BOARD OF STUDIES
NEW SOUTH WALES

2012

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, 25 and 27

Total marks – 100

Section I Pages 2–28

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 29–39

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.

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1 Why are there no active volcanoes on the Australian continent?

(A) The Australian continent is not located near any plate boundaries.

(B) Australian earthquakes are not intense enough to generate magma.

(C) Conservative plate boundaries are not usually associated with volcanic activity.

(D) The ancient cratons of western and central Australia are resistant to volcanic activity.

2 Which products of a volcanic eruption are most likely to result in a decrease in global temperature?

(A) Lahars

(B) Lava flows

(C) Carbon dioxide emissions

(D) Sulphur dioxide emissions

3 The cross-section shows the tectonic setting of the Australian continent.

If the tectonic processes shown continue unchanged into the future, which of the following will be the most likely outcome?

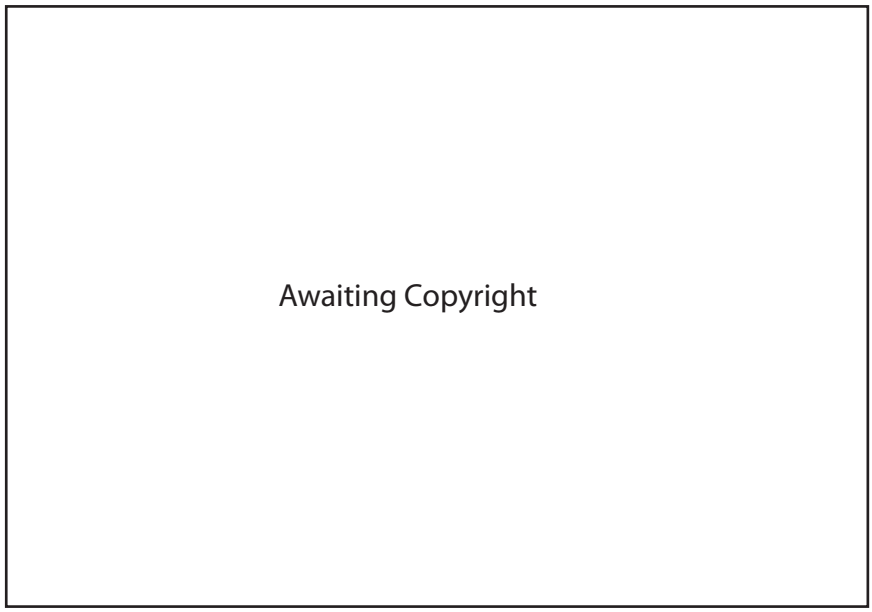
(A) The widening of the Timor Sea

(B) The growth of a new continent at the Indian-Pacific Ridge

(C) The closing of the ocean between Australia and Antarctica

(D) The formation of fold mountains at the northern edge of the Australian continent

4 The map shows areas of volcanic activity in Australia over the past 40 million years.



What is the cause of the volcanic activity shown?

(A) Movement over a hotspot

(B) Spreading at an old mid-ocean ridge

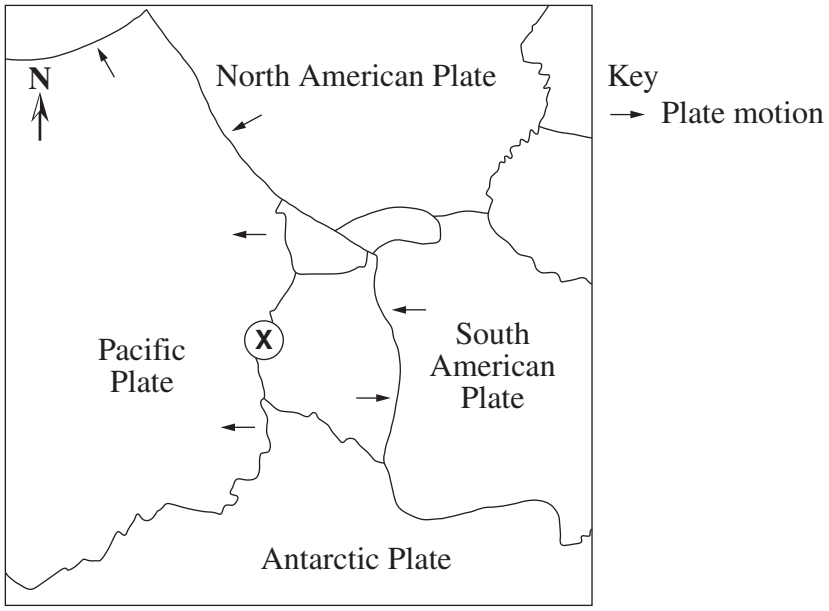
(C) Cratonisation of the Australian continent

(D) Subduction at an ocean–continent convergent plate boundary

5 Which row in the table correctly describes the magma composition and rock type formed at convergent and divergent plate boundaries?

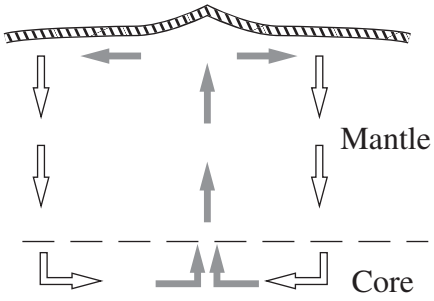
	Convergent plate boundaries		*Divergent plate boundaries*	
	Magma composition	*Rock type*	*Magma composition*	*Rock type*
(A)	Silica rich	Granite	Mg and Fe rich	Gabbro
(B)	Mg and Fe rich	Rhyolite	Silica rich	Basalt
(C)	Silica rich	Gabbro	Mg and Fe rich	Granite
(D)	Mg and Fe rich	Basalt	Silica rich	Rhyolite

6 The map shows the location of the Pacific Plate in relation to surrounding plates. The direction of motion of some plates is shown.

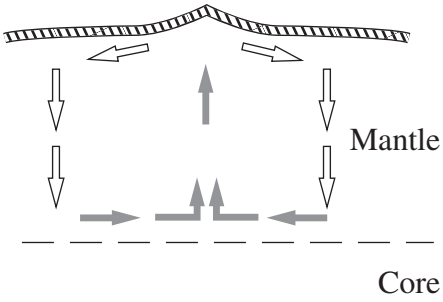


Which is the best tectonic model for the boundary located at **X**?

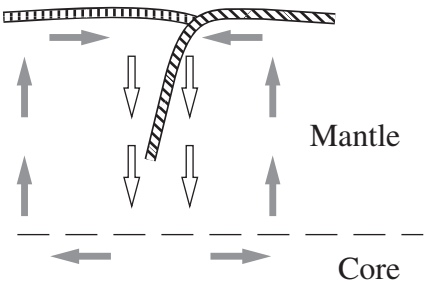
(A)



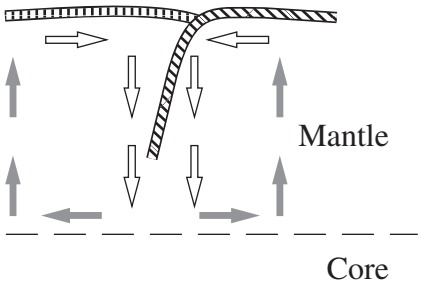
(B)



(C)



(D)



Key
Cold current
Warm current

7 How is the recent disappearance of the Australian megafauna best described?

(A) Single species extinction

(B) Catastrophic extinction

(C) Small extinction

(D) Mass extinction

8 What is the name given to the changes in life forms at the end of the Proterozoic Eon?

(A) The K–T extinction

(B) The Cambrian event

(C) The conquest of land

(D) The Permian–Triassic extinction

9 Which of the following describes the evolutionary changes that occurred at the beginning of the Phanerozoic Eon?

(A) Vertebrates colonised land.

(B) Seed-bearing plants appeared.

(C) Aquatic invertebrates became the dominant animals.

(D) Giant reptiles evolved and dominated terrestrial environments.

