BOARD OF STUDIES
NEW SOUTH WALES

2003

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 9, 13 and 17

Total marks – 100

Section I Pages 2–19

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 21–30

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.

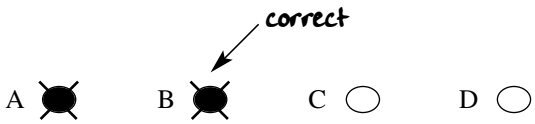
Select the alternative A, B, C or D that best answers the question. Fill in the response oval completely.

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

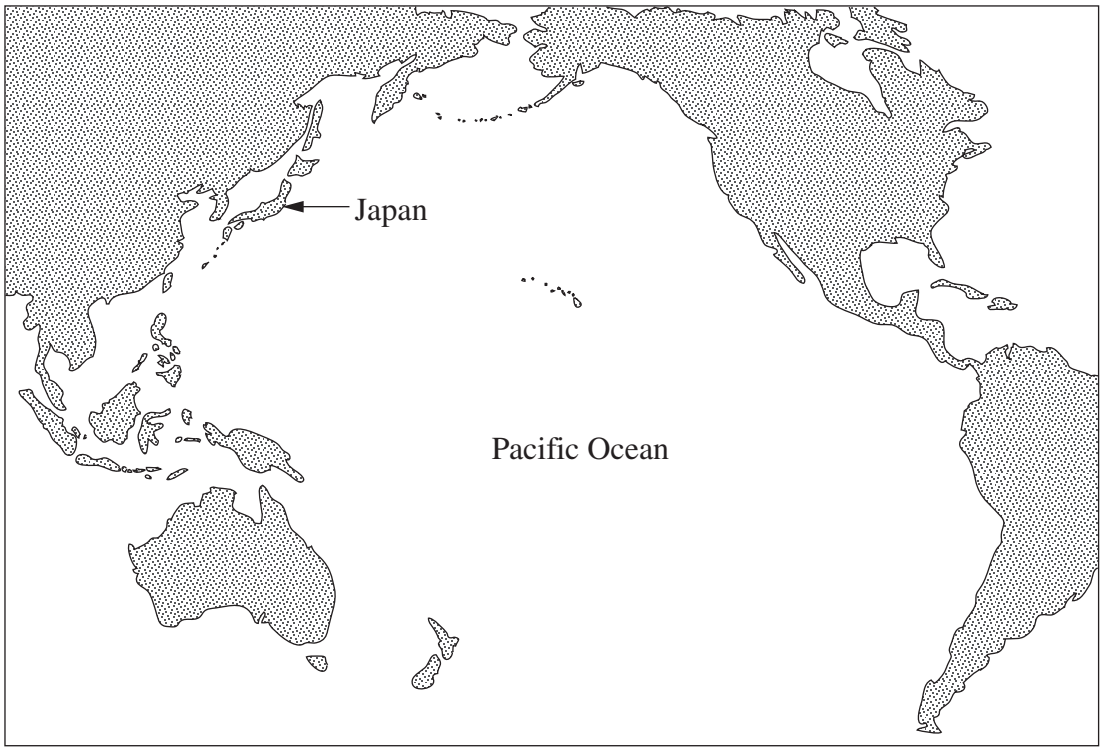
A ○ B ● C ○ D ○

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

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.



1 Volcanoes and earthquakes are common in Japan.



Stokes, William Lee, *Essentials of Earth History*, 4th edn, (c)1982. Electronically produced by permission of Pearson Education, Inc, Upper Saddle River, New Jersey.

What is the most likely tectonic setting of Japan?

(A) An intraplate hot spot

(B) A divergent plate boundary

(C) A convergent plate boundary

(D) A conservative plate boundary

2 Which statement summarises the plate tectonic supercycle?

(A) Large continents are completely destroyed and re-formed by partial melting.

(B) The positions of large continents repeatedly change but their basic shapes remain the same.

(C) The magnetic poles reverse periodically, thereby changing the relative locations of the continents.

(D) Large continents break up into smaller landmasses that eventually re-form into one large continent.

3 Which types of structures and igneous rock are most likely to be found at an ocean–continent convergent plate boundary?

(A) Normal faults and basalt

(B) Normal faults and granite

(C) Reverse faults and andesite

(D) Transform faults and rhyolite

4 Which of the following contributes most to the movement of lithospheric plates?

(A) Convection currents in the lithosphere

(B) Convection currents in the asthenosphere

(C) Crustal fracture due to tensional forces

(D) Movement of molten material in the inner core

5

In June 1991, Mt Pinatubo in the Philippines erupted. The photograph shows a volcanic plume above Mt Pinatubo. Eruptions of this type can produce ash-rich volcanic plumes that reach a height of more than 40 km.

Which of the following is the most likely global effect that would result from such a large explosive volcanic eruption?

