BOARD OF STUDIES
NEW SOUTH WALES

2013

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, 15, 17, 19, 21 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 21–30
- Allow about 1 hour and 40 minutes for this part

Section II Pages 27–36

25 marks

- Attempt ONE question from Questions 31–34
- 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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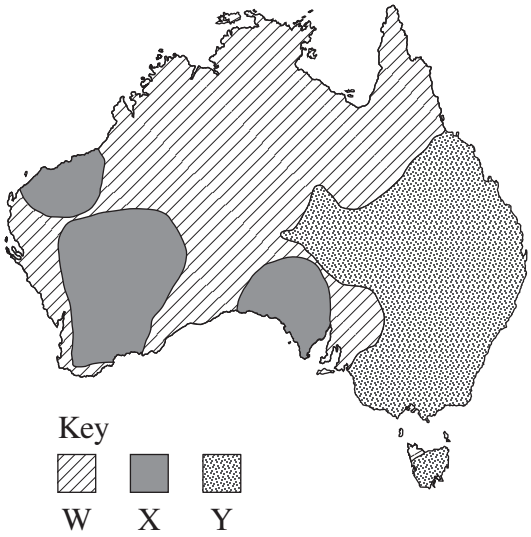
1 The map shows three geological regions in Australia.



Which alternative lists the three regions from youngest to oldest?

(A) Y, W, X

(B) Y, X, W

(C) X, W, Y

(D) W, X, Y

2 A plate tectonic super-cycle begins when thermal stress builds up beneath a super continent causing it to fracture.

What is formed in the final step of this super-cycle?

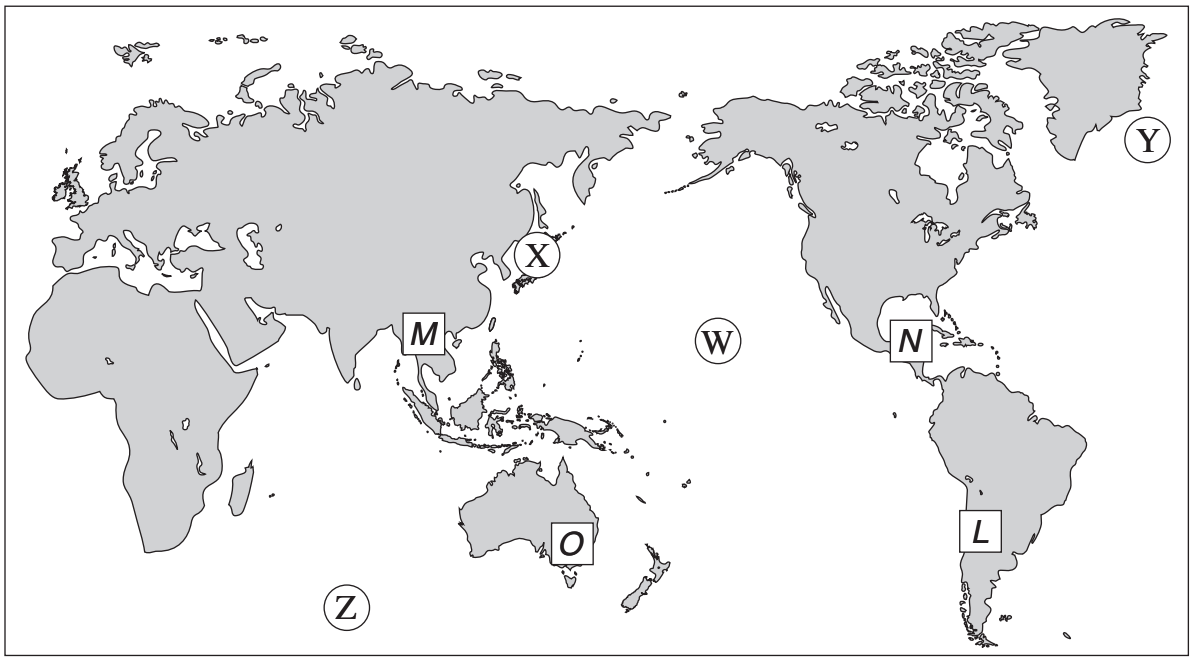
(A) A new super continent

(B) Two large ocean basins

(C) Explosive volcanic mountain ranges

(D) Two new continents with a mid-ocean ridge between them

Refer to the map below to answer Questions 3–4.



3 The map shows the locations of four earthquakes *L*, *M*, *N* and *O* that occurred late in 2012.

Which earthquake was NOT on a plate boundary?

(A) *L*

(B) *M*

(C) *N*

(D) *O*

4 The map also shows the location of four volcanic regions W, X, Y and Z.

At which location would andesitic lava be found?

