

B O A R D O F S T U D I E S
NEW SOUTH WALES

2011

**HIGHER SCHOOL CERTIFICATE
EXAMINATION**

Earth and Environmental Science

General Instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Write using black or blue pen
Black pen is preferred
- 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, 21, 23 and 25

Total marks – 100

Section I Pages 2–25

75 marks

This section has two parts, Part A and Part B

Part A – 20 marks

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

Part B – 55 marks

- Attempt Questions 21–31
- Allow about 1 hour and 40 minutes for this part

Section II Pages 27–35

25 marks

- Attempt ONE question from Questions 32–35
- Allow about 45 minutes for this section

Section I

75 marks

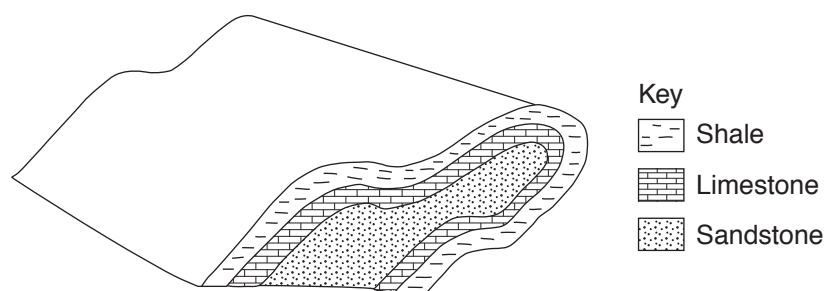
Part A – 20 marks

Attempt Questions 1–20

Allow about 35 minutes for this part

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

1 What is the structure shown in the diagram?



- (A) A fold formed at a divergent boundary
- (B) A fold formed at a convergent boundary
- (C) A fault formed at a divergent boundary
- (D) A fault formed at a convergent boundary
- 2 The diagram shows one model for mantle convection currents which drive plate motion.



What are the most likely types of plate boundary found at X, Y and Z?

	X	Y	Z
(A)	Convergent	Divergent	Convergent
(B)	Convergent	Conservative	Convergent
(C)	Divergent	Convergent	Divergent
(D)	Divergent	Conservative	Divergent

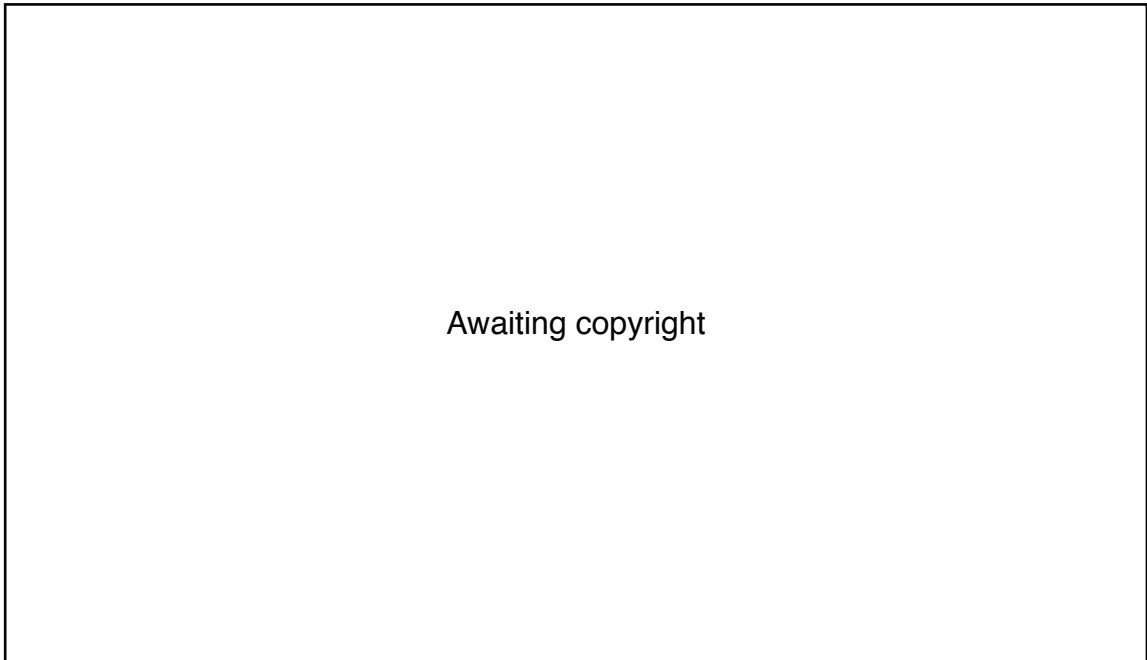
- 3** The Lachlan Fold Belt comprises predominantly northwest–southeast folded sandstone, limestone and volcanic rocks.