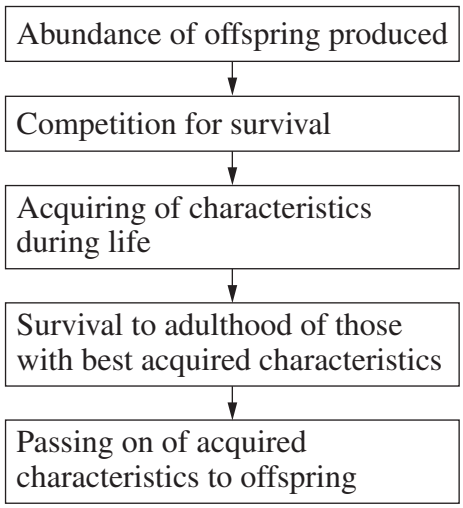
10 The organism *Dickinsonia costata* lived 565 million years ago and the organism *Pliomerops canadensis* lived 450 million years ago.

Which row in the table correctly identifies the difference between the organisms?

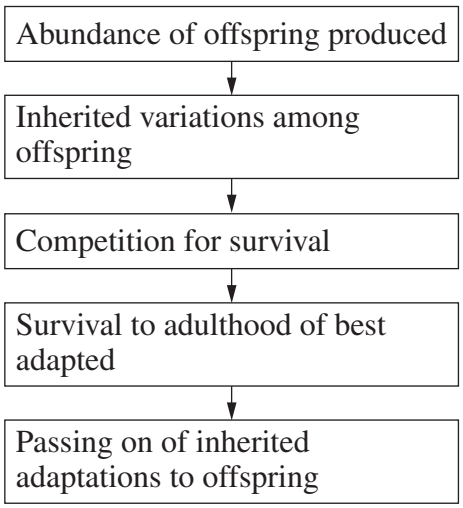
	Dickinsonia costata	*Pliomerops canadensis*
(A)	Carnivorous	Herbivorous
(B)	Aquatic	Terrestrial
(C)	Soft-bodied	Hard-shelled
(D)	Free-swimming plankton	Marine bottom dweller

11 Which of the following flowcharts best describes the process of evolution by natural selection?

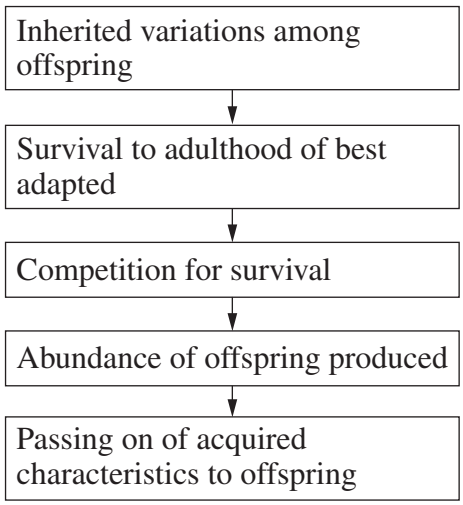
(A)



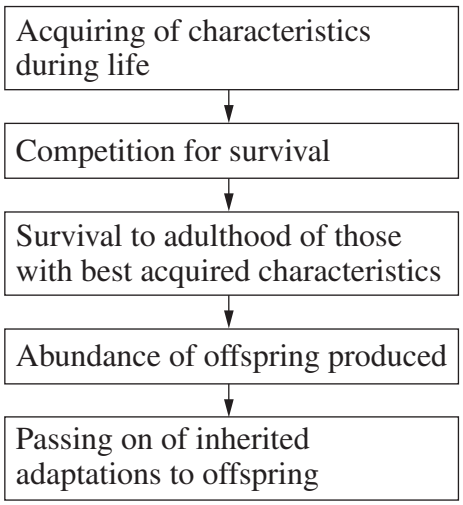
(B)



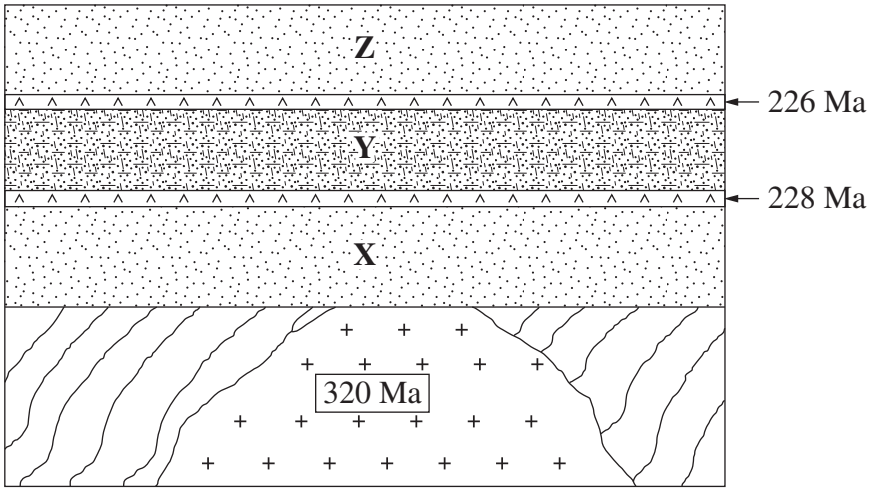
(C)



(D)



12 In the diagram **X**, **Y** and **Z** are fossils within a stratigraphic sequence. Fossil **Y** is Triassic in age.



Key

Sandstone Siltstone Schist

Volcanic ash Granite

Which row in the table does NOT show possible relative ages for the fossils **X** and **Z**?

	X	**Z**
(A)	Triassic	Triassic
(B)	Devonian	Tertiary
(C)	Carboniferous	Cretaceous
(D)	Permian	Jurassic

13 The ratio of the two stable isotopes of carbon, C-13 : C-12, is 1 : 89.91 in the non-living environment.

Which of the following C-13 : C-12 ratios indicates that carbon in an ancient rock came from a fossilised organism?

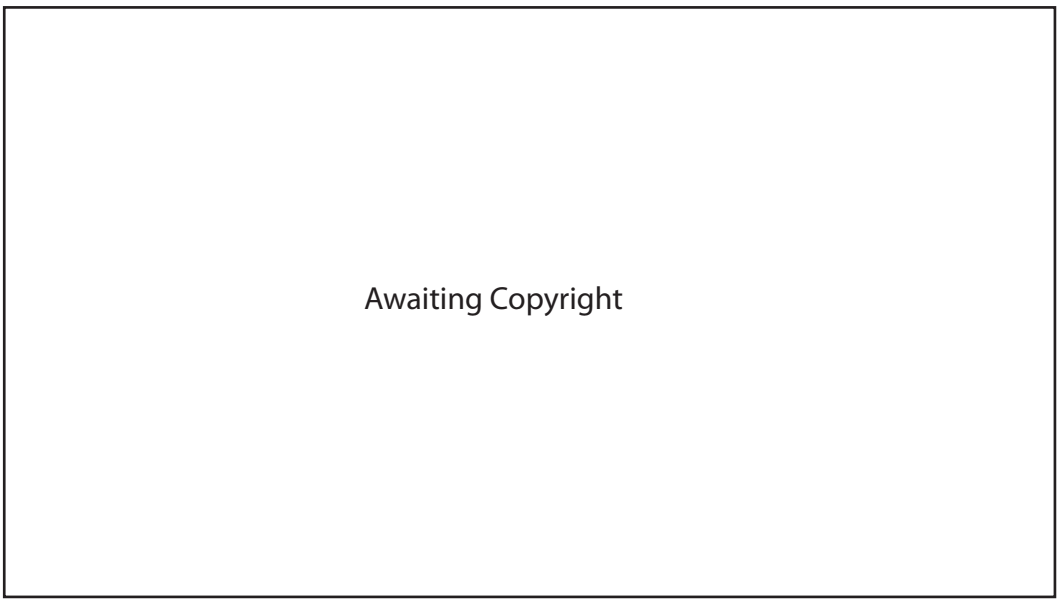
(A) 1 : 50.00

(B) 1 : 79.23

(C) 1 : 89.91

(D) 1 : 95.12

14 The diagram shows changes to a soil profile at a site over a long period of time.



What could have prevented the changes to this soil profile?

(A) Ploughing the site between crop plantings

(B) Planting tree corridors to form windbreaks

(C) Applying fertiliser and using irrigation at an earlier stage

(D) Using the land for intensive grazing instead of crop production

15 Dugongs are marine mammals that feed on large quantities of sea grasses in shallow coastal waters. In one study area, small concentrations of agricultural pesticides have been measured in both the sea grasses and in the sediments in which they grow.

A food chain for dugongs is: Sea grasses → Dugongs → Sharks

Dugong numbers have seriously declined in the study area but shark numbers have remained stable.

