



BOARD OF STUDIES
NEW SOUTH WALES

2004

**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 and 21

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 25–33

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

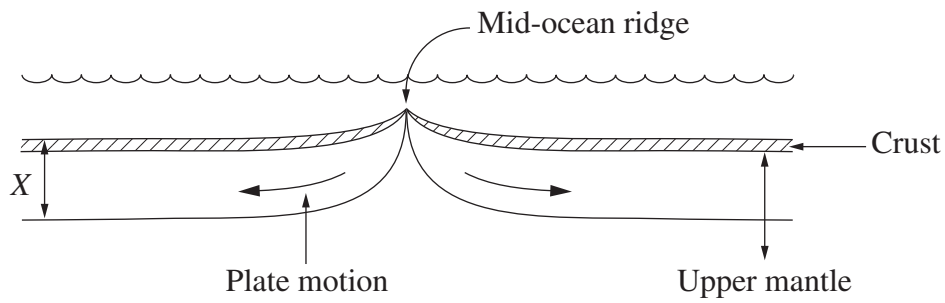
If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

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 ↙

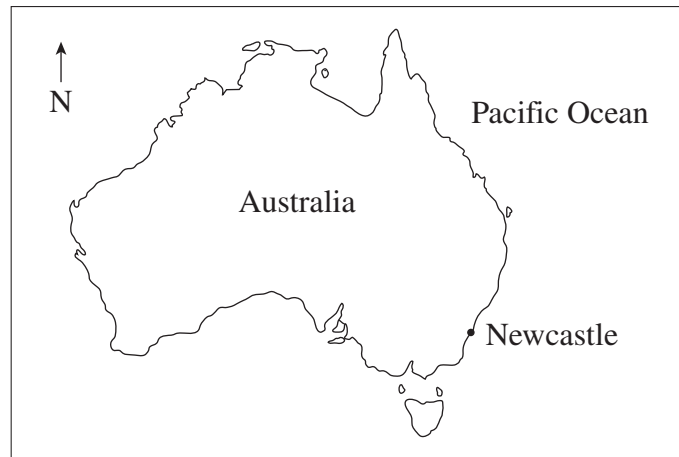
- 1 The diagram shows a cross-section through a mid-ocean ridge. Features of the ridge system are labelled.



What is represented by the letter X?

- (A) Lithosphere
 - (B) Ocean trench
 - (C) Asthenosphere
 - (D) Subduction zone
- 2 A plate boundary has a deep ocean trench and a chain of active volcanic islands.
- Which plate boundary and igneous rock typically characterise this type of boundary?
- (A) Oceanic divergent boundary and basalt
 - (B) Continental divergent boundary and andesite
 - (C) Ocean–ocean convergent boundary and andesite
 - (D) Ocean–continent convergent boundary and basalt

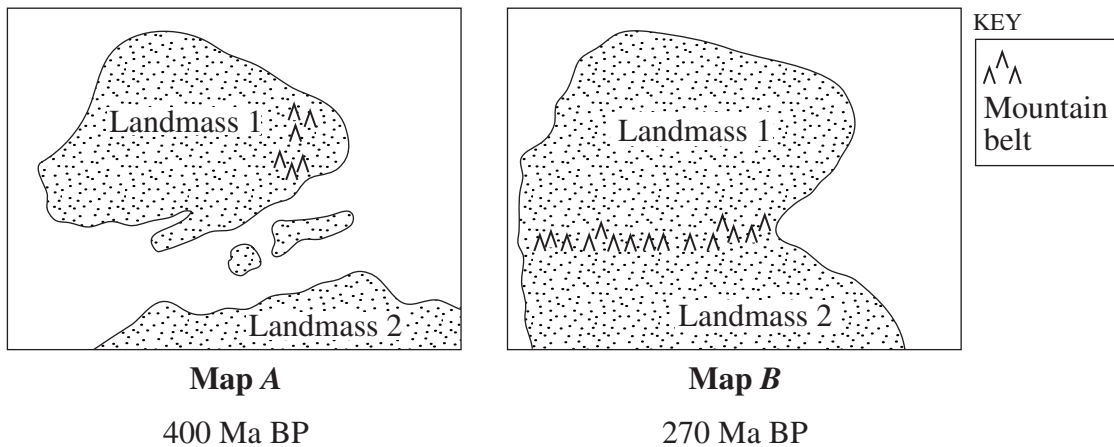
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Which present-day process was the likely cause of the 1989 Newcastle earthquake?