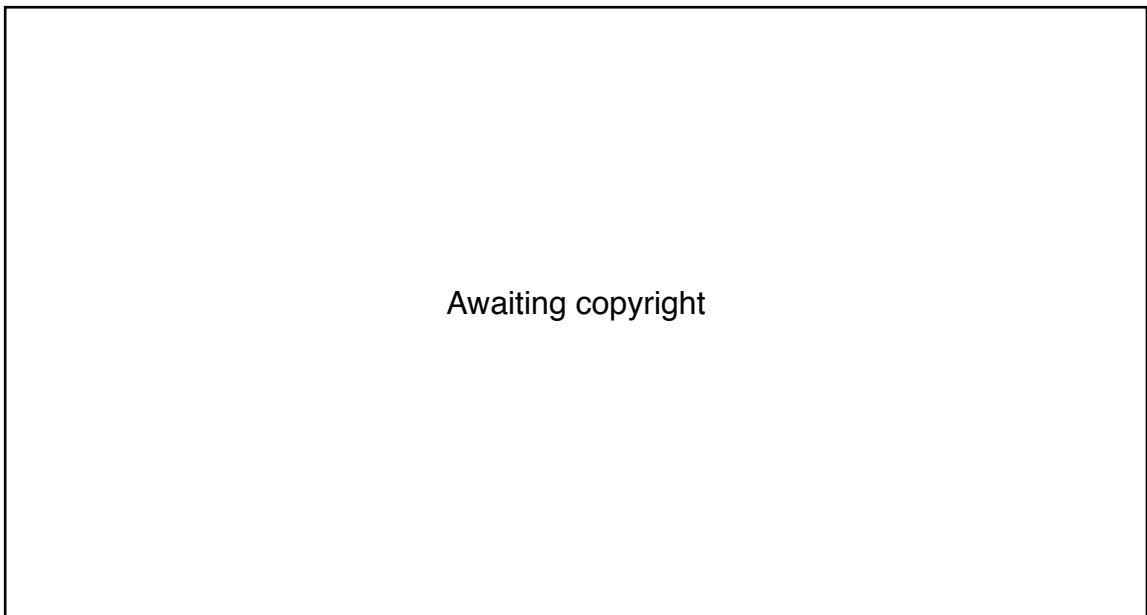
For which tectonic setting does the Lachlan Fold Belt provide evidence?

- (A) An Archaean craton
 - (B) A Proterozoic fold belt
 - (C) A Palaeozoic subduction zone
 - (D) A Cenozoic sedimentary basin
- 4** What is the effect of an erupting explosive volcano on the climate near the volcano?
- (A) CO₂ causes warming, which rapidly increases ocean temperatures.
 - (B) Ash particles promote the formation of clouds, which increases rainfall.
 - (C) Ash plumes block sunlight, which causes long-term atmospheric cooling.
 - (D) CO₂ clouds block sunlight, which causes short-term atmospheric cooling.
- 5** Which of the following is a feature of a tectonic supercycle?
- (A) The land masses form a supercontinent every 200 million years.
 - (B) Continental rifting increases volcanism and decreases atmospheric CO₂ levels.
 - (C) Formation of a supercontinent increases ocean surface area, causing worldwide cooling.
 - (D) Continental divergence reaches maximum separation, creating many small continental blocks.

- 6 The table provides a comparison between part of the Richter Scale and part of the Modified Mercalli Scale.



The diagram shows the Mercalli intensity contour map for an earthquake that hit southern Victoria on 6 March 2009.



For this earthquake which statement is most likely to be correct?

- (A) In Melbourne witnesses heard church bells ring.
- (B) The magnitude of the earthquake at Korumburra was 4.0.
- (C) Northwest of intensity contour III, people did not feel the earthquake.
- (D) Tourists on Phillip Island felt the ground shake and saw free-standing objects rocking.

7 The diagram shows a cross-section through a part of Earth.



Where would a deep focus earthquake and an andesitic volcano be located?