(A) An increase in rainfall

(B) A decrease in temperature

(C) An increase in temperature

(D) A decrease in atmospheric carbon dioxide levels

6 Which of the following practices is used to maintain an environmental flow?

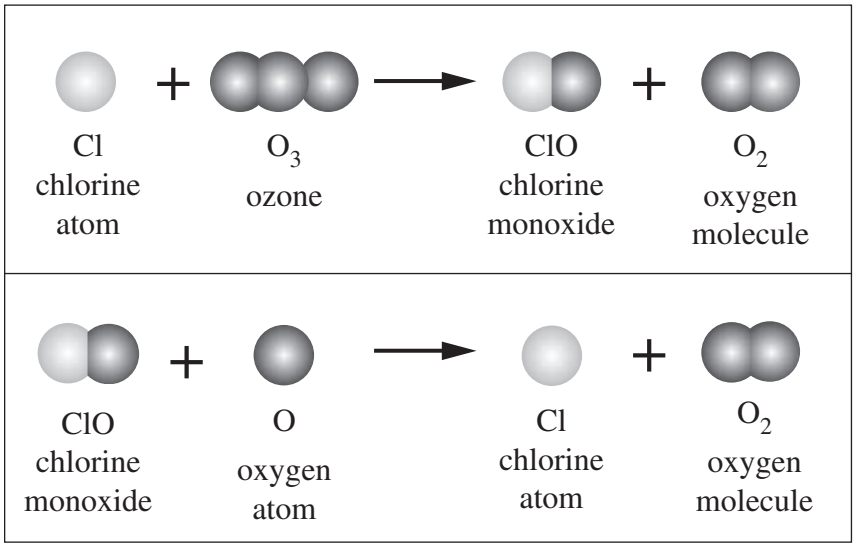
(A) Draining wetlands to reduce salinity levels in soils

(B) Release of water from dams during heavy rainfall

(C) Release of water from dams to maintain river ecosystems

(D) Diversion of coastal rivers inland for use during droughts

7 The diagram shows two chemical reactions that occur in the stratosphere.



What is the combined effect of these two reactions in the stratosphere?

(A) An increase in oxygen molecules and a decrease in ozone

(B) An increase in ozone and a decrease in oxygen molecules

(C) An increase in chlorine atoms and a decrease in oxygen atoms

(D) No change in the relative amounts of ozone and oxygen molecules

8 Which of the following was a feature of the Archaean atmosphere?

(A) It did not contain nitrogen.

(B) It was composed only of methane and ammonia.

(C) It contained more ozone than the atmosphere today.

(D) It contained less oxygen than the atmosphere today.

9 Terrestrial plants are thought to have evolved from aquatic plants.

What change would have been most significant in allowing plants to survive in terrestrial environments?

(A) Development of a reproductive system that relied less on water

(B) Ability to produce energy from reactions using oxygen rather than water

(C) Ability to produce energy from photosynthesis rather than respiration

(D) Development of larger tissues and parts composed of cells with a nucleus

10 Which of the following strategies could best reduce salinity in soils?

(A) Planting native grasses

(B) Planting deep-rooted trees

(C) Releasing water from dams

(D) Raising groundwater levels through engineering works

11 Why are the soils in eastern Australia that are formed on basalts from volcanic activity generally fertile?

(A) Basaltic ash produces well-drained, silica-rich soils.

(B) High relief promotes the development of fertile soils.

(C) Basalt contains elements essential to healthy plant growth.

(D) Steeply sloping volcanoes promote weathering and erosion.

12 The map shows the locations of seven megafauna fossil sites in Australia. The table shows the number and approximate age of megafauna reptile, bird and mammal species found at each site.

Site	*Number of bird species*	*Number of reptile species*	*Number of mammal species*	*Approximate age* (thousands of years)
1			7	46
2			10	52
3			1	60
4	1		19	171
5	1			60
6			1	80
7		1	10	55

What conclusion can be drawn from these data?

(A) Megafauna did not exist in the areas now known as NT or TAS.

(B) Mammals were better adapted to warm northerly climates than birds or reptiles.

(C) At least 48 different species of megafauna mammals lived throughout Australia.

(D) At least 10 different megafauna mammal species lived in the area now known as NSW approximately 52 000 years ago.

13 What is a cause of acid rain?

(A) Gases released in combustion combining with water

(B) CFCs causing the break-up of molecules to produce acid

(C) The greenhouse effect warming the atmosphere and increasing rainfall

(D) Radiation causing a reaction with water as a result of the hole in the ozone layer

14 During the Archaean eon, Earth's surface received higher levels of ultraviolet radiation than it does now.

What is the main reason for the reduction in the level of ultraviolet radiation reaching Earth's surface today?

(A) The increased greenhouse effect blocks incoming ultraviolet radiation.

(B) The stratosphere contains more ozone, which absorbs the ultraviolet radiation.