- (A) Build-up of pressure within the Australian Plate
- (B) Subduction of the Pacific Plate under the Australian Plate
- (C) Divergent rifting of a margin along Australia's east coast
- (D) Thermal uplift causing mountain building in eastern Australia

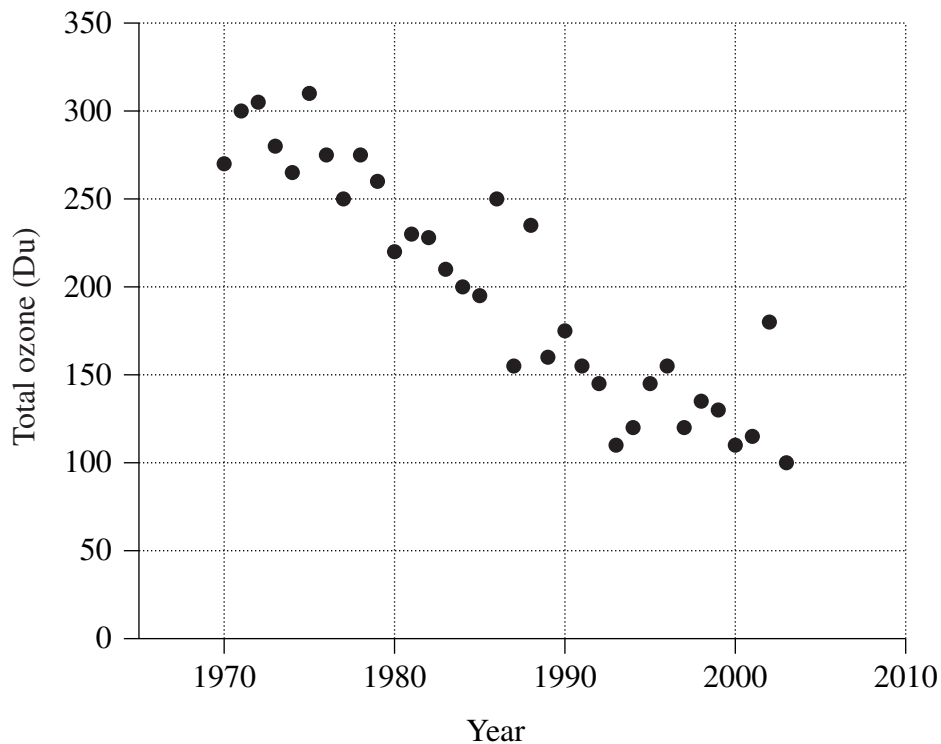
4



What is the most likely cause of the changes observed from Map A to Map B?

- (A) A drop in sea level during a major ice age
- (B) The convergence of two lithospheric plates
- (C) Sea floor spreading between the two landmasses
- (D) Accumulation of volcanic material erupted from an island chain

- 5 Which of the following is a common short-term effect of major explosive volcanic eruptions?
- (A) Increased rates of weathering due to acid rain from sulfur dioxide emissions
 - (B) Decreased agricultural production due to a reduction in available sunlight
 - (C) Decreased biodiversity due to the dispersion of toxic metals
 - (D) Increased plant growth due to carbon dioxide emissions
- 6 The graph shows the trend in total ozone in Dobson units (Du) above Antarctica in October from 1970 to 2003.



What is the likely consequence of this trend for Antarctica?

- (A) The extent of the ice sheet will decrease.
- (B) The amount of atmospheric water vapour will increase.
- (C) The intensity of sunlight reaching Antarctica's surface will decrease.
- (D) The level of ultraviolet radiation reaching Antarctica's surface will increase.

- 7 The photo shows a 425 million-year-old ostracode that was discovered under volcanic ash in the United Kingdom. The excellent preservation of this fossil allowed scientists to identify gills, eyes, limbs and a shell.