What is the most likely cause of the decline in the number of dugongs?

(A) Bioaccumulation of pesticides in the dugongs

(B) Biomagnification of pesticides in the sediments

(C) Biomagnification of pesticides in the sea grasses

(D) Bioaccumulation of pesticides in the drinking water

16 During high temperature combustion, nitrogen reacts with oxygen to form nitrogen dioxide which then combines with water in the atmosphere.

What is the result of these processes?

(A) Formation of acid rain

(B) Increased global temperatures

(C) Destruction of the ozone layer

(D) Depletion of nutrients in rivers

17 What is the major reason for the low fertility of most Australian soils?

(A) Low rainfall

(B) Type of parent rock

(C) Elevated soil temperature

(D) Geological stability over a long period

18 A lateritic soil is usually

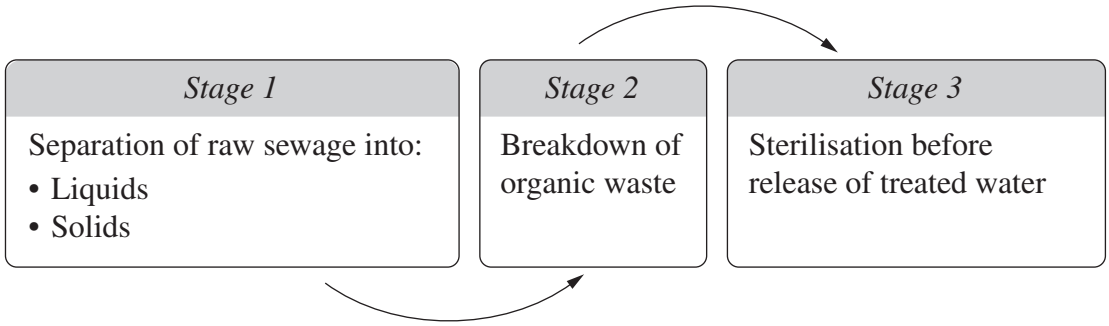
(A) a rusty-red soil formed by prolonged weathering.

(B) an alluvial soil deposited by rivers on flood plains.

(C) a coarse-grained sandy soil derived from sandstone.

(D) a black soil found in areas which have had recent volcanic activity.

19 The flowchart summarises the main stages in the treatment of sewage.



What types of processes occur in stages 1, 2 and 3?

	Stage 1	*Stage 2*	*Stage 3*
(A)	Physical	Chemical	Biological
(B)	Chemical	Biological	Physical
(C)	Physical	Biological	Chemical
(D)	Chemical	Physical	Biological

20 A book on global warming was recently published.

How would you determine if the information in the book was both valid and reliable?

(A) Find out if the newspaper reviews of the book were favourable and count how many other books the author had published.

(B) Find out if the author worked in an Australian university or research organisation and communicated regularly with international scientists.

(C) Find out if the information in the book came from reputable sources and see if the author had published papers on other topics in international journals.

(D) Find out if the author had other peer-reviewed research papers on the topic and compare the information in the book with several other relevant scientific sources.

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Centre Number

Student Number

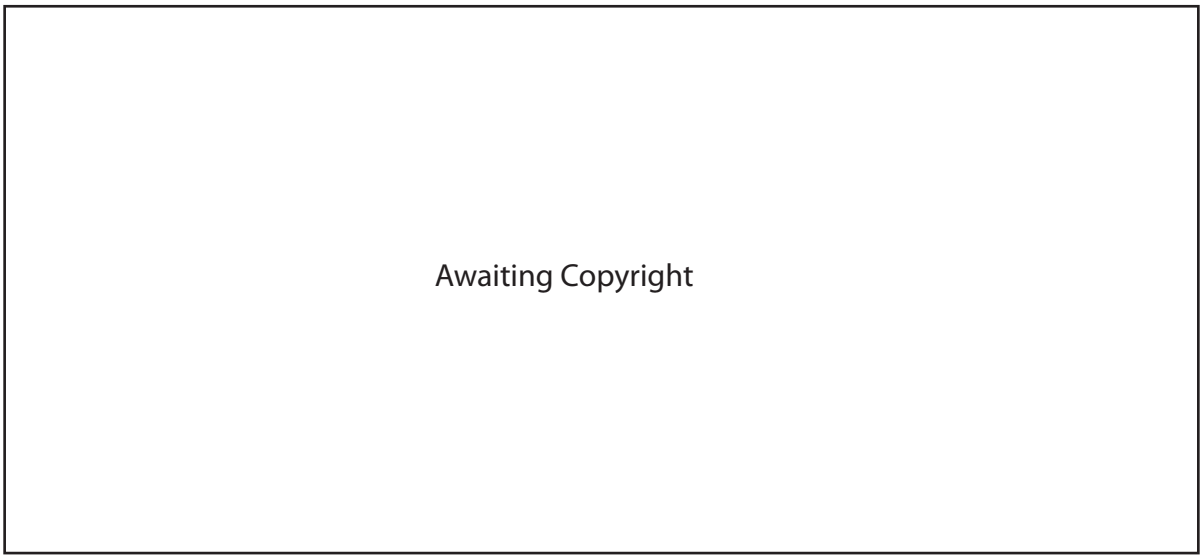
Section I (continued)

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)

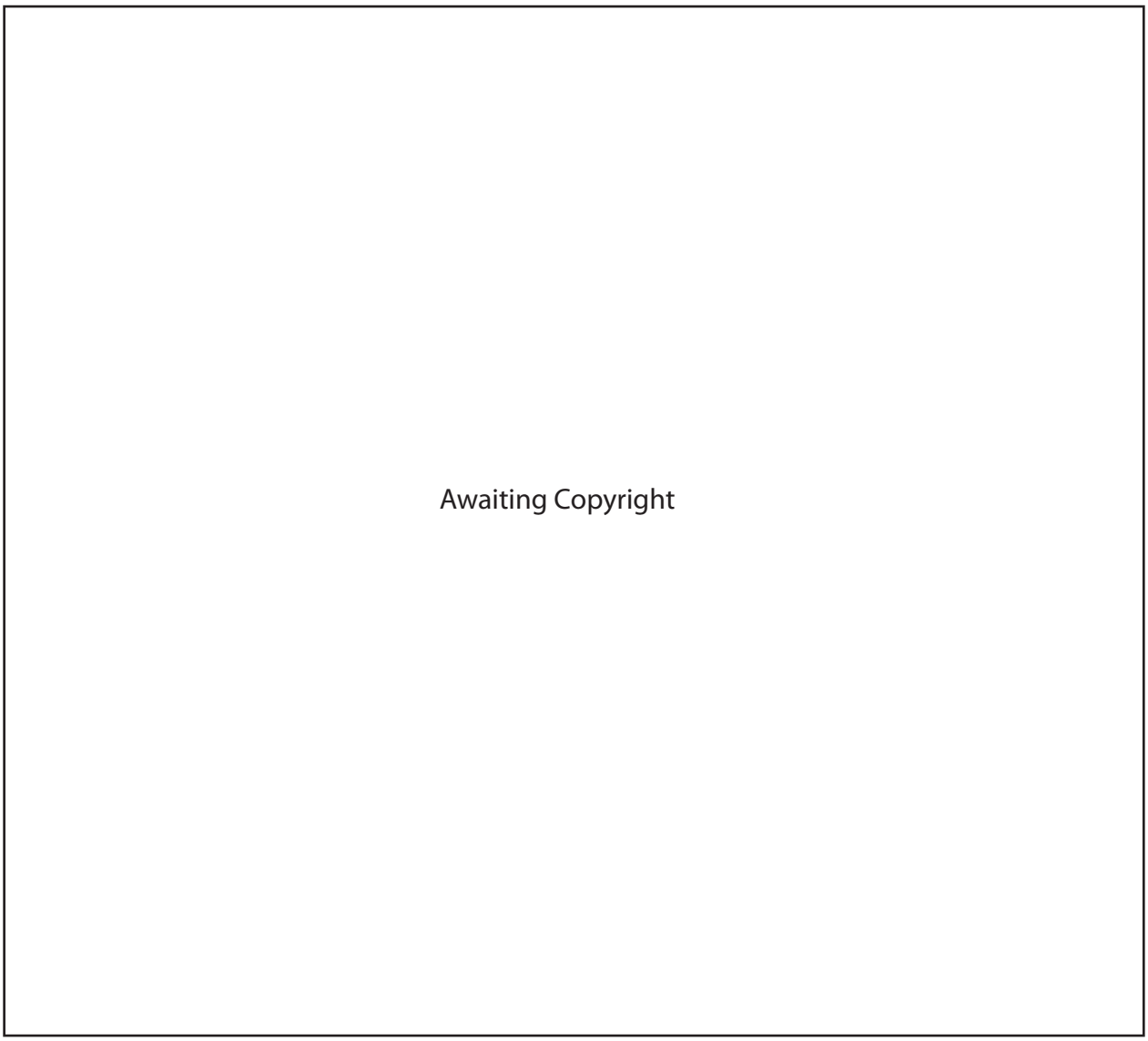
The cross-sections show two mountain belts. Complete the table to contrast these two mountain belts. **4**



	Mountain belt A	Mountain belt B
Type of fault shown		
Type of plate boundary		
Direction of forces		
One locality where found		

Question 22 (7 marks)

Table 1 and Table 2 give information on earthquakes.