	Deep focus earthquake	Andesitic volcano
(A)	Y	Z
(B)	V	W
(C)	X	Z
(D)	Y	W

8 What are cyanobacteria?

- (A) Deadly pathogenic organisms
- (B) The earliest organisms on Earth
- (C) Simple photosynthetic organisms
- (D) Organisms that can convert sulfur to energy

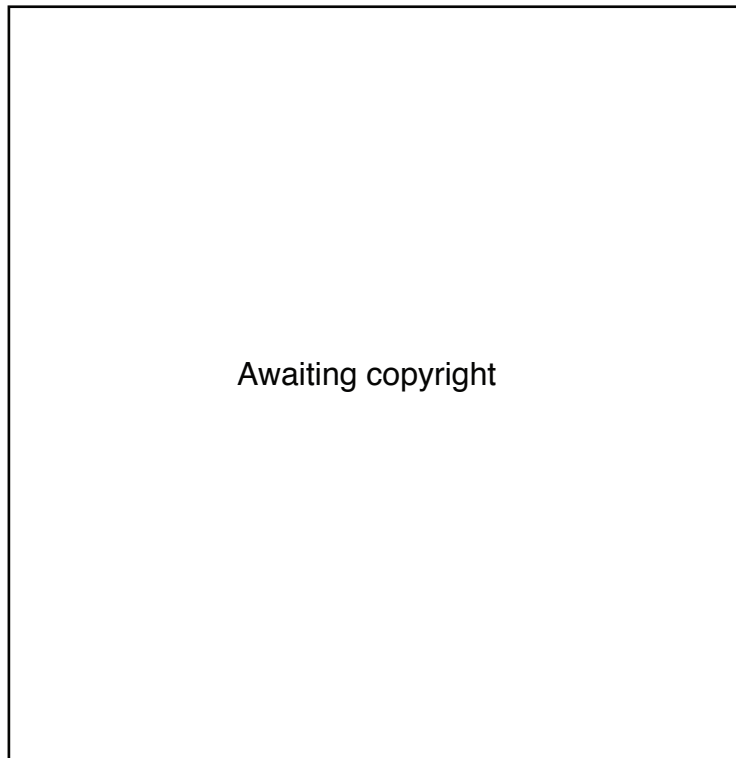
9 Which group of fossils is most likely to be found in a Cambrian shale bed?

- (A) Bacteria, fern, jellyfish, worm
- (B) Brachiopod, trilobite, algae, fish
- (C) Insect, coral, flower, brachiopod
- (D) Fish, stromatolite, dinosaur bone, jellyfish

10 What is the chemical relationship between ozone and oxygen?

- (A) Ozone is two atoms of oxygen bonded together.
- (B) Ozone is three atoms of oxygen bonded together.
- (C) Ozone is two molecules of oxygen bonded together.
- (D) Ozone is three molecules of oxygen bonded together.

- 11** Why was the formation of ozone necessary for the evolution of terrestrial life?
- (A) Ozone was required for respiration.
 - (B) Ozone was required for photosynthesis.
 - (C) Ozone protected life forms from infrared radiation.
 - (D) Ozone protected life forms from ultraviolet radiation.
- 12** The diagram shows the stratigraphic range of six fossils in a geological sequence.



Which of the following statements is correct?

- (A) Fossils J, M and N could be used to date the Goat Shale.
- (B) Fossils L, M and O could be used to date the Cyclax Shale.
- (C) Fossils J, K and O could be used to date the Una Sandstone.
- (D) Fossils L, M and N could be used to date the Bilby Sandstone.

- 13** There are thirteen species of finch living on the Galapagos Islands. They are thought to have evolved from a common ancestral finch population that arrived from South America.

Which of the following statements best accounts for the thirteen species of finch?

- (A) The ancestral finches had an increased rate of mutations after they arrived on the islands.
- (B) The ancestral finches would have adapted to different environments during their life span.
- (C) The ancestral finches with variations suited to different environments were able to survive and reproduce.
- (D) The ancestral finches reproduced with selected local birds which were suited to different environments.

- 14** The following is a description of a soil found in Australia.

The soil is a red fertile soil with a relatively high moisture content. It is high in ferro-magnesium minerals and low in silica. Rainwater infiltrates the soil quite well and there is little run-off.