(C) The atmosphere contains more oxygen, which absorbs the ultraviolet radiation.

(D) Two-thirds of Earth's crust is now covered by water, which absorbs the ultraviolet radiation.

15 The theory of evolution by natural selection suggests that organisms have developed from other organisms that lived in the past.

Which sequence best shows how natural selection occurs?

(A)	Genetic variation in the population	Change in the environment	Survival of the fittest	New species
(B)	Change in the environment	Increase in population size	Change in the species	Survival of the fittest
(C)	Large numbers in the population	Change in the environment	Decrease in the population	New species
(D)	Genetic variation in the population	Decrease in the population	Change in the species	Increase in population size

Earth and Environmental Science

Centre Number

Student Number

Section I (continued)

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 (5 marks)

Despite the dangers associated with volcanic eruptions, people still live in areas where there is volcanic activity.

(a) Identify TWO hazards associated with volcanoes that might affect people living in areas of volcanic activity. **1**

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(b) Describe the potential impact on people (apart from death and injury) of ONE hazard identified in part (a). **2**

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(c) Explain why people would live in an area where volcanoes are active. **2**

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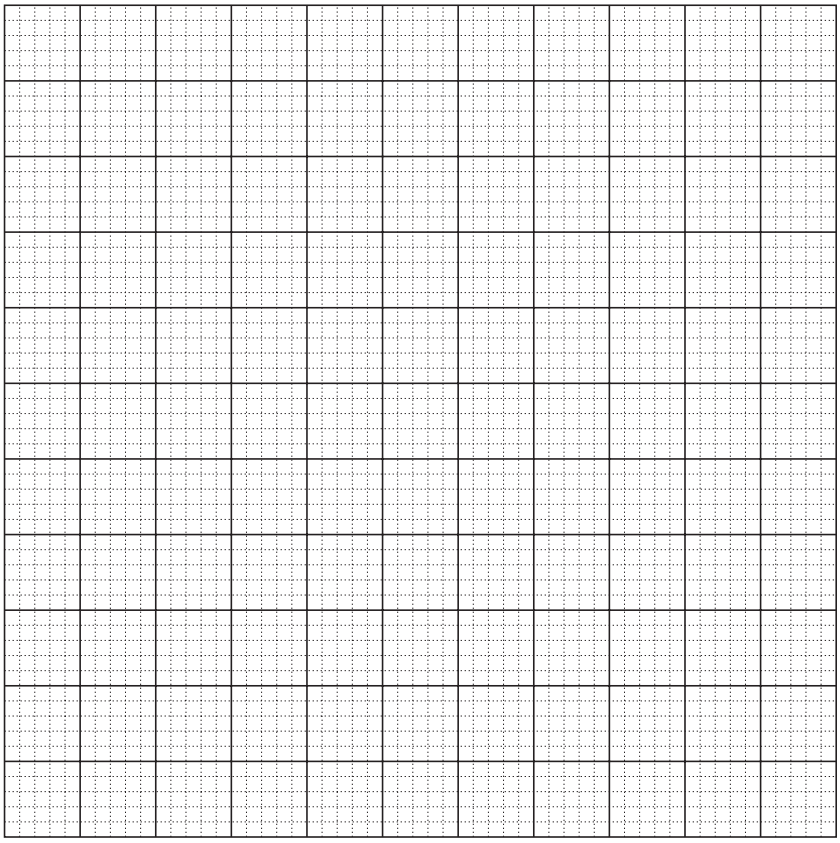
Marks

Question 17 (5 marks)

The table shows data collected by satellites in orbit around Earth from 1980 to 1999. The satellites measured the ozone concentration over Antarctica.

Year	*Minimum ozone concentration* (Dobson units)
1980	209
1982	205
1986	146
1987	159
1988	120
1989	173
1990	124
1993	124
1995	88
1997	111
1999	90

(a) On the grid provided, plot the points using the above data. Include a line of best fit. **3**



Question 17 continues on page 11

Question 17 (continued)

(b) Outline how ONE Australian scientist has contributed to the ongoing research into ozone depletion. **2**

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Question 18 (6 marks)

(a) Identify ONE feature of lithospheric plates. **1**

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(b) Outline briefly TWO hypotheses used to explain the movement of lithospheric plates. **2**

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(c) Use ONE of the hypotheses you outlined in part (b) to explain how divergent margins form. **3**