Question 22 continues on page 15

Question 22 (continued)

(a) Propose one reason why three of the largest Australian earthquakes occurred at the same location (Burakin, WA). **1**

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(b) Account for the differences in earthquake magnitude and fatalities between the two tables. **3**

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(c) Why should Australian scientists continue to research earthquakes given that none of the large Australian earthquakes from 2001 to 2007 resulted in any fatalities? **3**

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End of Question 22

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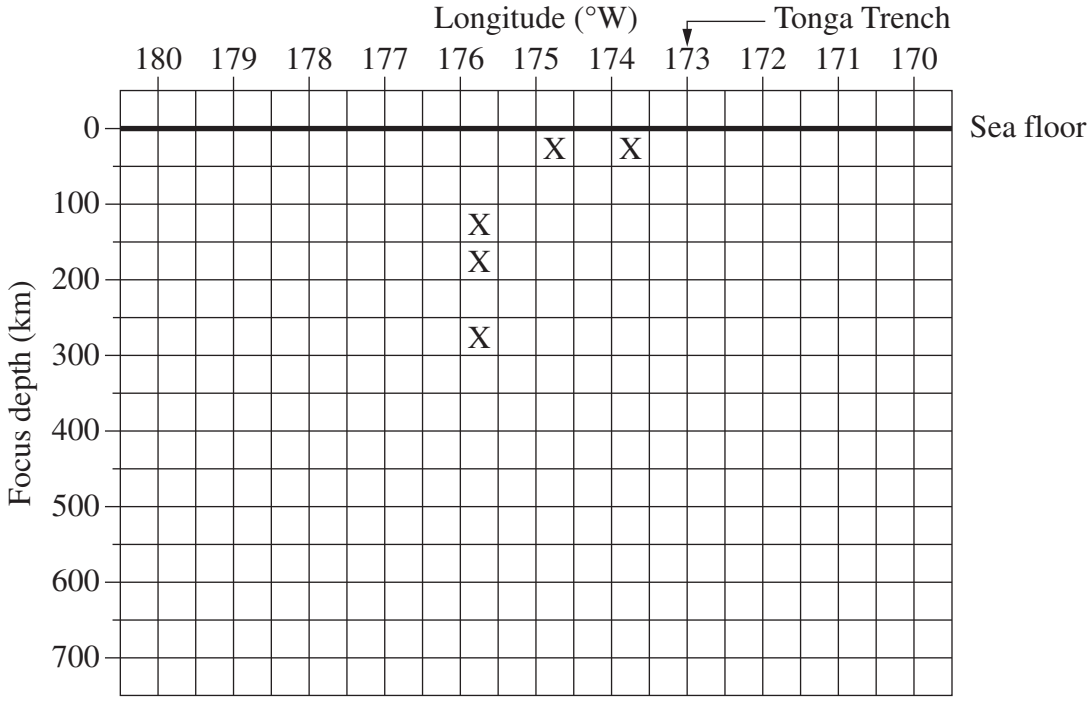
Question 23 (5 marks)

The table gives information on the depth and location of five earthquakes near the Tonga Trench in the southwest Pacific Ocean.

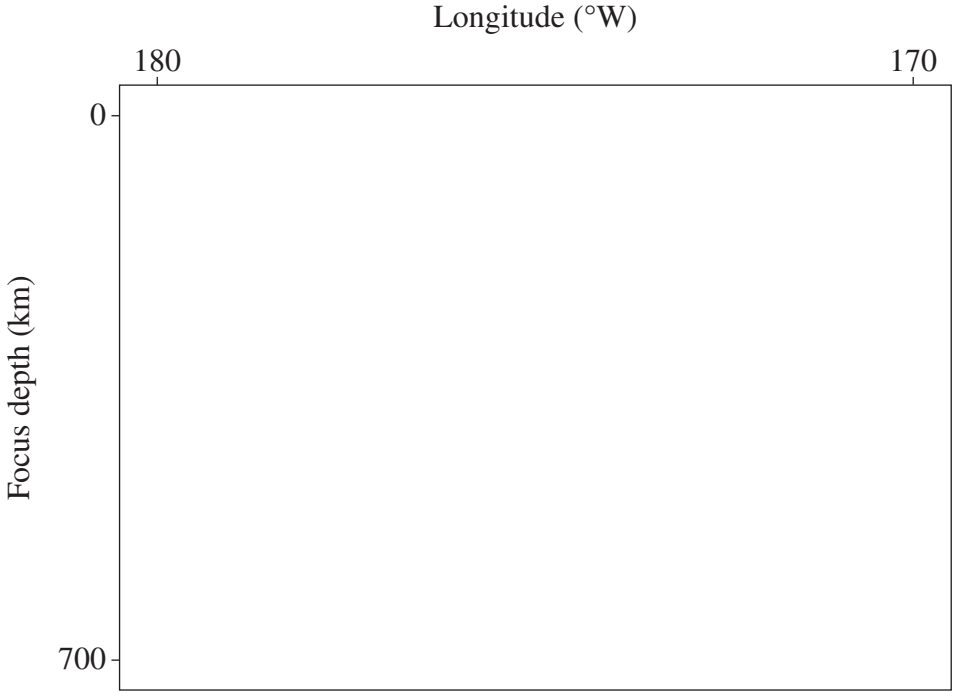
Focus depth (km)	Longitude (°W)
270	176.2
590	178.8
350	177.0
650	179.2
460	177.8

(a) The positions of five additional earthquakes have been plotted on the graph below. Complete the graph by plotting the positions of the earthquakes given in the table. **2**



Question 23 continues on page 18

(b) Using the information from part (a), construct a detailed labelled cross-section to illustrate the tectonic process occurring at the Tonga Trench. **3**