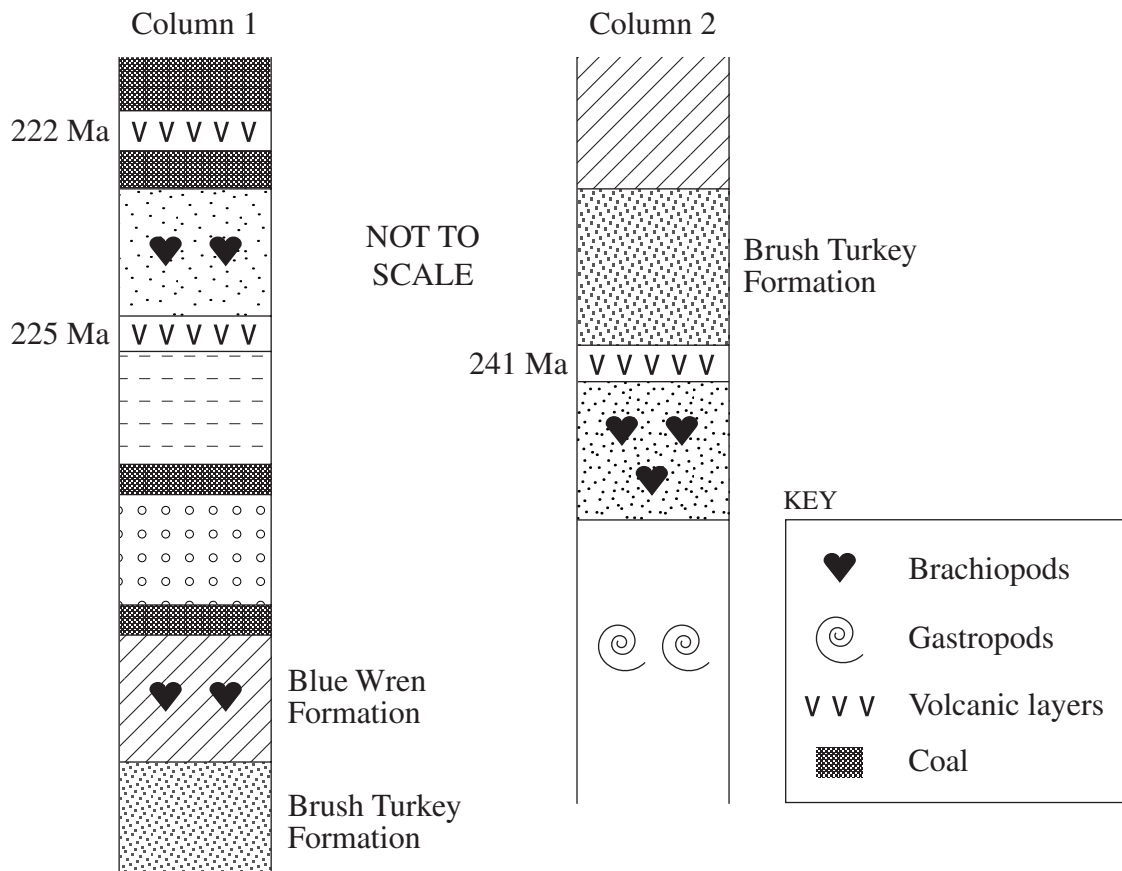


Ostracode Photo from the Article 'Oldest beast from the deep', December 5, 2003 -1:36 PM.
Reproduced with the permission of AAP.

What is a likely conclusion that can be drawn from a study of this ostracode?

- (A) The cause of the extinction of its species
- (B) The geographical distribution of its species
- (C) The position of the species in the evolutionary tree for ostracodes
- (D) The nature of the chemical environment in which the organism lived

- 8 The diagram shows two stratigraphic columns from a Permian sedimentary basin.



Which of the following best describes the age of the Blue Wren Formation?

- (A) Older than 241 Ma
- (B) Younger than 225 Ma
- (C) Between 222 Ma and 225 Ma
- (D) Between 225 Ma and 241 Ma
- 9 Which of the following appears in the geological record immediately after the 'Cambrian event'?
- (A) The first terrestrial plants in swampy environments
- (B) A diversity of primitive fish in marine environments
- (C) A diversity of hard-shelled organisms in marine environments
- (D) The first multi-cellular organisms in deep marine environments

- 10 Which of the following best describes the organisms that formed the first-known stromatolites?
- (A) Layer-forming bacteria that lived in the Hadean
 - (B) Sediment-trapping cyanobacteria that lived in the Archaean
 - (C) Mound-building filamentous green algae that lived in the Proterozoic
 - (D) Sediment-trapping primitive flat worms that lived in the Cambrian
- 11 Why do Australian soils typically have low fertility?
- (A) They are highly saline in nature.
 - (B) Australia has low annual rainfall.
 - (C) Nutrient ions are rapidly depleted.
 - (D) Australia has long-term tectonic stability.
- 12 The following table shows some of the organisms found in a river ecosystem and the average concentration of a particular pesticide within each organism.

<i>Organism</i>	<i>Concentration of pesticide (in parts per million)</i>
Bird	26.4
Fish	2.07
Prawn	0.23
Plankton	0.04

- Which is the most likely explanation for the difference in the concentration of pesticide?
- (A) Bioaccumulation due to the position of the organism in the food chain
 - (B) Biomagnification due to the position of the organism in the food chain
 - (C) Bioaccumulation due to the size and sensitivity of the organism
 - (D) Biomagnification due to the size and sensitivity of the organism

- 13 Which geological features are important in selecting a suitable site for a waste dump?
- (A) A clear, level site close to transport links
 - (B) Stable rock structures and available groundwater
 - (C) Non-porous rock types with no faults or fractures
 - (D) Rock types that allow good drainage and deep excavations

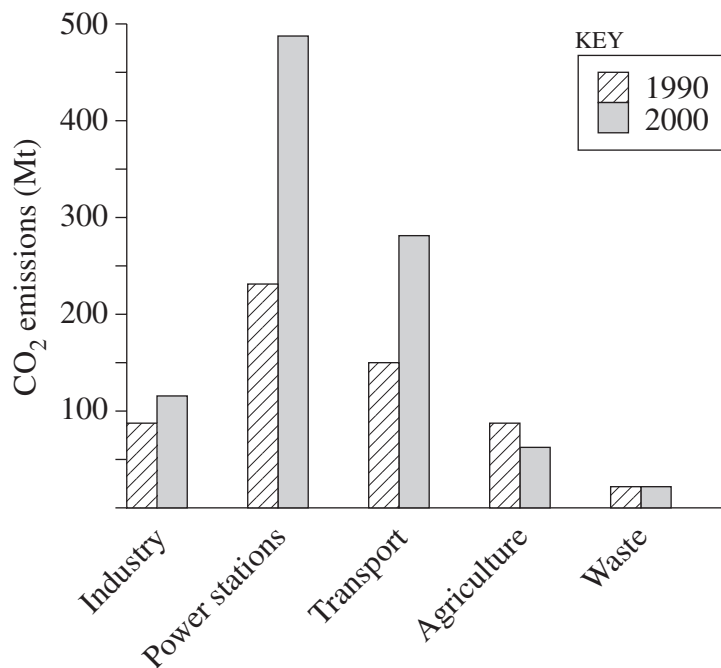
- 14 The graph shows variations in global temperature and carbon dioxide concentration over the last 160 000 years.