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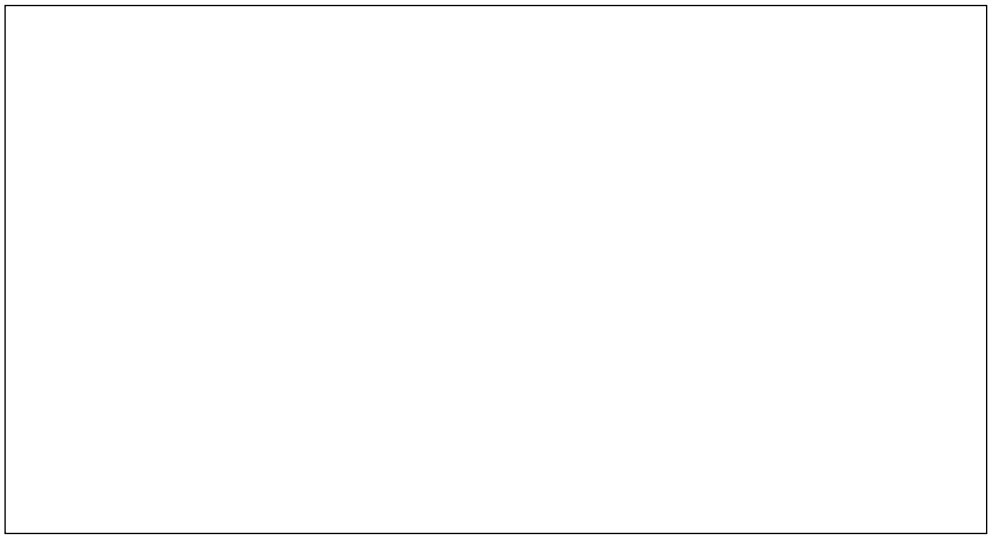
Marks

Question 19 (6 marks)

Draw diagrams of a convergent plate boundary AND of a divergent plate boundary. Label the following features on each diagram: **6**

- direction of plate movement
- sites of likely earthquake activity
- sites of likely igneous activity.

Convergent Plate Boundary

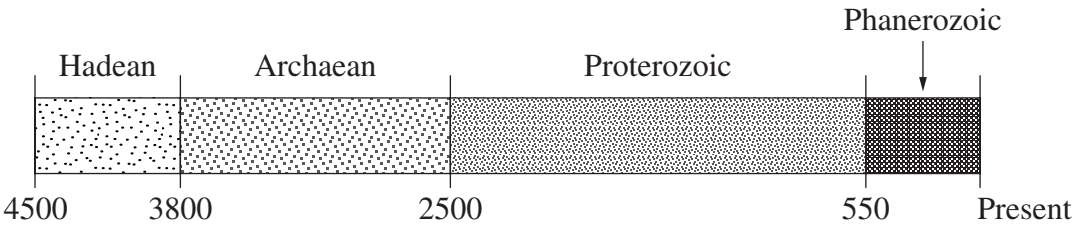


Divergent Plate Boundary

Marks

Question 20 (5 marks)

The diagram represents the eons of geological time.



Time before the present (millions of years)

(a) Recall the basis for the division of the geological timescale into eons. **1**

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(b) Outline why the Australian Banded Iron Formations (BIFs) formed prior to the Phanerozoic eon. **2**

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(c) Outline the stable isotope evidence to support the theory that life first appeared approximately 3800 million years ago. **2**

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Marks

Question 21 (3 marks)

Outline the process by which a fish living in a freshwater lake may eventually become a fossil. **3**

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Question 22 (3 marks)

Discuss how Silurian organisms with hard body parts had an advantage over Proterozoic organisms with soft bodies in terms of predation, protection and defence. **3**

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Marks

Question 23 (8 marks)

Name a plate tectonic process that has been linked to a named extinction event, and analyse the relationship between the process and the event. **8**

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Marks

Question 24 (7 marks)

In your Earth and Environmental Science course you gathered information about a pesticide, the use of which is now banned.

Name the pesticide you studied .....

(a) Name ONE pest for which this pesticide was used. **1**

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(b) Outline why this pesticide is now banned. **2**

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(c) Assess TWO impacts of this pesticide in the environment. **4**

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Marks

Question 25 (6 marks)

(a) Identify ONE possible cause of soil erosion in an urban area. **1**

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(b) Identify ONE possible cause of soil erosion on a farming or grazing property. **1**

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(c) Explain TWO management strategies that could be used to reduce soil erosion in a national park frequently visited by people. **4**