End of Question 23

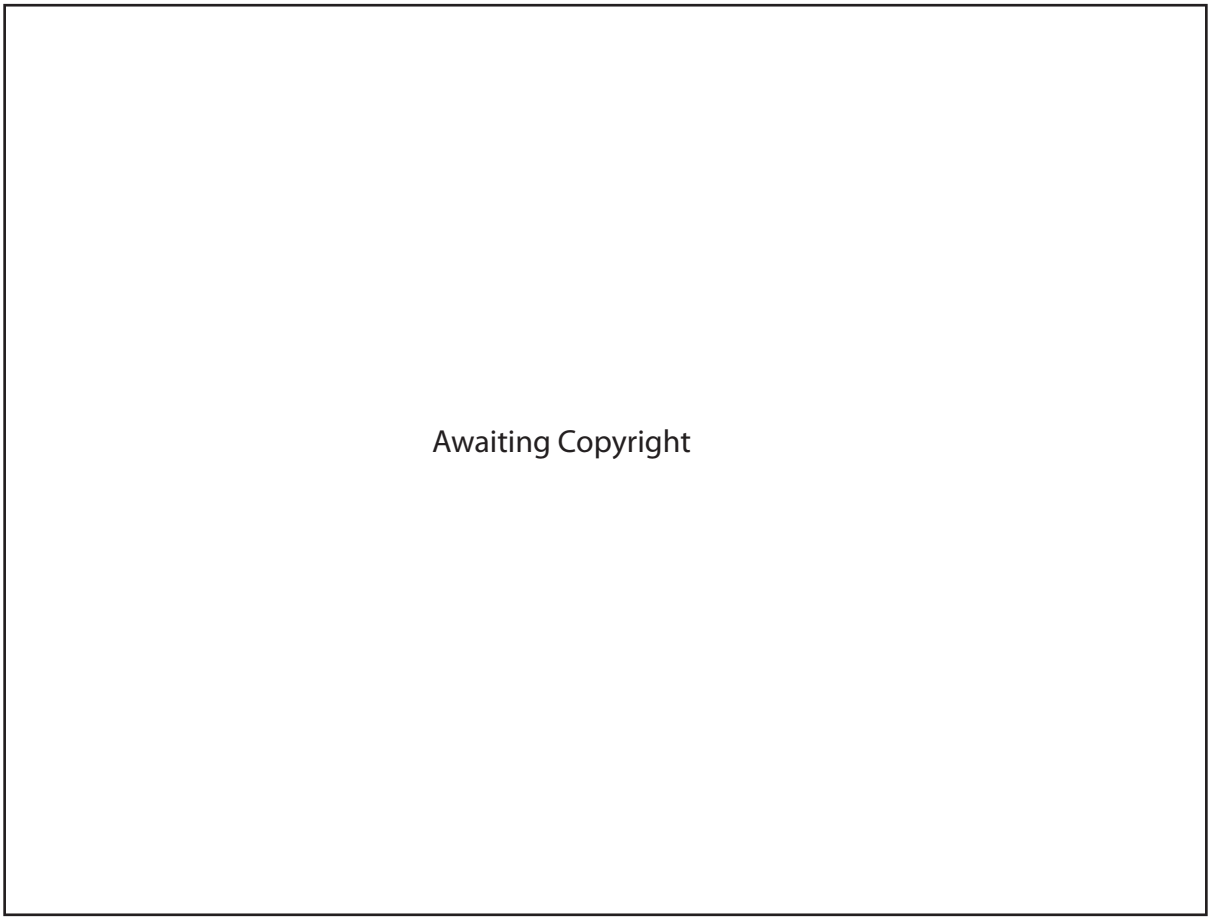
Centre Number

Student Number

Section I – Part B (continued)

Question 24 (5 marks)

The graph shows changes in the number of genera of marine animals over the last 550 Ma of Earth's history.



(a) What events do the arrows represent? **1**

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Question 24 continues on page 20

Question 24 (continued)

(b) Choose one of the events in the graph and contrast TWO hypotheses that have been proposed to explain the event. **4**

Event: .....

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End of Question 24

Question 25 (4 marks)

(a) Describe the diversity and numbers of organisms at a fossil site you have studied. **2**

Fossil site: .....

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(b) Using the information in part (a), explain what you have learnt about the nature of the site at the time the fossils formed. **2**

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Question 26 (4 marks)

Stromatolites are abundant and widespread in the fossil record of the Archaean and Proterozoic Eons.

(a) Identify the organism responsible for the formation of stromatolites. **1**

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(b) Account for differences in the occurrence of modern stromatolites compared to that of the fossil forms. **3**

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Question 27 (3 marks)

Name ONE evolutionary advance made by early plants and explain how it helped them to spread into the terrestrial environment. **3**

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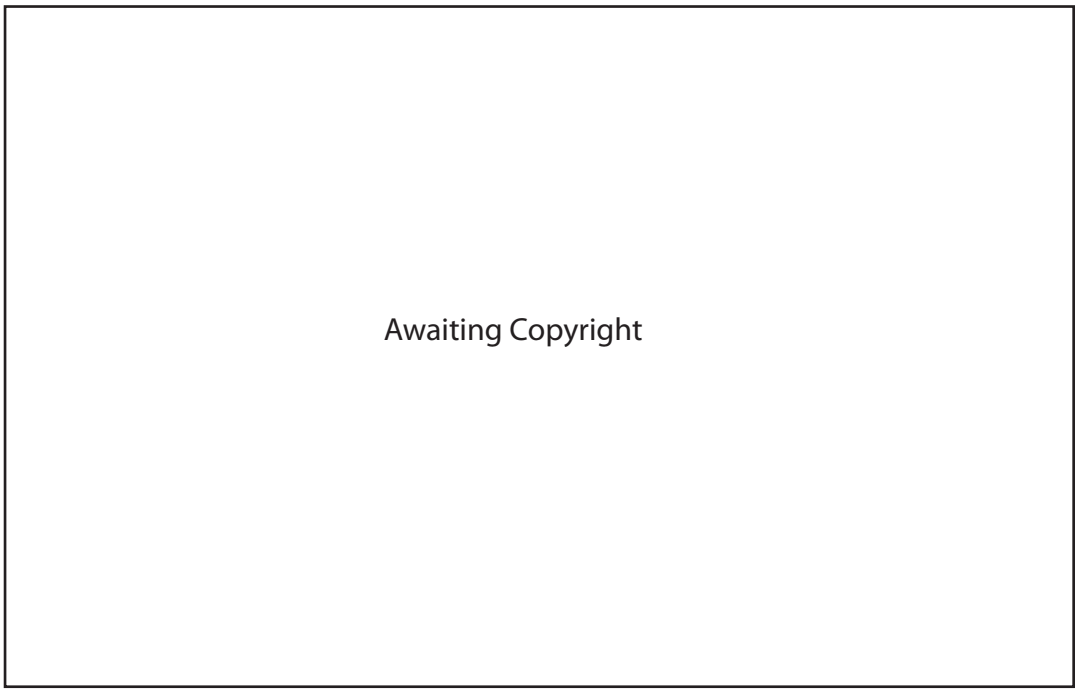
Centre Number

Student Number

Section I – Part B (continued)

Question 28 (7 marks)

The map shows grazing and crop-growing land in Australia.



(a) Explain how ONE agricultural practice could cause land degradation in the areas identified as being at risk. **3**

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Question 28 continues on page 24

(b) Propose a management plan that could be used to minimise the damage you described in part (a). Justify your plan. **4**

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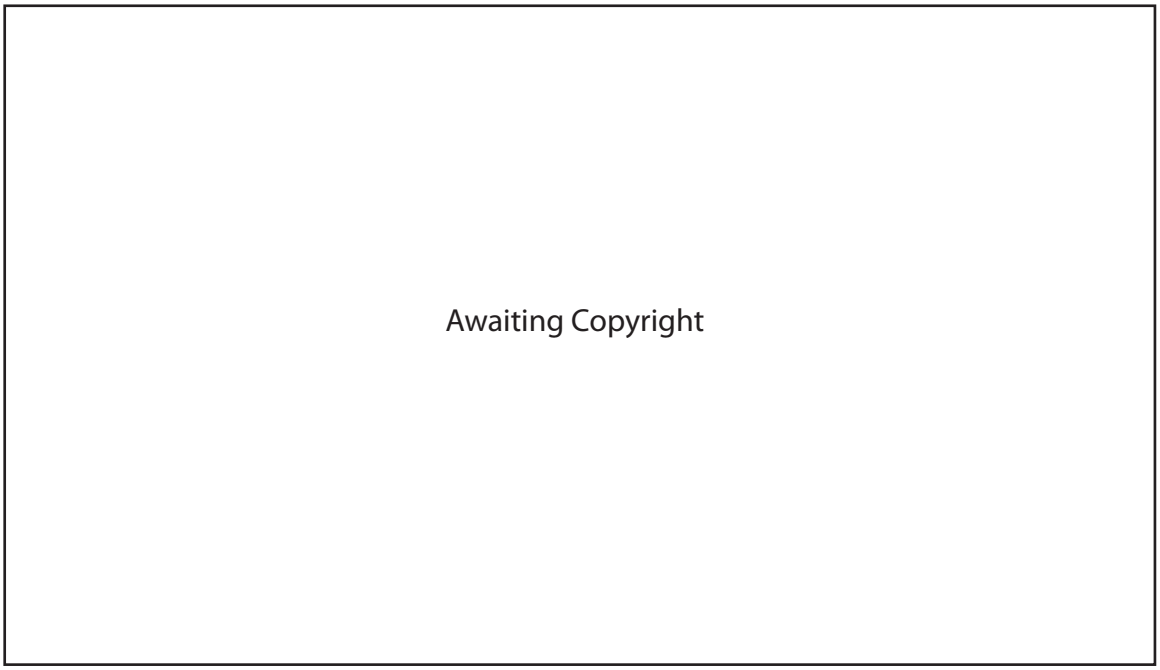
End of Question 28

Question 29 (5 marks)

Please turn over

Question 29 (5 marks)

The table summarises a range of pest management practices that are available for use in the banana industry. The banana industry currently relies heavily on pesticides. **5**



Rating scale for effectiveness of management practice:

E = excellent (>90% control) G = good (75–90% control)
P = poor (<75% control) – = has no effect

Use the information in the table to design an integrated pest-management strategy for banana growers that would minimise the impact of pesticides on the environment. Justify this strategy.