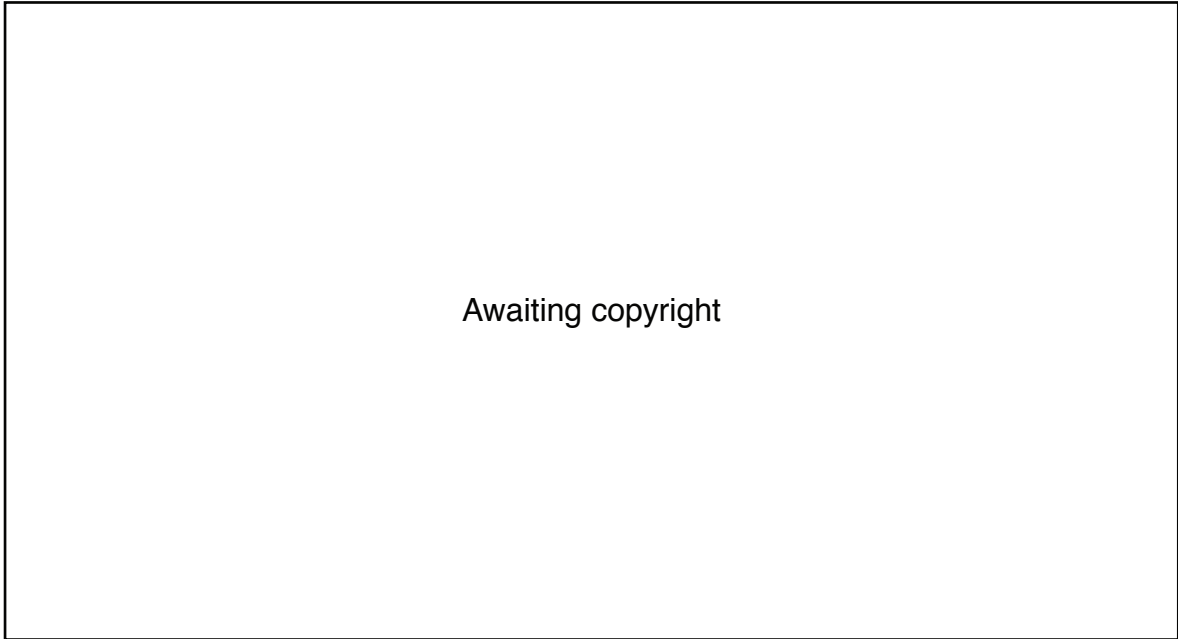
How was this soil formed?

- (A) Weathering of a granite intrusion
 - (B) Weathering of a basaltic lava flow
 - (C) Weathering of folded sedimentary rocks
 - (D) Weathering of a flat-lying Banded Iron Formation
- 15** Australian scientists have played a significant role in investigating ozone depletion over Antarctica.

What important change has resulted from their research?

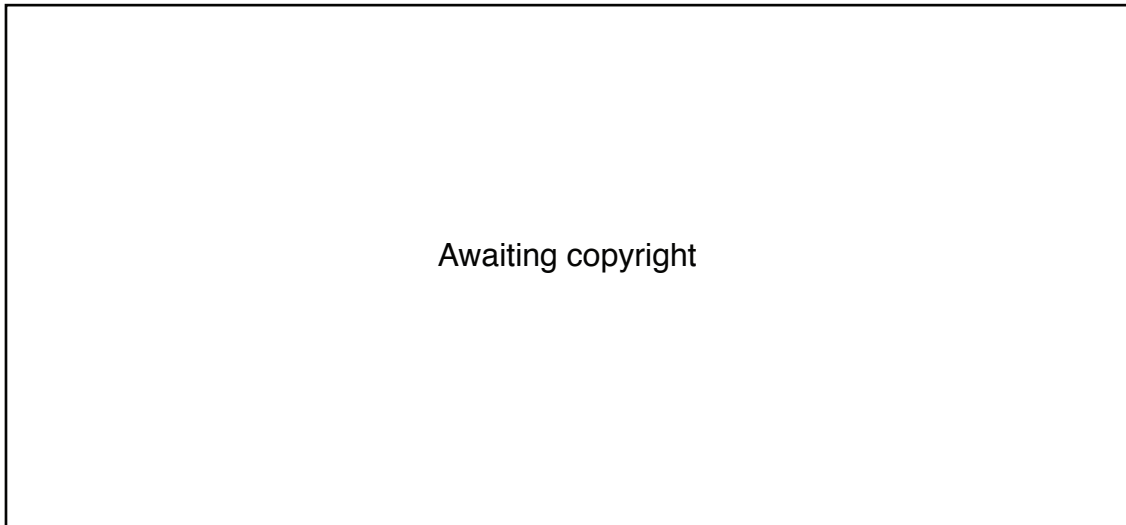
- (A) The increased use of CFCs in refrigeration
- (B) The introduction of stricter laws to limit backyard burning
- (C) The development of alternative propellants for aerosol products
- (D) The application of new technologies to produce clean fuels for public transport

- 16** The following graph compares the percentage of sugarcane farms in NSW affected by particular environmental issues and the percentage of sugarcane growers who have expressed their concern about those environmental issues.



- Which of the following statements is best supported by the data in the graph?
- (A) The data show that these particular environmental issues are related.
 - (B) More growers are concerned with a loss of soil quality than an increase in noxious weeds.
 - (C) Some growers are concerned about environmental issues that have not affected their farms.
 - (D) There is a direct relationship between farms affected by an increase in erosion and the loss of remnant vegetation.
- 17** What are the major components of vehicle emissions that contribute to global warming?
- (A) Methane and CFCs
 - (B) Carbon dioxide and water vapour
 - (C) Sulfur dioxide and nitrogen oxides
 - (D) Carbon monoxide and particulate matter

- 18** The diagram shows the pH tolerance for some organisms that live in a stream with a normal pH range of 6.5 to 6.0.