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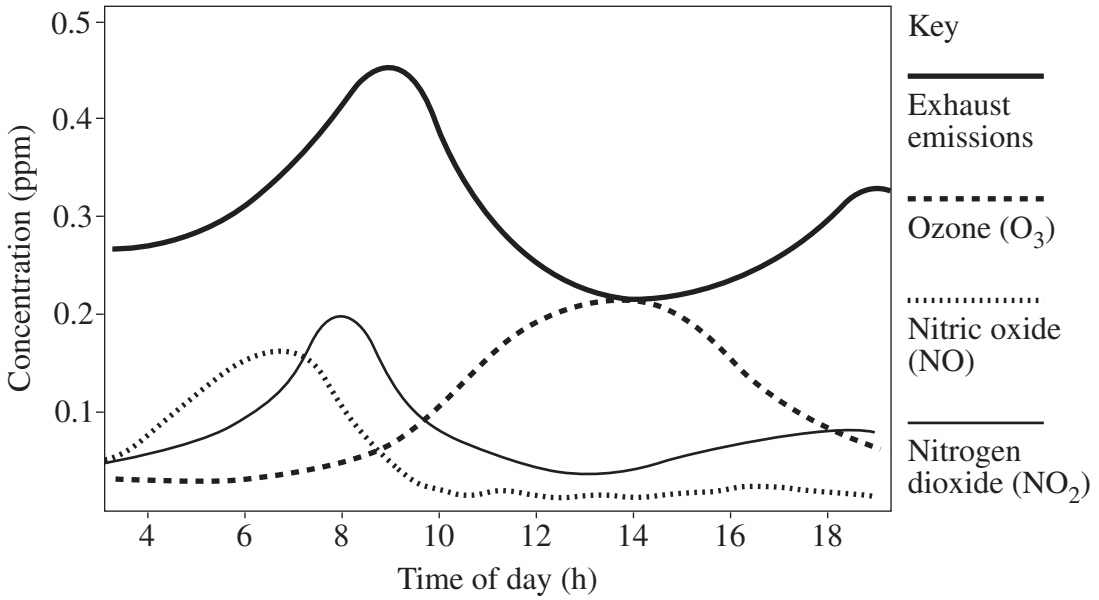
Marks

Question 26 (6 marks)

The graphs show the concentration of compounds in the atmosphere in an urban area such as Sydney on a clear summer day. Ozone (O_3) is a pollutant produced in the lower atmosphere in urban environments. Ozone is produced in a photochemical reaction.



(a) Name TWO compounds found in vehicle emissions. **2**

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(b) Explain the trends in exhaust emissions shown on the graph. **2**

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(c) Propose a reason for the trend in ozone (O_3) concentration. **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.

Marks

Question 27 — Introduced Species and the Australian Environment (25 marks)

(a) (i) Identify ONE way in which a non-indigenous species of animal, and ONE way in which a non-indigenous species of plant, may be accidentally introduced into Australia's coastal waters and harbours. **1**

(ii) Describe TWO quarantine methods used in Australia to control the introduction of non-indigenous species. **2**

(b) In your study of Introduced Species and the Australian Environment you carried out an investigation to identify and distinguish between biotic and abiotic components of the environment that may have been affected by an introduced species.

(i) Summarise the results of your investigation. **2**

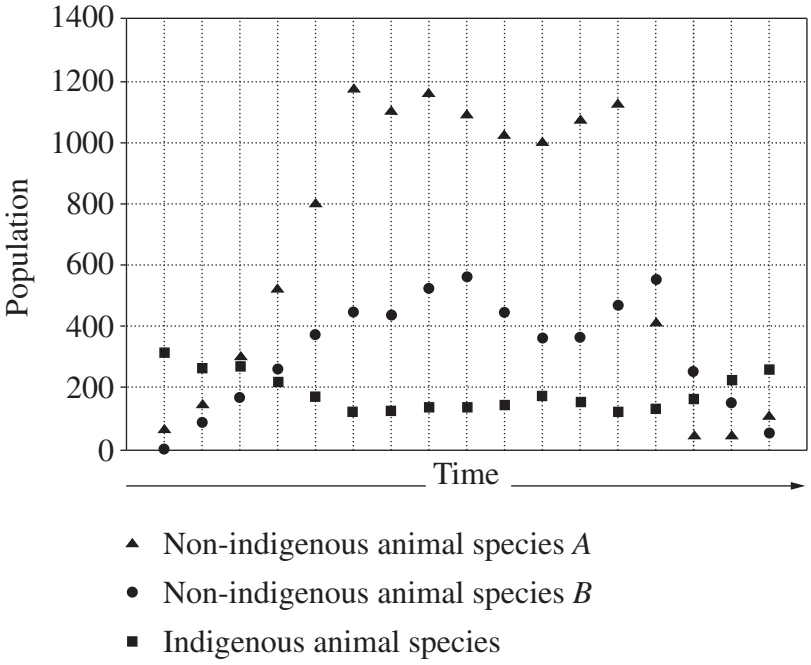
(ii) Describe how your investigation was designed to ensure the data you collected were both valid and reliable. **2**

(c) Assess the use and success of TWO strategies used as forms of biological control. **5**

Question 27 continues on page 23

Question 27 (continued)

(d) The graph shows the populations of TWO non-indigenous and ONE indigenous animal species with time.



(i) Describe the trends for non-indigenous animal species *A* and the indigenous animal species. **2**

(ii) Account for ONE of these trends. **2**

(iii) Predict what may happen to the population of non-indigenous animal species *B* in the future. Account for your prediction. **2**

(e) Before a new species of animal is allowed to be introduced into the Australian environment today, a detailed study of the species should be undertaken. This study should include: **7**

1 Its habitat and food source
2 Its reproductive capacity
3 Dispersal techniques
4 Potential predators.

Justify why each of these factors has to be included in the study.