Based on the graph, which of the following is a valid conclusion?

- (A) An increase in CO₂ concentration causes a rapid increase in temperature.
- (B) Over the last 160 000 years, CO₂ concentrations have steadily increased.
- (C) An increase in temperature causes an immediate increase in CO₂ concentration.
- (D) An increase in CO₂ concentration usually follows a rapid rise in temperature.

- 15 The graph shows the amount of CO₂ in megatonnes (Mt) emitted by different sources in 1990 and 2000 for a developing country. Over the same period, the population increased by 15%.



Based on the information provided, what are the most likely reasons for the differences in the amount of CO₂ emissions between 1990 and 2000?

- (A) Increased use of power in homes and the introduction of waste reduction and recycling
- (B) Development of more efficient power stations and a change to hydroelectricity generation
- (C) Increase in CO₂ emissions from power stations due to an increase in industry
- (D) Increase in agricultural production and extensive use of public transport

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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.

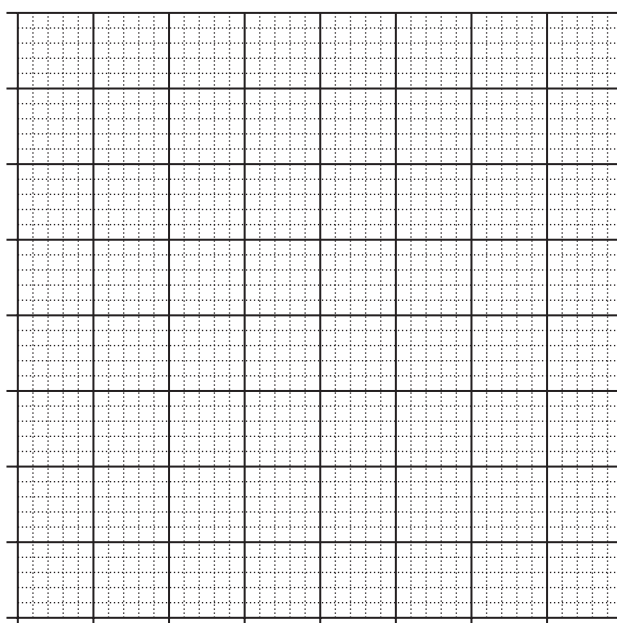
	Marks
Question 16 (4 marks)	
(a) State the name given to very old, stable continental crust.	1
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(b) Explain why the geological regions in Australia generally become younger from west to east.	3
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Question 17 (5 marks)

- (a) The table shows the frequency index and the volcanic explosivity index of eruptions for some major volcanoes. 3

<i>Frequency index</i>	<i>Volcanic explosivity index</i>
3.3	3.5
2.8	4
2.6	4.5
2.0	5
1.5	5.5
1.0	6
0.6	6.5
0.2	7

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



- (b) Describe an impact on people of ONE hazard associated with volcanic eruptions. 2

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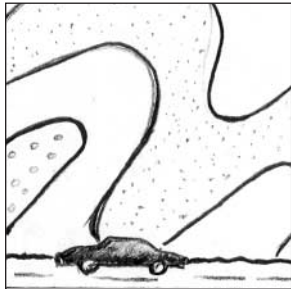
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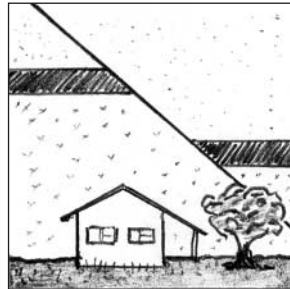
Question 18 (8 marks)

8

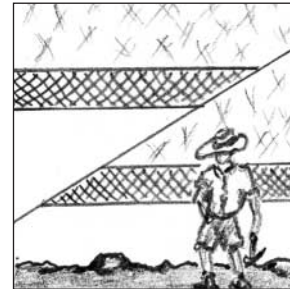
A geologist sketched three geological structures found in an area of ancient continental crust, shown below. The geologist gave each structure an age and suggested this was evidence for the plate tectonic super-cycle.



Structure 1
1500 Ma



Structure 2
600 Ma



Structure 3
650 Ma

Discuss this evidence in terms of plate tectonic processes and relate it to the plate tectonic super-cycle. In your answer, name each structure.

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Question 19 (5 marks)

During your Earth and Environmental Science course you used computer simulations, data loggers, photographs or other technologies to gather information.