If a coal-fired power station was built near this stream, which pair of organisms would be least affected by the gas emissions from the power station when it rains?

- (A) Bass and frogs
 - (B) Trout and perch
 - (C) Crayfish and snails
 - (D) Mussels and mayflies
- 19** What role does Earth's surface play in global warming?
- (A) It reflects all of the sun's energy reaching the surface.
 - (B) It absorbs the sun's energy and radiates infrared energy.
 - (C) It absorbs the sun's energy and radiates ultraviolet energy.
 - (D) It absorbs the sun's energy, keeping the temperature of Earth's crust constant.
- 20** Which of the following conditions would an environmental planner consider most appropriate for the location of a domestic waste dump?
- (A) Impermeable rock layers to isolate liquid waste
 - (B) Compactible soils to facilitate rapid burial of the waste
 - (C) Layers of soft soil and rock for rapid site development
 - (D) Low tectonic activity to prevent waste being re-exposed after it is buried

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Centre Number

Section I (continued)

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Part B – 55 marks

Attempt Questions 21–31

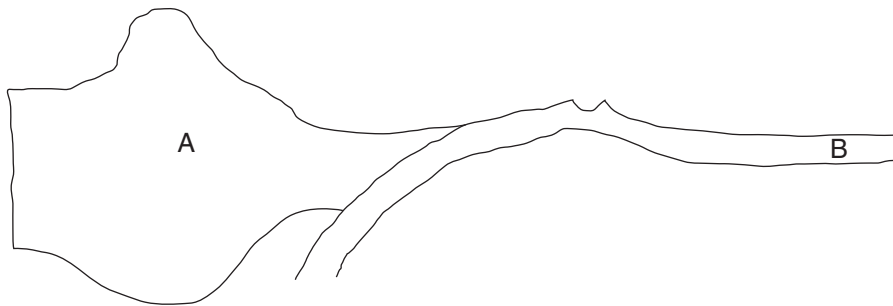
Allow about 1 hour and 40 minutes for this part

Answer the questions in the spaces provided. These spaces provide guidance for the expected length of response.

Question 21 (4 marks)

(a) Identify the types of crust at positions A and B.

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A

B

(b) Apart from thickness, account for TWO differences between the types of crust labelled A and B in (a).

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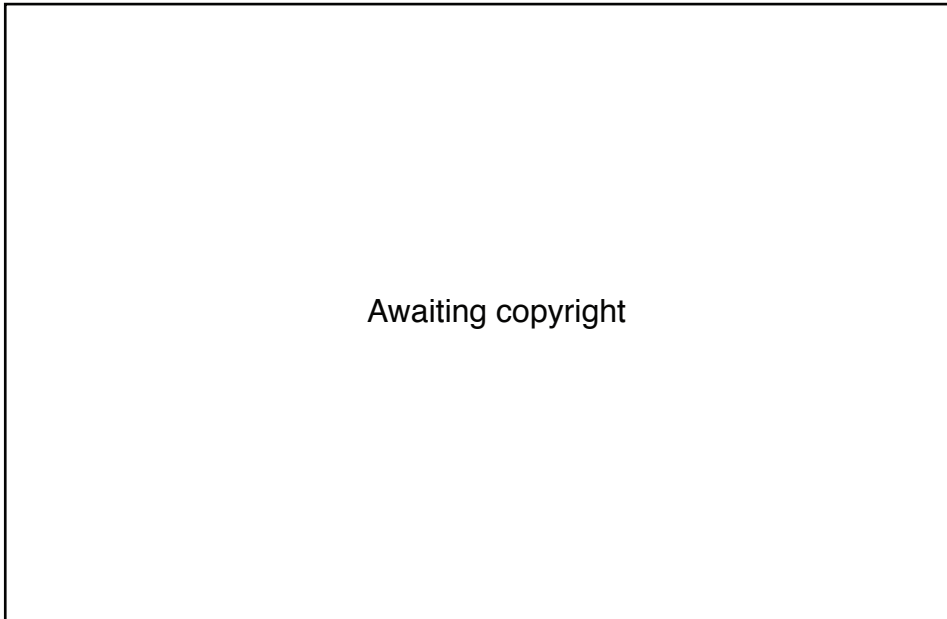
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Question 22 (6 marks)

- (a) The graph shows the relationship between the silica content of magma and volcanic explosivity.



- (i) Point **X** on the graph represents the magma from a hotspot volcano, such as a Hawaiian volcano. **1**

Estimate the silica content of the magma.