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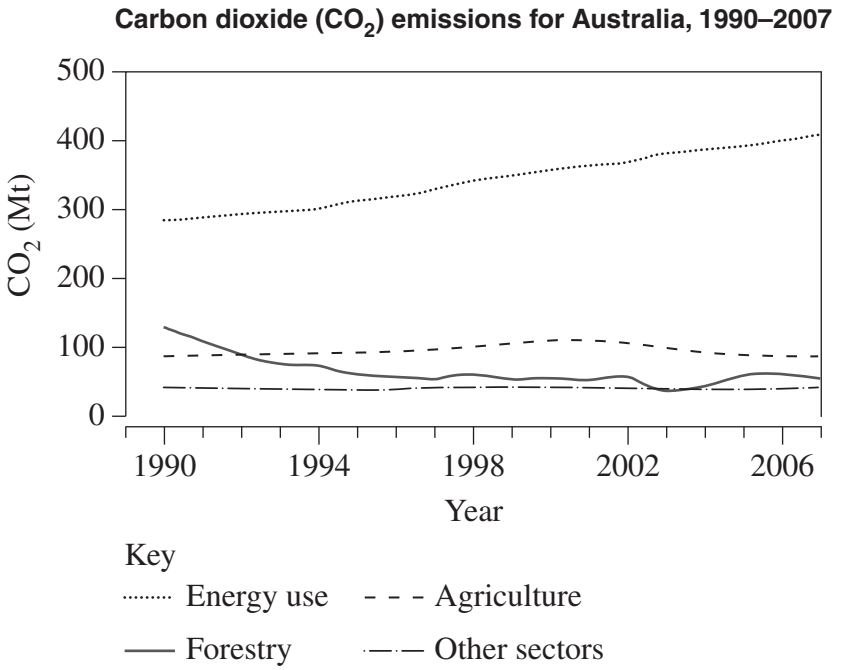
Question 30 (4 marks)

The graph shows carbon dioxide emissions from four activities in Australia from 1990 to 2007.



(a) Which activity is the main contributor of CO_2 emissions on this graph? **1**

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(b) Account for differences in trends between the Energy use and Forestry curves on the graph. **3**

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Question 31 (7 marks)

Evaluate how advances in knowledge in the field of earth and environmental science have given us a better understanding of the evolution of our continent and challenge us to use our resources more sustainably. Give examples in your answer. **7**

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.

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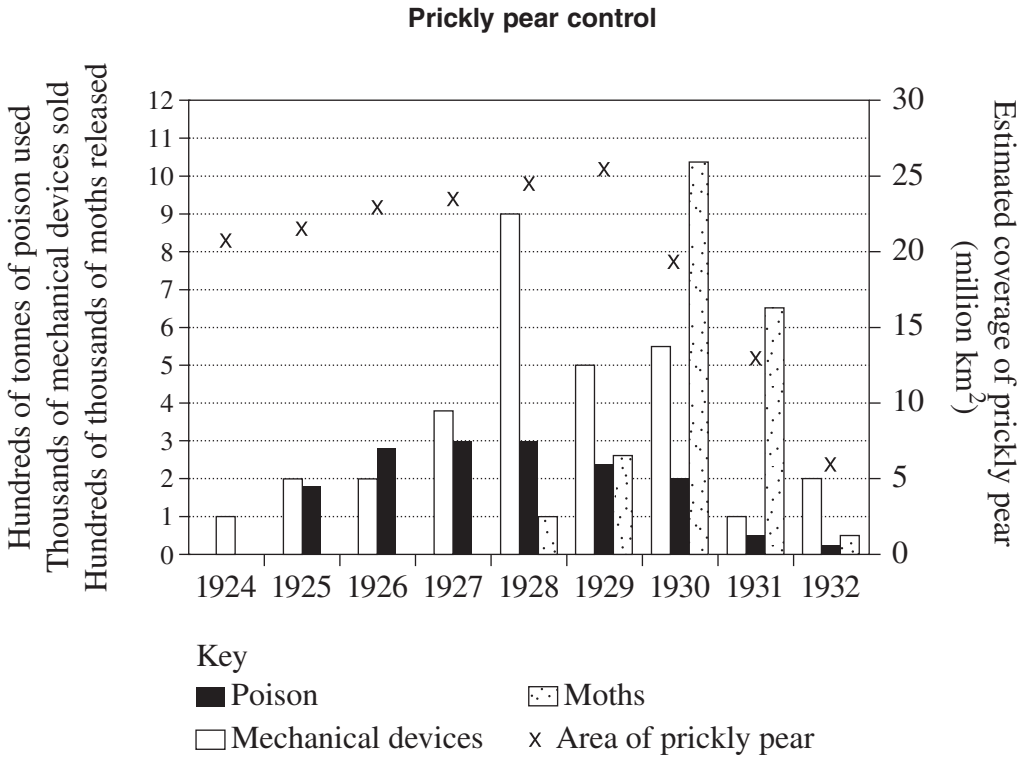
Question 32 — Introduced Species and the Australian Environment (25 marks)

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

(a) (i) Define the term *introduced species*. **1**

(ii) Recent research has shown that dingoes arrived in Australia some time between 4 600 and 18 300 years ago. At present, there is debate about whether the dingo should be classified as a native or introduced species. Give ONE reason for each viewpoint. **2**

(b) The graph shows information about the distribution of prickly pear and control strategies used to manage it. **4**



Using the data in the graph, assess the effectiveness of control strategies for prickly pear.

(c) (i) Name an introduced animal and give TWO reasons why it became a pest. **2**

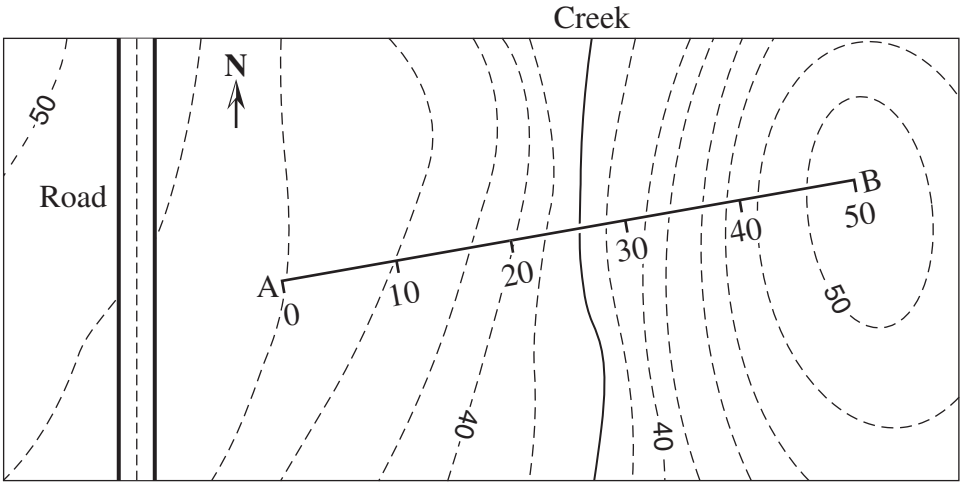
(ii) Compare TWO strategies that have been used to control the introduced animal named in part (c) (i). **4**