Name ONE technology you used

- (a) Outline ONE advantage of using this technology. **1**

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- (b) Outline ONE disadvantage of using this technology. **1**

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- (c) Name ONE other technology, and evaluate its suitability and effectiveness for an investigation within this course. **3**

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Centre Number

Section I – Part B (continued)

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Student Number

Marks

Question 20 (6 marks)

- (a) Identify TWO features that allow you to distinguish between a mass extinction event and a smaller extinction event such as the recent extinction of megafauna in Australia. **2**

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- (b) Describe TWO different hypotheses to explain mass extinction events. **4**

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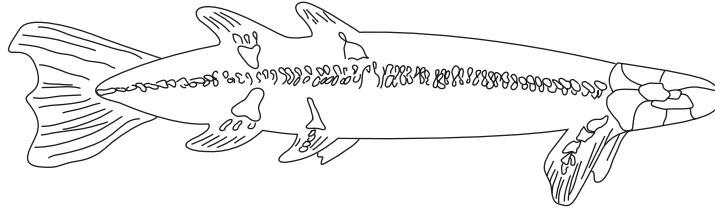
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Question 21 (6 marks)

- (a) Crossopterygian fish are commonly regarded as a transition group because they provide a link between aquatic and terrestrial organisms.

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Crossopterygian fish

Complete the table provided to identify **THREE** problems encountered by the descendants of crossopterygian fish and describe how each problem is overcome to allow them to survive in terrestrial environments.

<i>Problem</i>	<i>Description of how this problem is overcome</i>
1.
2.
3.

- (b) Describe **TWO** methods that can be used to establish the age of fossils.

3

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Question 22 (6 marks)

Global climate changes have occurred throughout the history of Earth. Explain how both geological events before the Cenozoic AND recent human impact have contributed to global climate change.

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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 23 (3 marks)

Draw a diagram or flowchart to outline the sequence of events by which release of chlorofluorocarbons to the atmosphere can result in more ultraviolet radiation reaching Earth's surface.

3



Question 24 (4 marks)

Crop-eating beetles can be controlled using pesticides.

- (a) Identify ONE other management practice that could be used to control this beetle. **1**

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- (b) Outline THREE conditions necessary for the management practice identified in part (a) to be effective in controlling the crop-eating beetle. **3**

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Question 25 (6 marks)

During your Earth and Environmental Science course you performed an investigation to determine the effect of compaction or tracking on soil.

- (a) Outline the investigation you performed. Include any equipment you used and the method you followed. **3**

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- (b) Based on your results and/or observations, evaluate a strategy used in NSW to treat soil erosion. **3**

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Question 26 (7 marks)

Evaluate the effectiveness of recycling compared with landfill in disposing of solid and liquid waste in a large city such as Sydney.

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2004 HIGHER SCHOOL CERTIFICATE EXAMINATION
Earth and Environmental Science

Section II

25 marks

Attempt ONE question from Questions 27–30

Allow about 45 minutes for this section

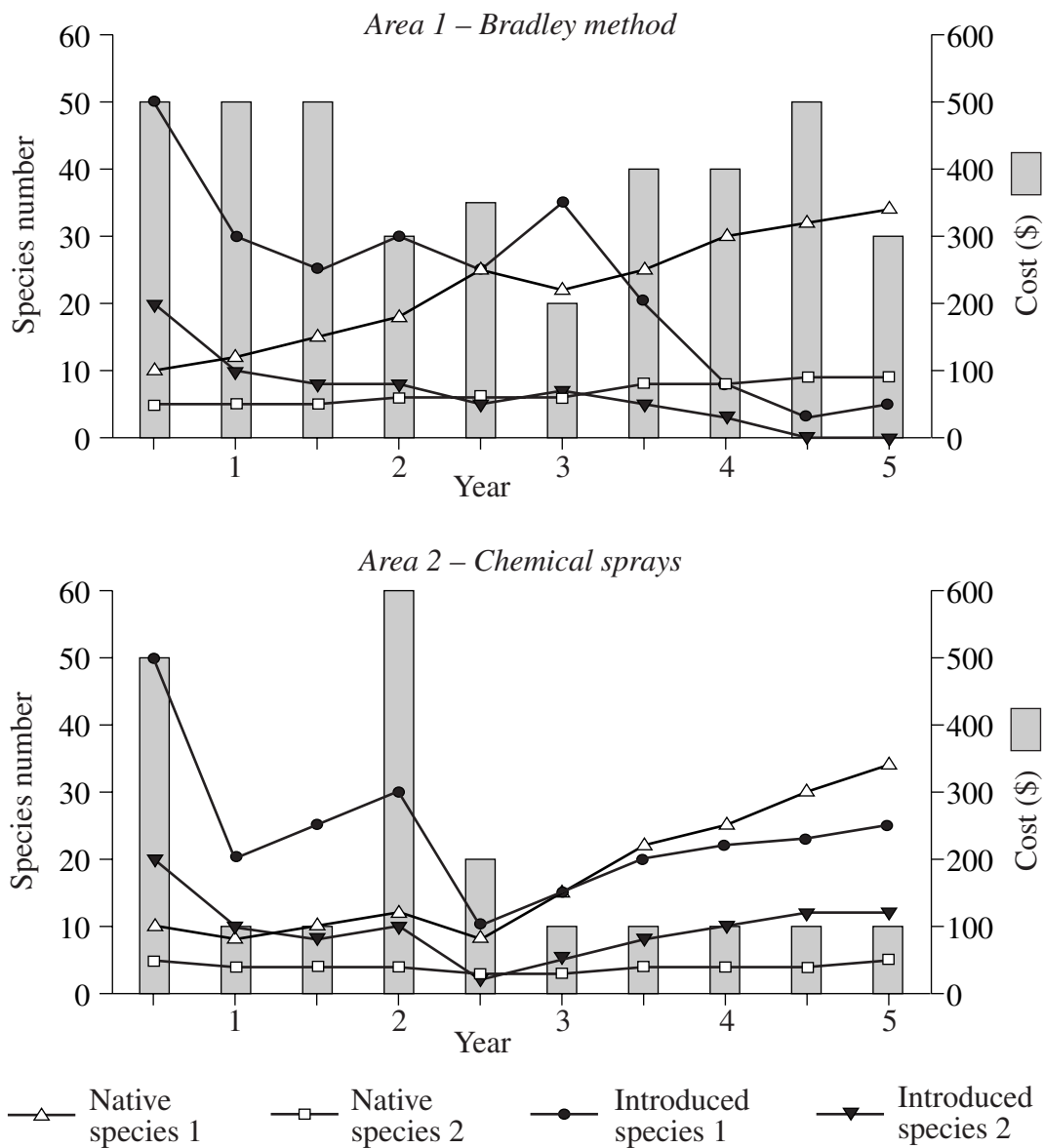
Answer the question in a writing booklet. Extra writing booklets are available.