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- (ii) On the graph, plot and label an area that shows the silica content of magma at a mid-ocean ridge. **1**

- (iii) On the graph, plot and label an area that shows the silica content of magma at a convergent boundary. **1**

Question 22 continues on page 15

Question 22 (continued)

- (b) The map shows the location of a chain of active and extinct volcanoes that extends from the Aleutian Trench to the Hawaiian Islands.



The graph gives the relationship between the ages of the volcanoes and their distances from the active volcano *Kilauea*.



Using information from the map and graph, account for the relationship between the age of the volcanoes and their distances from *Kilauea*.

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End of Question 22

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Centre Number

Section I – Part B (continued)

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Student Number

Question 23 (4 marks)

Explain how buildings are designed to limit damage caused by earthquakes. **4**

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Question 24 (3 marks)

Describe ONE impact each of the following hazards has on the environment.

Lahar: **1**

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Ash flow: **1**

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Poisonous gas: **1**

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Section I – Part B (continued)

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Question 25 (5 marks)

- (a) Use a flowchart to outline the steps involved in the deposition of the bands in a Banded Iron Formation. **3**

- (b) How are Banded Iron Formations evidence of life that existed in Archaean oceans? **2**

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Question 26 (7 marks)

- (a) Complete the following table to compare the features of fish, amphibians and reptiles.

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Animal group	Main environment inhabited	Method for getting oxygen	Age range		
			Palaeozoic	Mesozoic	Cenozoic
Fish	Aquatic	Gills to absorb oxygen from water			
Amphibians					
Reptiles					

- (b) Compare the adaptive strategies that amphibians and reptiles need in order to overcome TWO challenges in their respective environments.

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In your answer, refer to challenges other than those of obtaining oxygen.

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Centre Number

Section I – Part B (continued)

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Student Number

Question 27 (5 marks)

Compare the causes and effects of mass extinctions and smaller extinctions. In your answer, give examples of both types of extinctions.

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Question 28 (4 marks)

A mine was worked for about 80 years to produce silver, lead, gold and some copper.

Extensive environmental damage has been caused by the unused rock from the mine shafts and waste from the processed ore, both of which were dumped in large piles nearby.

Outline TWO environmental problems that could have resulted from the mining activities and give ONE solution for EACH of these problems.

Problem 1 **1**

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Solution **1**

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Problem 2 **1**

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Solution **1**

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Centre Number

Section I – Part B (continued)

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Student Number

Question 29 (5 marks)

You have been asked to investigate alternatives to the use of pesticides for controlling pests.

- (a) Name TWO secondary sources of information you could use to research this issue. **1**

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- (b) (i) How will you ensure that the information gathered from this research will be valid? **2**

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- (ii) How will you ensure that the information gathered from this research will be reliable? **2**

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Question 30 (5 marks)

- (a) Poor farming practices have caused a salinity problem on an alluvial plain. The diagram shows a cross-section of the plain.



Outline TWO farming practices that may have contributed to salinity problems on the alluvial plain. **2**

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- (b) Justify ONE management strategy that could be used to rehabilitate a salt-affected area. **3**

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Centre Number

Section I – Part B (continued)

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Student Number

Question 31 (7 marks)

Evaluate how a knowledge of Earth’s processes and environmental factors has influenced management of fragile Australian ecosystems.

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Earth and Environmental Science

Section II

25 marks

Attempt ONE question from Questions 32–35

Allow about 45 minutes for this section

Answer parts (a)–(c) of the question in Section II Answer Booklet 1.

Answer parts (d)–(e) of the question in Section II Answer Booklet 2.

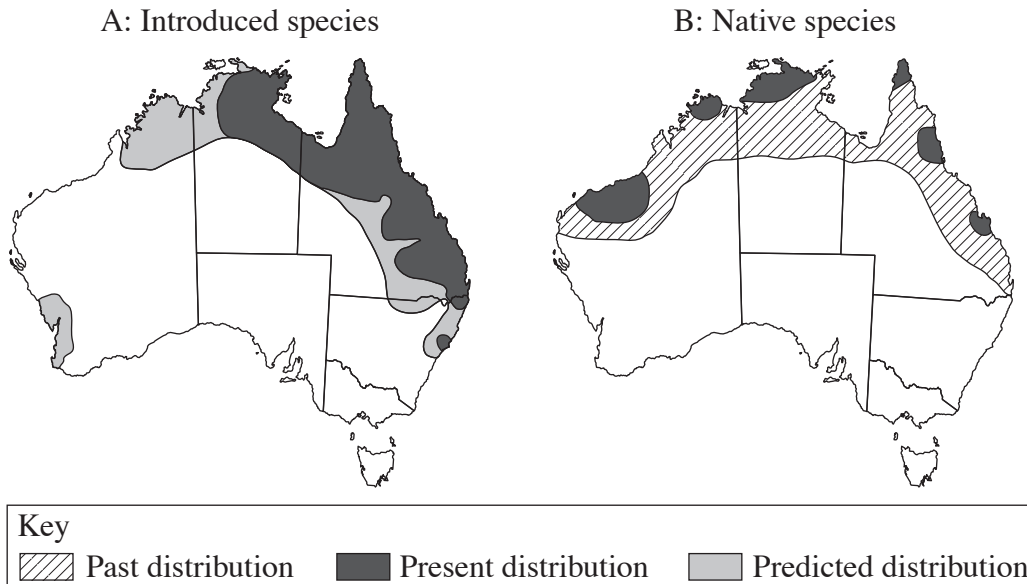
Extra writing booklets are available.