End of Question 27

Marks

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

(a) (i) Identify ONE renewable and ONE non-renewable energy resource. **1**

(ii) Choose ONE of the resources identified above and describe TWO impacts that its use would have on the Australian environment. **2**

(b) In your study of Organic Geology you carried out a first-hand investigation to identify a variety of fossil fuels and compare their properties.

(i) Summarise the results of your investigation for TWO of these fossil fuels. **2**

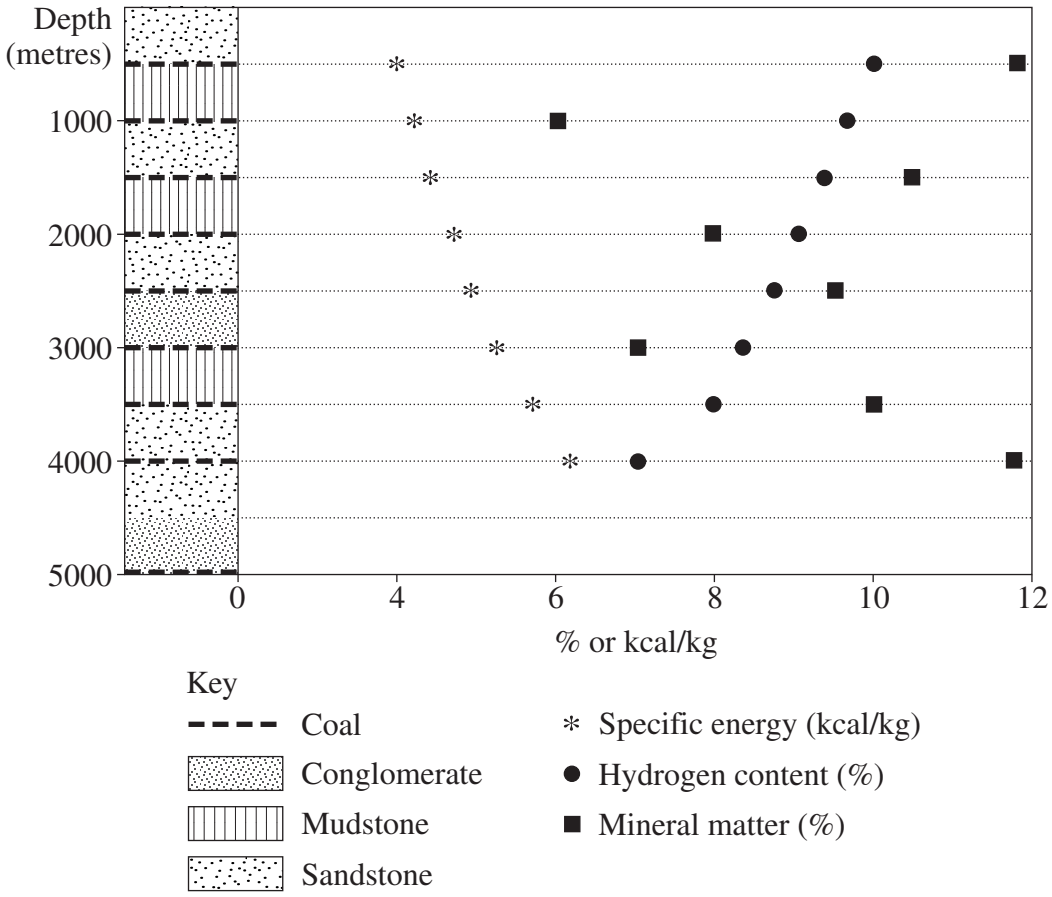
(ii) Describe how your investigation was designed to ensure the data you collected were both valid and reliable. **2**

(c) Assess the relative importance and potential of TWO alternative energy sources. **5**

Question 28 continues on page 25

Question 28 (continued)

(d) The graph shows the geological log for a drill-hole that intersected nine coal seams. The upper eight coal seams were analysed, and the values for some of their properties are shown.



(i) Describe TWO trends shown by the graph. **2**

(ii) Account for ONE of these trends. **2**

(iii) Predict the approximate values for specific energy and hydrogen content for coal intersected at 5000 m in this drill-hole. Account for your prediction. **2**

(e) Before locating and developing a fossil fuel resource, a detailed study should be undertaken. This study should include: **7**

1 An exploration program
2 Determining the geology of the deposit
3 Determining the uses of the resource
4 Consideration of the environmental issues.

Justify why each of these factors has to be included in the study.

End of Question 28

Marks

Question 29 — Mining and the Australian Environment (25 marks)

(a) (i) Identify ONE renewable and ONE non-renewable resource. **1**

(ii) Choose ONE of the resources identified above, and describe TWO impacts that its use would have on the Australian environment. **2**

(b) In your study of Mining and the Australian Environment you carried out an investigation to test for the presence of ore minerals or metals using a geophysical method OR a geochemical method.