	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	30–31
Question 30 Oceanography	32–33

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

- (a) (i) Identify TWO modes of introduction of introduced species. 2
- (ii) Describe the reasons why groups of people have introduced plants and animals into the Australian environment. 2

(b) The graphs show the numbers for four species at two similar locations. *Area 1* is being rehabilitated using the Bradley Method and *Area 2* is being rehabilitated using chemical sprays.



Question 27 continues on page 27

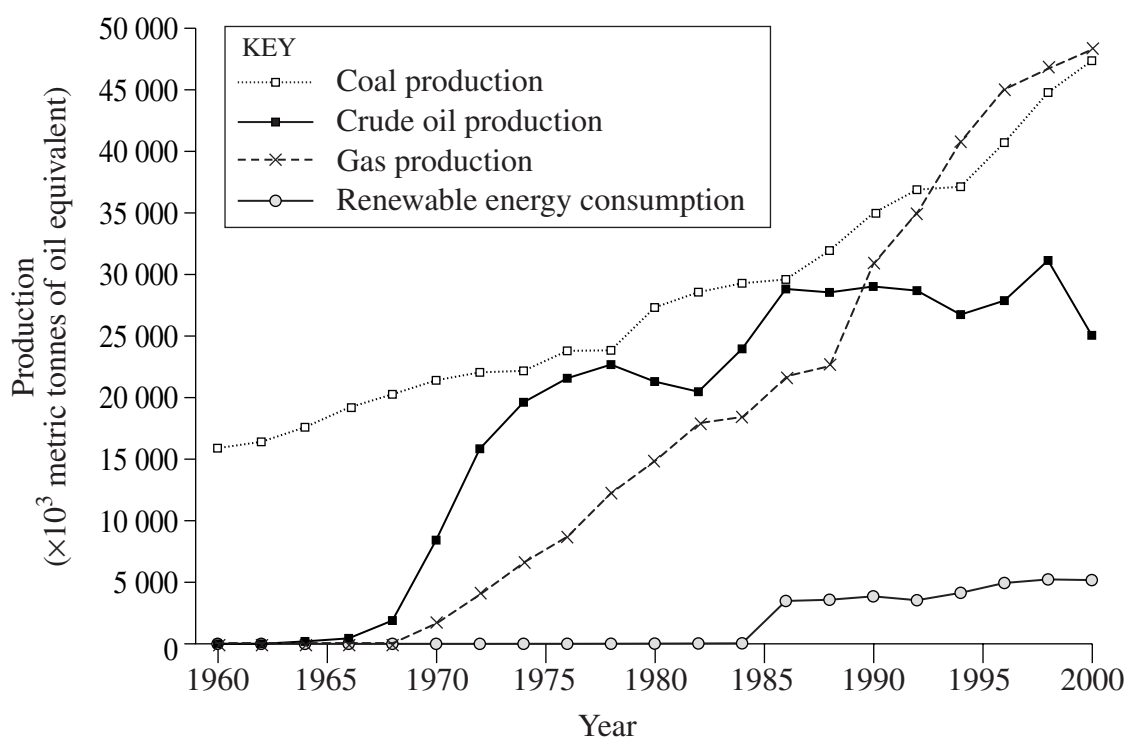
	Marks
Question 27 (continued)	
(i) Describe the trend in numbers for Native species 1 in <i>Area 1</i> and Introduced species 1 in <i>Area 2</i> .	2
(ii) Account for the trend shown for cost in <i>Area 2</i> .	2
(iii) Based on the information in the graphs, assess which method of rehabilitation is more effective.	2
(c) Assess the impact of introduced species on the physical and biological environment and the relative contributions of different conditions that caused the organisms to become pests.	7
(d) In your study of Introduced Species and the Australian Environment, you studied a local environment.	
(i) Name the local environment that you studied, and outline TWO methods that you used to gather data.	2
(ii) Explain the steps that you took to minimise risk from potential hazards during your investigation.	2
(iii) Justify how the plan that you developed for this investigation allowed you to identify, classify and account for the presence of an introduced species.	4

End of Question 27

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

- (a) (i) Identify TWO properties of coal that change with increasing rank. 2
- (ii) Describe how coal forms in a sedimentary basin. 2

- (b) The graph shows the production of coal, crude oil, gas and the consumption of renewable energy in Australia from 1960 to 2000.