	Pages
Question 32 Introduced Species and the Australian Environment	28–29
Question 33 Organic Geology – a Non-renewable Resource	30–31
Question 34 Mining and the Australian Environment	32–33
Question 35 Oceanography	34–35

Question 32 – Introduced Species and the Australian Environment (25 marks)

Answer parts (a)–(c) in Section II Answer Booklet 1.

(a) The maps show the distributions of an introduced species and a native species.



- (i) Using information in the maps, compare the present distribution of both species. **2**
- (ii) Account for the difference between the present and predicted distributions of the introduced species. **2**

(b) The following passage is an excerpt from a news report.



Assess the potential of this treaty to reduce the number of introduced species entering Australia. **4**

(c) Compare the merits of TWO strategies used to control an animal introduced into Australia. **4**

Question 32 continues on page 29

Question 32 (continued)

Answer parts (d)–(e) in Section II Answer Booklet 2.

- (d) An introduced plant was first noticed on a farm five years ago. To study the impact that the plant may have had on other plants, students counted the number of seedlings of three plant species in a 100 square metre plot at each of three locations.

The results are given below.

Location 1: 4 eucalypt seedlings, 1 grass seedling and 25 introduced plant seedlings; Location 2: 2 eucalypt seedlings, 5 grass seedlings and 35 introduced plant seedlings; Location 3: 23 eucalypt seedlings, 19 grass seedlings and 2 introduced plant seedlings.

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| (i) Organise the results in a more scientific way. | 2 |
| (ii) Comment on any trends in the results and then write a suitable conclusion for the investigation. | 3 |
| (iii) Outline ONE method that could have been used to ensure the reliability of the results. | 2 |
- (e) Evaluate the impact that humans have had on the Australian environment by both deliberately and accidentally introducing other species. Give examples in your answer. **6**

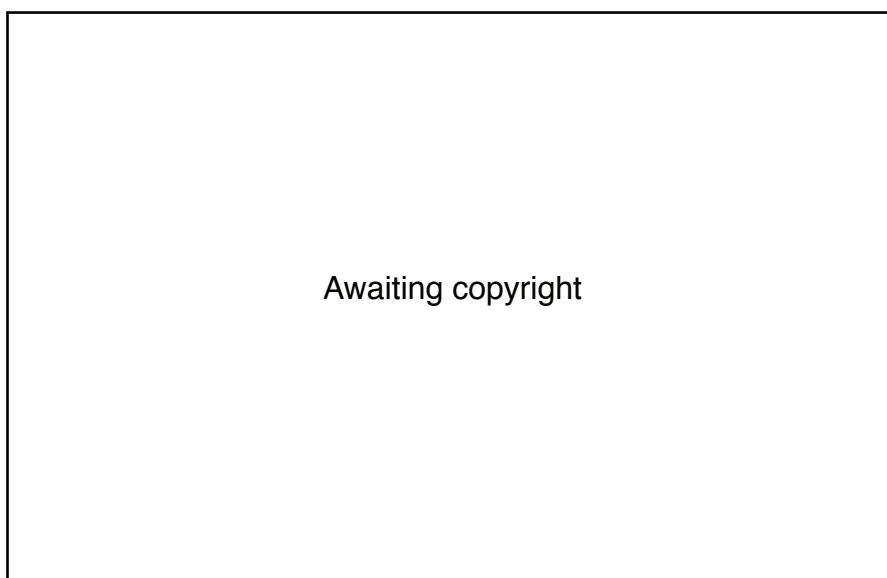
End of Question 32

Question 33 – Organic Geology – a Non-renewable Resource (25 marks)

Answer parts (a)–(c) in Section II Answer Booklet 1.