(i) Summarise the results of your investigation. **2**

(ii) Describe how your investigation was designed to ensure the data you collected were both valid and reliable. **2**

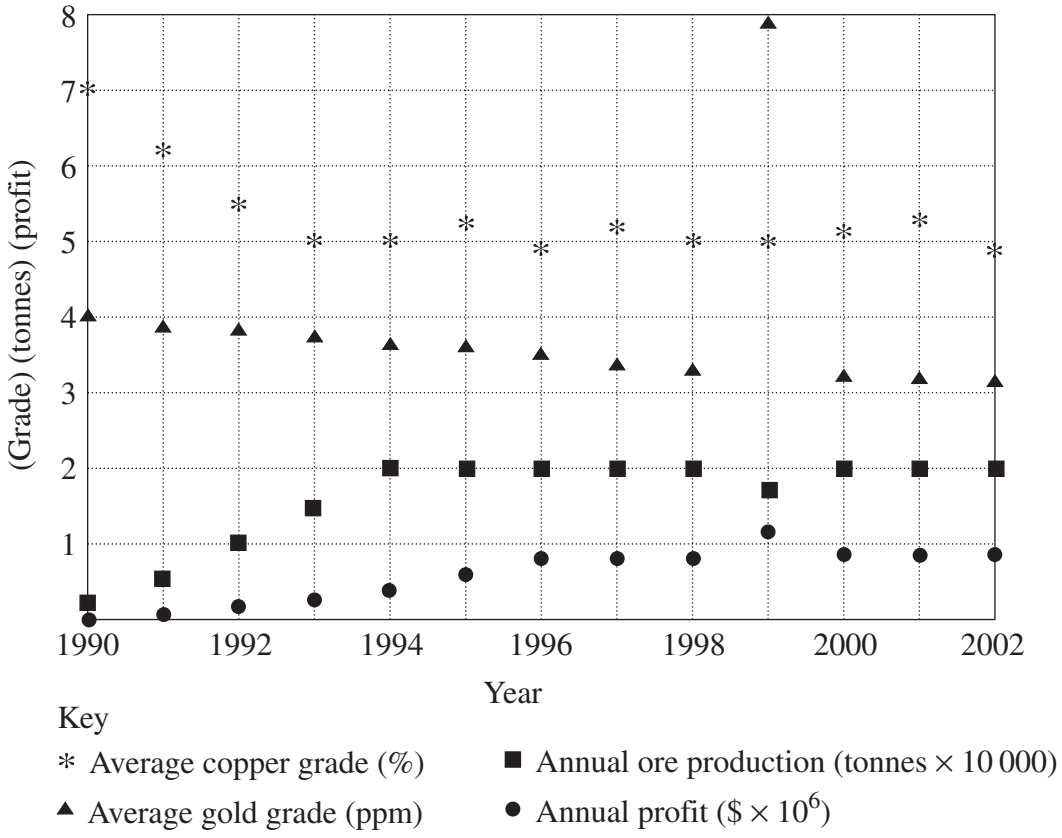
(c) Name a major landmark court decision that has impacted on mining operations in Australia and name an ore body affected by this decision. **5**

Assess the present and future implications of this decision on the mining of the ore body you named.

Question 29 continues on page 27

Question 29 (continued)

(d) A copper and gold mine commenced production in 1990 with an expected life of 30 years. The graph shows the metal grades, annual ore production and profits from 1990 to 2002.



(i) Describe the trends for annual production and annual profits over the period shown. **2**

(ii) Account for ONE of these trends. **2**

(iii) Predict approximate gold and copper grades for the next five years. Give geological reasons to explain the grades you predicted. **2**

(e) Before locating and developing an ore body, a detailed study should be undertaken. This study should include: **7**

1 An exploration program

2 Determining the size and nature of the ore body

3 Determining the economic viability of the ore body

4 Consideration of the environmental issues.

Justify why each of these factors has to be included in the study.

End of Question 29

Marks

Question 30 — Oceanography (25 marks)

(a) (i) Identify the probable origins of the oceanic waters. **1**

(ii) Describe the link between the evolution of the atmosphere and the evolution of the oceanic waters. **2**

(b) In your study of Oceanography you carried out an investigation to determine the relationship between the rate of hatching of brine shrimp, and salt-water concentration and temperature.