- (i) Describe the trends shown for crude oil production and renewable energy consumption. 2
- (ii) Account for the trend shown for crude oil production. 2
- (iii) Outline the environmental concerns that could have contributed to the trend shown for renewable energy consumption. 2

Question 28 continues on page 29

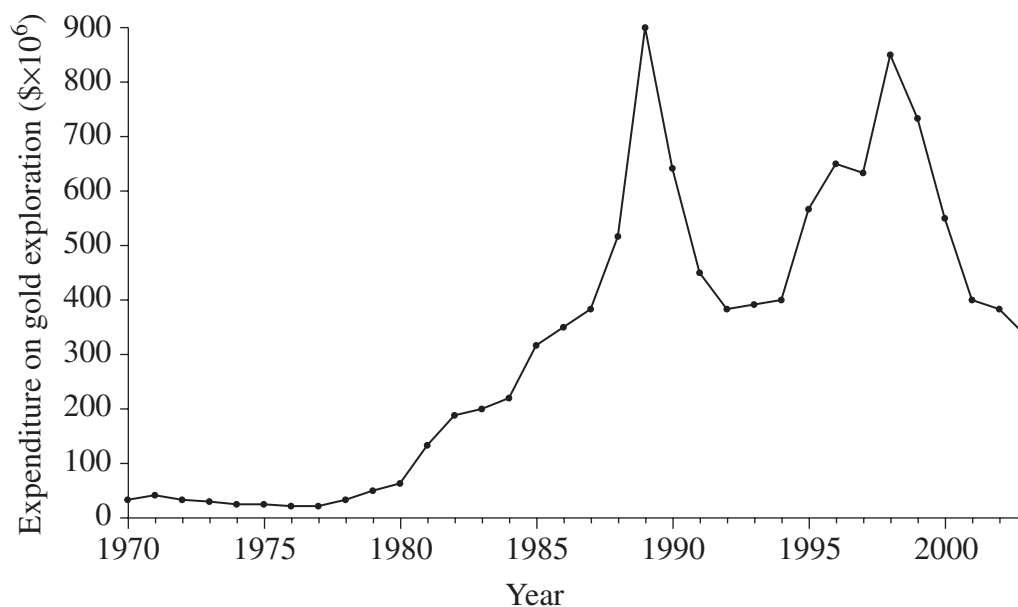
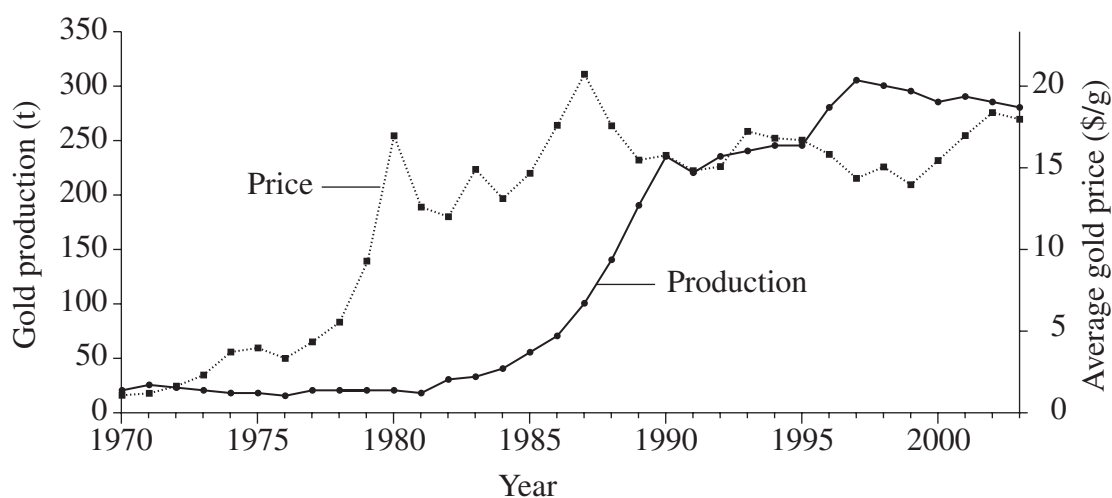
Question 28 (continued)

- (c) Based on the environment of formation and geological features of EITHER coal deposits OR oil accumulations, recommend appropriate exploration methods to locate new deposits. **7**
- (d) In your study of Organic Geology – A Non-renewable Resource you performed a first-hand investigation to test the energy efficiency of various non-fossil fuel alternative energy sources.
- (i) Outline TWO methods that you used to gather data. **2**
 - (ii) Explain the steps that you took to minimise risk from potential hazards during your investigation. **2**
 - (iii) Justify how the plan that you developed for this investigation allowed you to make conclusions about the energy efficiency of various non-fossil fuel alternative energy sources. **4**

End of Question 28

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

- (a) (i) Identify TWO landmark legal decisions that have impacted on mining operations in Australia. 2
- (ii) Describe the effects of ONE of the decisions identified above on mining operations OR mineral exploration. 2
- (b) The graphs show the annual production of gold in Australia, the average gold price, and the expenditure on gold exploration over the period 1970 to 2003.