Question 32 continues on page 32

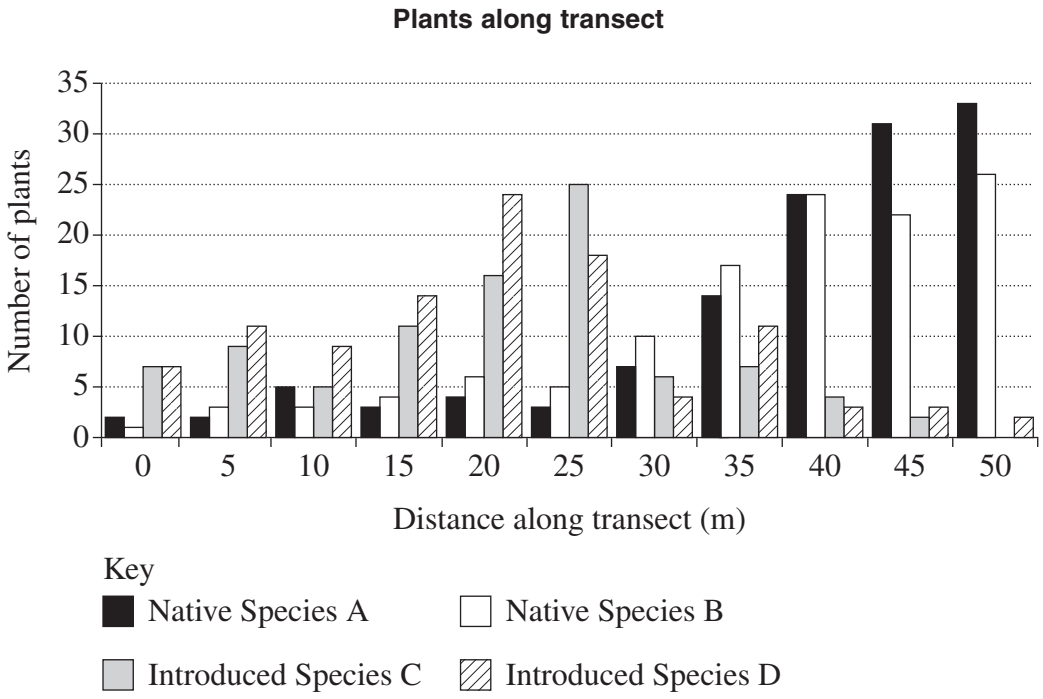
Question 32 (continued)

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

(d) The map shows a reserve that has been studied by a group of students to assess the impact of introduced species on native species. The students completed a 50 m transect from point A to point B across the reserve.



The graph shows data collected along the transect.



Question 32 continues on page 33

(i) Outline how ONE feature of the reserve may have had an impact on the distribution of the introduced species. **1**

(ii) The students concluded that the introduced species were increasing in the reserve. Their teacher told them this was not a valid conclusion. What additional information would the students need to make this conclusion valid? **2**

(iii) Explain how the Bradley Method could be used to rehabilitate the native species in the reserve. **3**

(e) Some people have argued that Australian quarantine regulations should be relaxed to allow plant species from overseas to be introduced into Australia as garden plants. **6**

Evaluate the need for Australia to continue to apply quarantine regulations and restrict the entry of plant species from overseas. Give examples in your answer.

End of Question 32

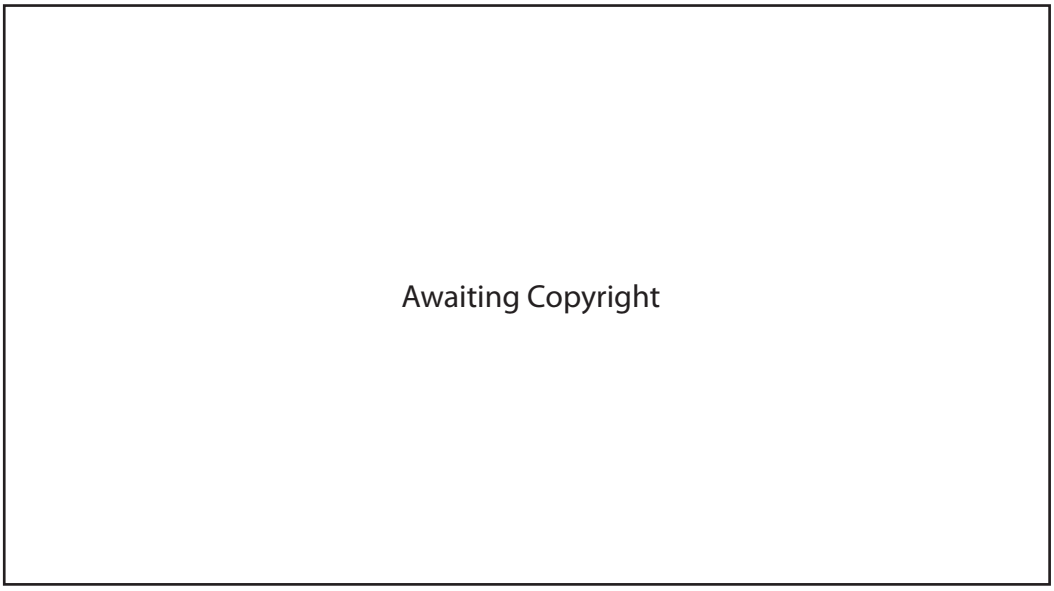
Question 33 — Organic Geology – a Non-renewable Resource (25 marks)

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

(a) (i) Why is the term *fossil fuel* used to describe coal? **1**

(ii) Outline the changes in composition and energy yield as the rank of coal increases. **2**

(b) The graphs show a breakdown of Australia's actual and predicted energy supply for the period 1980 to 2020. **4**



Account for the differences in the supply of wind and solar energy from 1980 to 2020 compared to that supplied by coal over the same period. Use information from the graphs.

(c) (i) How is knowledge of the geological features of known fossil fuel reserves useful to geologists when searching for new fossil fuel resources? **2**

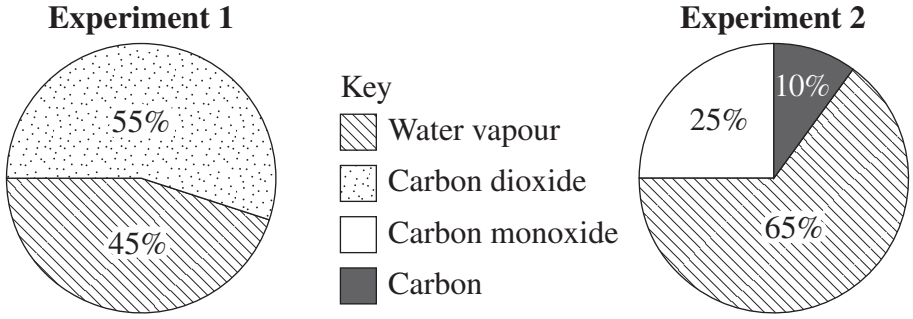
(ii) Compare the exploration methods used to determine the location and size of new coal and new oil resources. **4**

Question 33 continues on page 35

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

(d) (i) Distinguish between complete and incomplete combustion in terms of energy yield. **1**

(ii) Methane was burnt under two sets of conditions. The products of combustion were analysed and the results given in the graphs. **2**



Identify which experiment represents incomplete combustion and outline how conditions would have to be changed to bring about complete combustion.

(iii) Assess the impact of the products of incomplete combustion on the environment. **3**

(e) Many scientists argue that Australia should increase its use of alternative energy sources, although this would bring about an increase in the cost of energy in the short term. **6**

Evaluate the need for Australia to increase its use of alternative energy sources other than wind and solar. Give examples in your answer.

End of Question 33

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

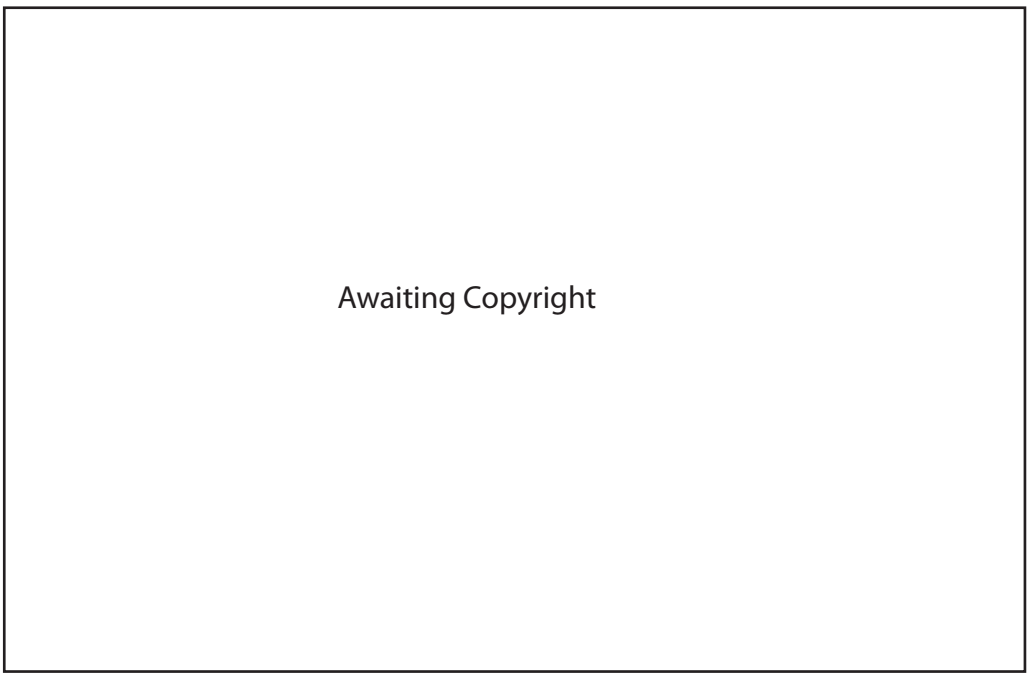
Answer parts (a)–(c) in Section II Answer Booklet 1.