(i) Summarise the results of your investigation. **2**

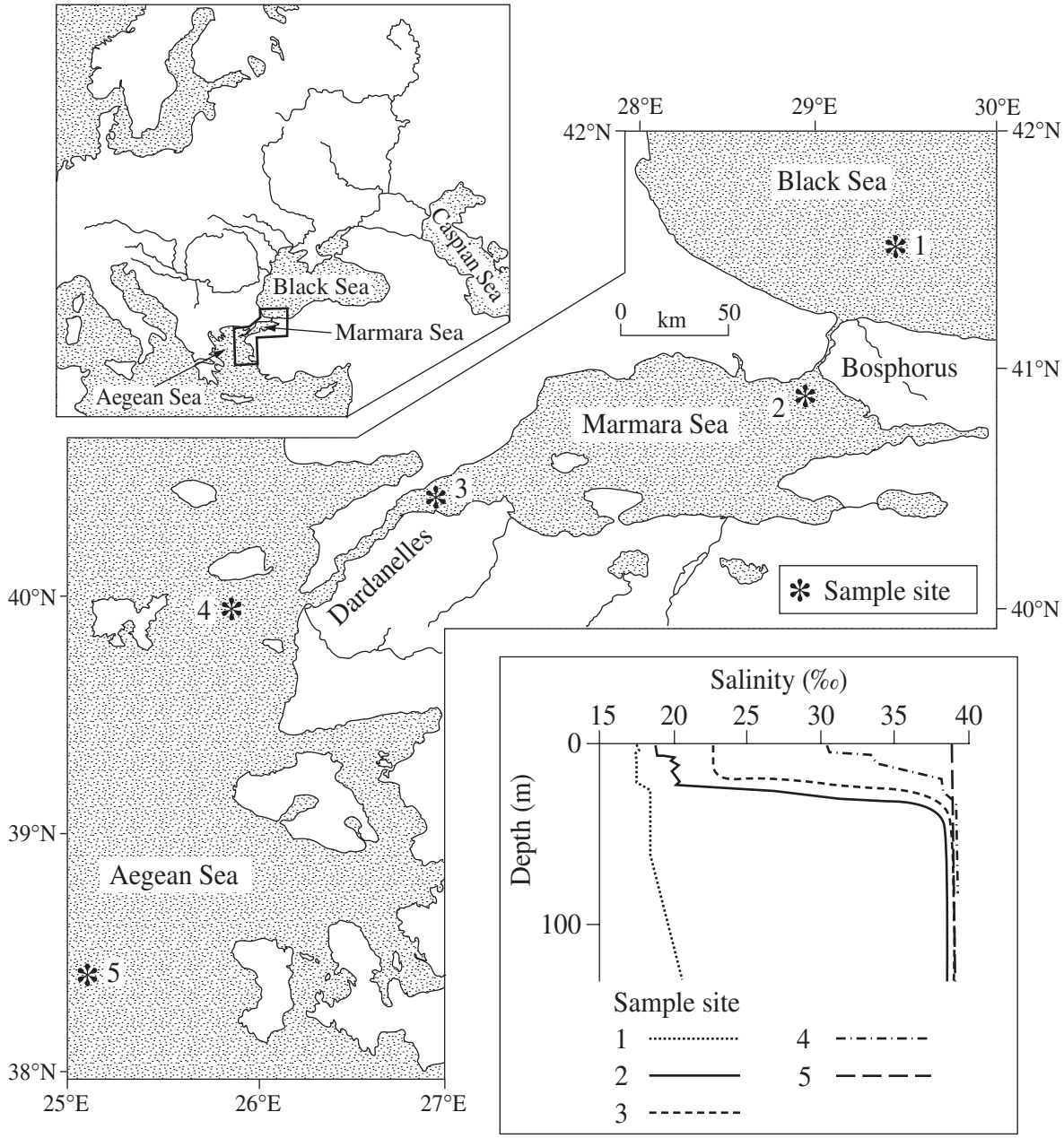
(ii) Describe how your investigation was designed to ensure the data you collected were both valid and reliable. **2**

(c) Explain the distribution on the ocean floor of calcareous ooze and siliceous ooze. Include in your answer the origin of each sediment type. **5**

Question 30 continues on page 29

Question 30 (continued)

(d) The maps show the Marmara Sea in Turkey. Water flows from the Black Sea through the Marmara Sea to the Aegean Sea. The graphs show salinity data taken at five sites in the Black Sea, Marmara Sea and Aegean Sea.



(i) Describe trends shown by the curves for data at Sites 1 and 3. **2**

(ii) Account for the trend shown by the curve for data at Site 3. **2**

(iii) Predict how salinity levels in the Marmara Sea would change if it was no longer connected to the Black Sea. Give reasons for your prediction. **2**

Question 30 continues on page 30

Marks

Question 30 (continued)

(e) Hydrothermal metal deposits can form in ocean environments. In order to locate such deposits, a detailed study should be undertaken. This study should include: **7**

1 Determining the likely tectonic setting

2 Determining the mode of formation of the deposit

3 Describing the type of sediment associated with the deposit

4 Choosing appropriate technology to assist the search.

Justify why each of these factors has to be included in the study.

End of paper

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Geological Time Scale