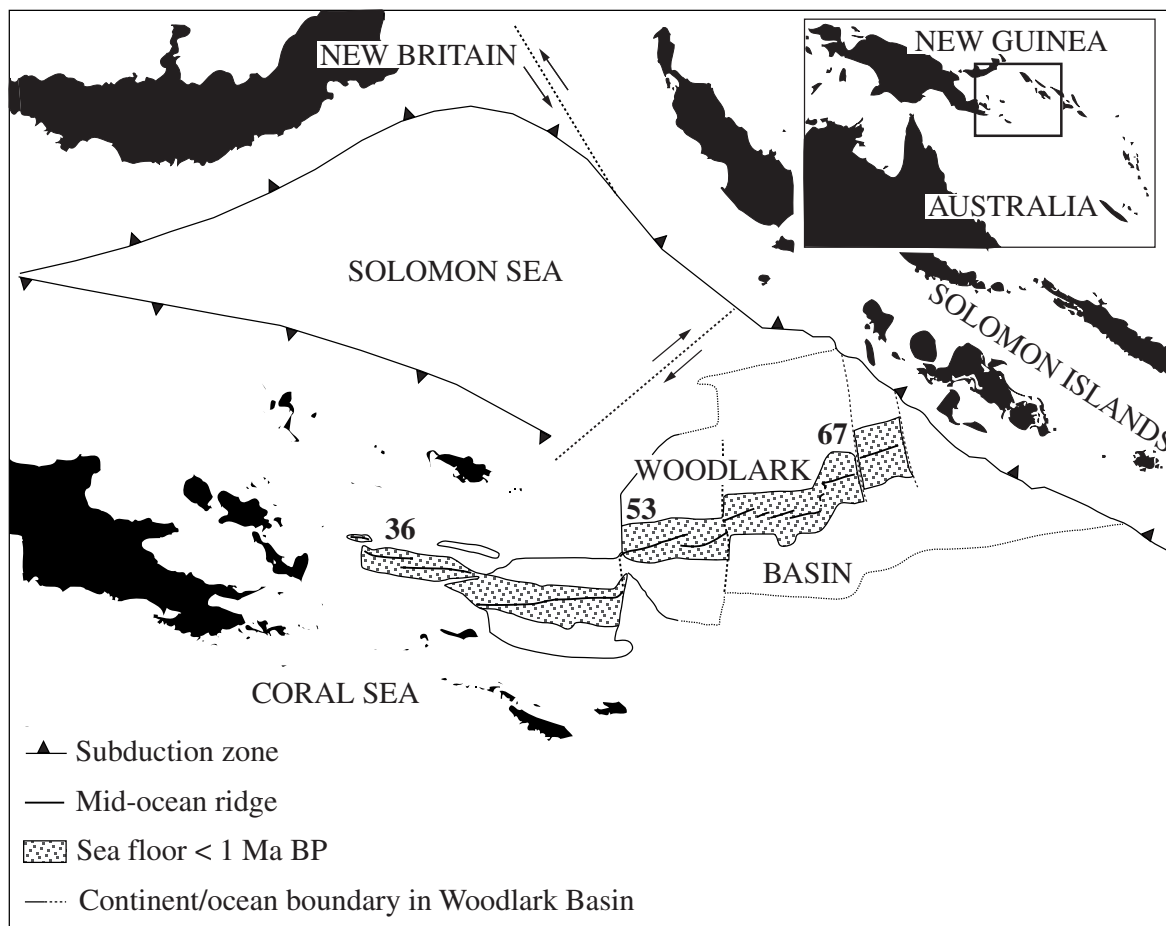
End of Question 29

		Marks
Question 30 — Oceanography (25 marks)		
(a)	(i) Identify the end of the visible light spectrum that can penetrate furthest into seawater.	1
	(ii) Describe ONE effect of differential light penetration on the distribution of marine plants.	2
(b)	In your study of Oceanography, you have undertaken first-hand investigations of the effect of temperature on the precipitation of common salts.	
	(i) Describe the procedure that you performed to test this effect.	2
	(ii) Explain ONE implication of these investigations for your understanding of naturally-occurring bodies of water.	2
(c)	Describe the characteristics and processes at hydrothermal vents.	4
	Your answer should consider both mineral deposits and biotic communities.	

Question 30 continues on page 34

Question 30 (continued)

- (d) The diagram shows an area north-east of Australia. The mid-ocean ridge and rates of spreading (in millimetres per year) are indicated for the Woodlark Basin.



- (i) Describe ONE method that could be used to date the ocean floor in the Woodlark Basin. 2
- (ii) Explain the likely outcomes of the tectonic processes operating within the Solomon Sea and Woodlark Basin regions. 4
- (e) Analyse how the use of echo sounders and magnetometers has improved our understanding of the oceans. 8

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Geological Time Scale