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

(ii) Outline the impact of ONE modern technology on mineral exploration. **2**

(b) A mining company discovered a large nickel deposit in 2005. Throughout 2006, the company carried out feasibility studies on the deposit and concluded that it was economically viable to mine it if the price of nickel was $40 per kilogram. **4**

The graph below shows the variation in nickel prices between 2007 and 2011.



Explain how the company could maintain economic viability of the deposit between 2007 and 2011 even though the nickel price changed.

Question 34 continues on page 37

Question 34 (continued)

(c) (i) Outline how the size and grade of an ore deposit you studied was determined. **2**

(ii) Describe how the size and grade of the deposit influence the mining and concentration process of the ore. **4**

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

(d) The table shows the properties of some minerals commonly found in ores.

Mineral	*Hardness*	*Lustre*	*Streak*	*Density* (g/cm^3)	*Cleavage*
A	3.5–4	Metallic	Greenish black	4.2	None
B	7	Glassy	White	2.6	None
C	2–2.5	Pearly	Pale	2.7	Good – 1 direction
D	4	Resinous to sub-metallic	Brown	4.0	Poor – 6 directions
E	3	Pearly	White	3.0	Perfect – 3 directions
F	2.5	Metallic	Lead-grey	7.5	Perfect – 3 directions

(i) Identify ONE of the above mineral properties that could be determined by a quantitative test, and ONE property that could be determined by a qualitative test. **1**

(ii) Outline how the quantitative test identified in part (i) could be carried out in a laboratory. **2**

(iii) Use the information in the table to classify the six minerals as either ore minerals or gangue minerals. Justify your classification. **3**

(e) Governments set conditions on mining companies that include protection and rehabilitation of the environment. **6**

Assess how these government policies affect both the day-to-day operation of a mine and its long-term impact on the sustainability of the local environment. Give examples in your answer.

End of Question 34

Question 35 — Oceanography (25 marks)

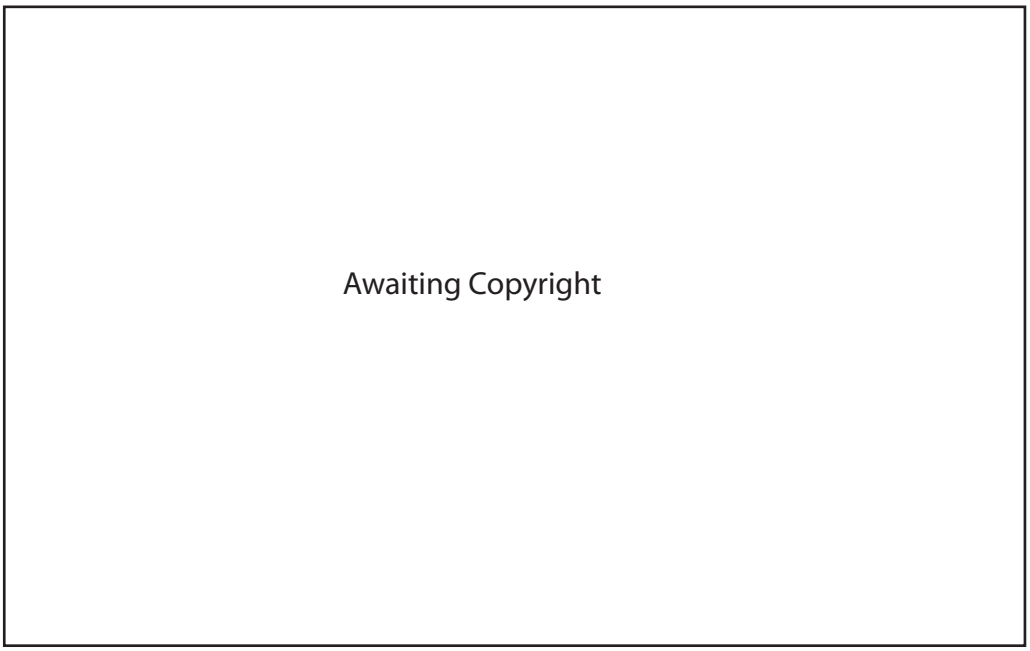
Answer parts (a)–(c) in Section II Answer Booklet 1.

(a) (i) Name TWO technologies used to study the ocean floor. **1**

(ii) Name ONE deep sea sediment and outline its origin and distribution. **2**

(b) In 2011 the NASA satellite Aquarius sent back to Earth measurements of sea surface salinity collected over seventeen days. **4**

The data was compiled into the following map.



Explain how processes occurring in the Pacific Ocean have resulted in the distribution of salinities shown on the map.

(c) (i) How has an understanding of plate tectonics improved our knowledge of the nature of the deep sea floor? **3**

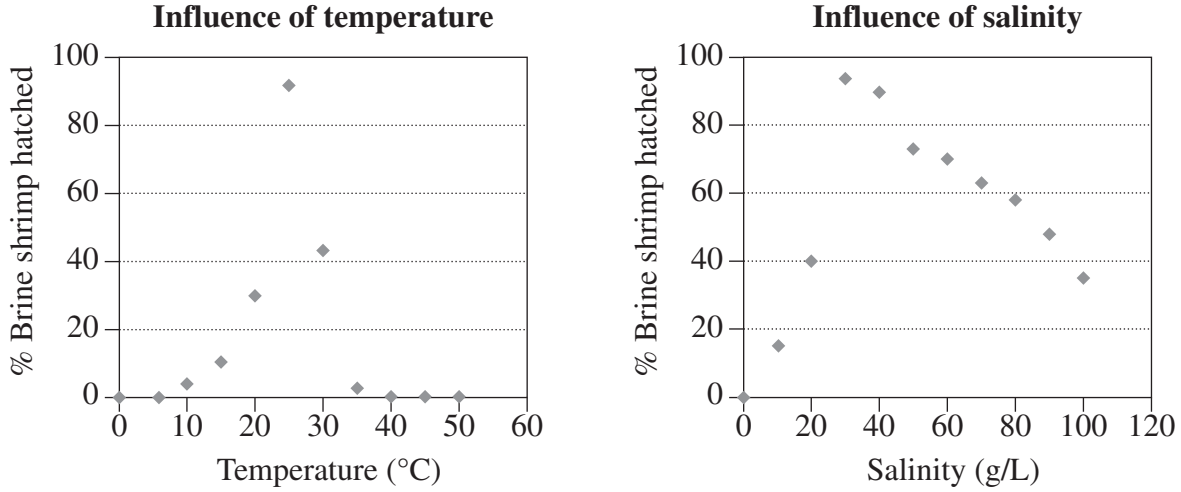
(ii) Describe the biotic communities around deep ocean vents. **3**

Question 35 continues on page 39

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

(d) (i) Identify TWO characteristics of brine shrimp that make them suitable for breeding at home or school. **1**

(ii) The graphs below give the results of experiments to show the effects of temperature and salinity on the hatching rates of brine shrimp after four days. **2**



If you had carried out the experiment, outline how you would have ensured the method was valid.

(iii) Using the data in the graphs, compare the tolerance of brine shrimp to variations in temperature and salinity. **3**

(e) Models of the global circulation of ocean currents indicate that sea water takes approximately 1000 years to complete one cycle. **6**

Evaluate how a knowledge of global circulation of ocean currents influences human activities that use the oceans' resources. Give examples in your answer.

End of paper

Geological Time Scale