- (a) (i) Define the term *non-renewable resource*, and give ONE example. **1**
- (ii) Justify the need for catalytic cracking to produce petroleum products for industry. **3**

- (b) A block diagram of an oil reservoir is shown.



- Justify the use of a combination of drilling and ONE geophysical technique to determine if oil may be located in the geological setting shown. **4**
- (c) Compare the process of coalification with the process of hydrocarbon maturation. **4**

Question 33 continues on page 31

Question 33 (continued)

Answer parts (d)–(e) in Section II Answer Booklet 2.

- (d) To compare the products of combustion when a fuel is burned, students burned equal amounts of coal in small, medium and large containers of air. The final volumes of carbon dioxide, water vapour and carbon were measured.

The results are given below.

100 ml container: 15 units carbon dioxide, 10 units water vapour and 5 units carbon; 200 ml container: 29 units carbon dioxide, 18 units water vapour and 4 units carbon; 300 ml container: 48 units carbon dioxide, 32 units water vapour and no carbon.

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| (i) Organise the results in a more scientific way. | 2 |
| (ii) Comment on any trends in the results and then write a suitable conclusion for the investigation. | 3 |
| (iii) Outline ONE method that could have been used to ensure the reliability of the results. | 2 |
|
 | |
| (e) Evaluate the need for a change in the use of fossil fuels as a source of energy. In your answer, refer to specific examples. | 6 |

End of Question 33

Question 34 – Mining and the Australian Environment (25 marks)

Answer parts (a)–(c) in Section II Answer Booklet 1.

- (a) (i) Name ONE base metal OR precious metal and give one mineral province in Australia where this metal is found. **1**
- (ii) Explain how the geological features of the province named in (a) (i) have allowed this mineralisation to occur. **3**
- (b) The graph shows the annual profit or loss for a metalliferous mine that had a life of 10 years.



- Account for the changes in the annual profit or loss over the life of this mine. **4**
- (c) Describe the impact of ONE government policy and ONE landmark legal decision on mining operations in Australia. **4**

Question 34 continues on page 33

Question 34 (continued)

Answer parts (d)–(e) in Section II Answer Booklet 2.

- (d) To distinguish between ore minerals and gangue minerals, students took samples of lead, copper and zinc ores and for each sample identified the ore mineral and two gangue minerals. A hardness test was carried out on the ore minerals and gangue minerals by scratching the minerals with a range of materials.

The results are given below.

Lead ore: galena 2.5, gangue mineral A 7 and gangue mineral B 6; Copper ore: chalcopyrite 3.5, gangue mineral A 7 and gangue mineral B 6.5; Zinc ore: sphalerite 4, gangue mineral A 6 and gangue mineral B 6.

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| (i) | Organise the results in a more scientific way. | 2 |
| (ii) | Comment on any trends in the results and then write a suitable conclusion for the investigation. | 3 |
| (iii) | Outline ONE method that could have been used to ensure the reliability of the results. | 2 |
- (e) To what extent is it necessary to consider environmental issues when exploring and exploiting a mineral resource? Give examples in your answer. **6**

End of Question 34

Question 35 – Oceanography (25 marks)

Answer parts (a)–(c) in Section II Answer Booklet 1.

- (a) (i) Outline ONE influence of light on the distribution of organisms in the oceans. **1**
- (ii) Explain how hydrothermal vents extend the distribution of life in oceans. **3**
- (b) Assess how technologies have improved our understanding of oceans. **4**
- (c) The block diagram shows a section of sea floor from coastline to the deep ocean basin.



Describe the sediments found on the sea floor at X and Y, and state how each is formed. **4**

Question 35 continues on page 35

Question 35 (continued)

Answer parts (d)–(e) in Section II Answer Booklet 2.

- (d) To study the influence of water temperature on the solubility of salts in water, students measured the mass of three salts that were able to be dissolved in 100 ml samples of water at three temperatures.

The results are given below.

Sodium chloride: 0 degrees Celsius 35 grams, 20 degrees Celsius 36 grams and 100 degrees Celsius 39 grams; Potassium chloride: 0 degrees Celsius 28 grams, 20 degrees Celsius 34 grams and 100 degrees Celsius 58 grams; Magnesium chloride: 0 degrees Celsius 53 grams, 20 degrees Celsius 55 grams and 100 degrees Celsius 73 grams.

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| (i) Organise the results in a more scientific way. | 2 |
| (ii) Comment on any trends in the results and then write a suitable conclusion for the investigation. | 3 |
| (iii) Outline ONE method that could have been used to ensure the reliability of the results. | 2 |
| (e) Evaluate the impact that human activities have had on the oceans and the biological resources found within them. Give examples in your answer. | 6 |

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Geological Time Scale