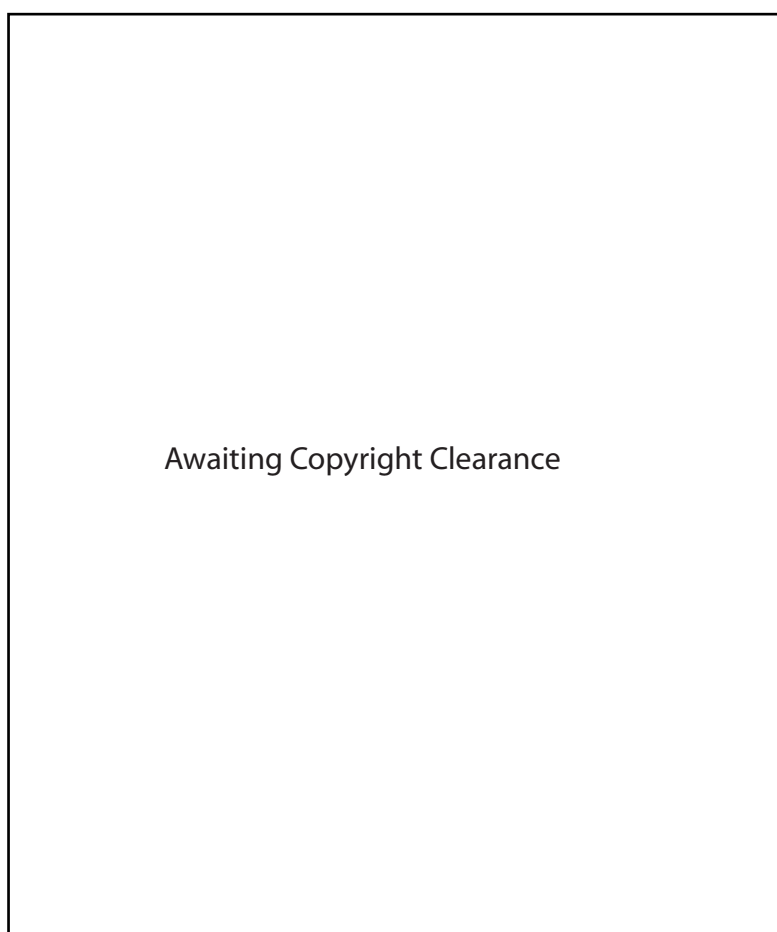
Question 29 continues on page 31

	Marks
Question 29 (continued)	
(i) Describe the trend shown for gold production and the average gold price.	2
(ii) Account for the trend shown for gold production.	2
(iii) Propose a reason for the increased expenditure on gold exploration over the period 1995–1999.	2
(c) Based on the geological setting and features of EITHER base/precious metal deposits in island arc terrains OR iron ore deposits in ancient continental or sedimentary environments, recommend appropriate exploration methods to locate new deposits.	7
(d) In your study of Mining and the Australian Environment you performed a first-hand investigation to distinguish between waste rock and ore, and ore and gangue minerals.	
(i) Outline TWO methods that you used to gather data.	2
(ii) Explain the steps that you took to minimise risk from potential hazards during your investigation.	2
(iii) Justify how the plan that you developed for this investigation allowed you to make conclusions about the difference between waste rock and ore, and ore minerals and gangue minerals.	4

End of Question 29

Question 30 — Oceanography (25 marks)

- (a) (i) Identify TWO long-lived pollutants that may be transported by the mass motions of sea water. 2
- (ii) Describe how long-lived pollutants can be transported significant distances within an ocean basin. 2
- (b) The graph shows temperature, salinity and density with respect to depth in an ocean basin.



- (i) Describe the trend shown for temperature with increasing depth in the ocean. 2
- (ii) Account for the trend shown for density. 2
- (iii) Propose a reason for the rapid increase in salinity between 1000 m and 3000 m depth. 2

Question 30 continues on page 33

Question 30 (continued)

- (c) Analyse how a knowledge of food chains and an understanding of the physical environment of the ocean and sea floor allow oceanographers to choose appropriate technologies for evaluating resources in the ocean. **7**
- (d) In your study of Oceanography, you performed a first-hand investigation of the effect of varying surface area to volume ratios of solids on their cooling rate in water.
- (i) Outline TWO methods that you used to gather data. **2**
- (ii) Explain the steps that you took to minimise risk from potential hazards during your investigation. **2**
- (iii) Justify how the plan that you developed for this investigation allowed you to make conclusions about the effect of surface area to volume ratio of solids on their cooling rate in water. **4**

End of paper

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Geological Time Scale