(A) W

(B) X

(C) Y

(D) Z

5 Which row of the table contains features characteristic of a collision between two continents?

	Volcanic activity	*Depth of earthquake focus*	*Type of fault*
(A)	Explosive	Shallow to deep	Thrust
(B)	Explosive	Shallow	Normal
(C)	None	Shallow	Thrust
(D)	None	Deep to shallow	Normal

6 A sequence of rocks contains gently folded fossiliferous limestone alternating with layers of volcanic ash.

What was the tectonic setting at the time these rocks were deposited?

(A) Two oceanic plates colliding

(B) Two oceanic plates diverging

(C) Two continental plates colliding

(D) Two continental plates diverging

7 The image shows the 150 million-year-old fossil, *Archaeopteryx*.

Archaeopteryx is evidence that

(A) birds evolved into reptiles.

(B) the first vertebrates had feathers.

(C) only animals with hard body parts form fossils.

(D) present day organisms have developed from past life forms.

8 Which combination of structures, in addition to support tissue, was essential for terrestrial plants to evolve from simple aquatic plants?

(A) Roots, leaves and spores

(B) Stomates, spores and leaves

(C) Transport tissue, seeds and flowers

(D) Transport tissue, stomates and seeds

9 Which of the following correctly matches the interval of geological time with a major biological event?

	Interval of geological time	*Biological event*
(A)	Early Hadean	First life on Earth
(B)	Late Proterozoic	Earliest land plants
(C)	Late Phanerozoic	First marine animals
(D)	Early Archaean	First photosynthetic bacteria

10 On what basis is the Phanerozoic Eon divided into Eras?

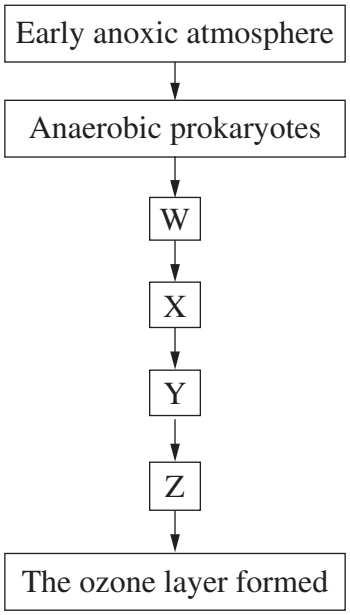
(A) Minor extinction events

(B) Minor variations in global climate

(C) Major changes in the fossil record

(D) Major changes in the positions of continents

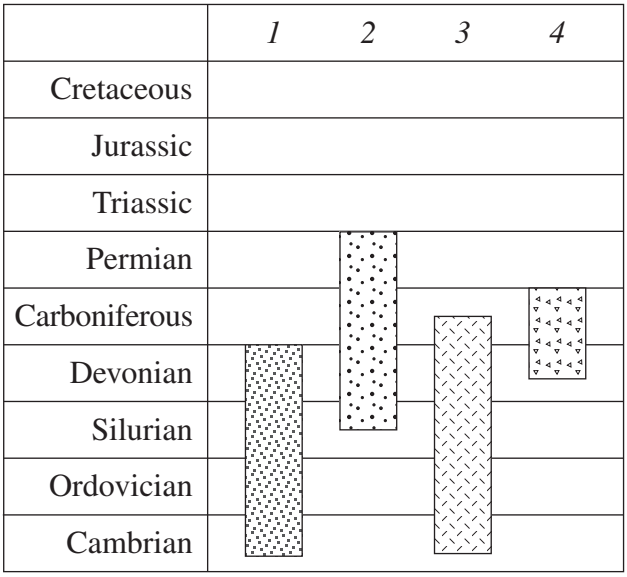
11 The flow chart shows a sequence of events that occurred during Earth's history.



Which alternative correctly matches the events in the table with the letters W, X, Y and Z in the flow chart?

	Banded Iron Formations deposited	*Cyanobacteria evolved*	*Atmospheric oxygen concentration increased*	*Oceanic oxygen concentration increased*
(A)	W	Z	Y	X
(B)	X	Y	Z	W
(C)	Y	W	Z	X
(D)	Z	W	Y	X

12 The diagram shows the times during which four species of organisms lived.



TIME INTERVALS NOT TO SCALE

Which combination of fossils would indicate that a rock was deposited ONLY in the Devonian Period?

(A) *1*, *2*

(B) *1*, *4*

(C) *2*, *3*

(D) *3*, *4*

13 Which of the following statements is correct?

(A) Fossil stromatolites are found throughout Australia.

(B) Banded Iron Formations are evidence of the first plant life on land.

(C) Metazoan fossils dating back to the Proterozoic Eon have been found in South Australia.

(D) The oldest rocks on Earth containing fossilised prokaryotic cells have been found in 3.8 billion-year-old cratons in Australia.

14 What is the main effect of the impact of a raindrop on loose soil in a ploughed paddock?

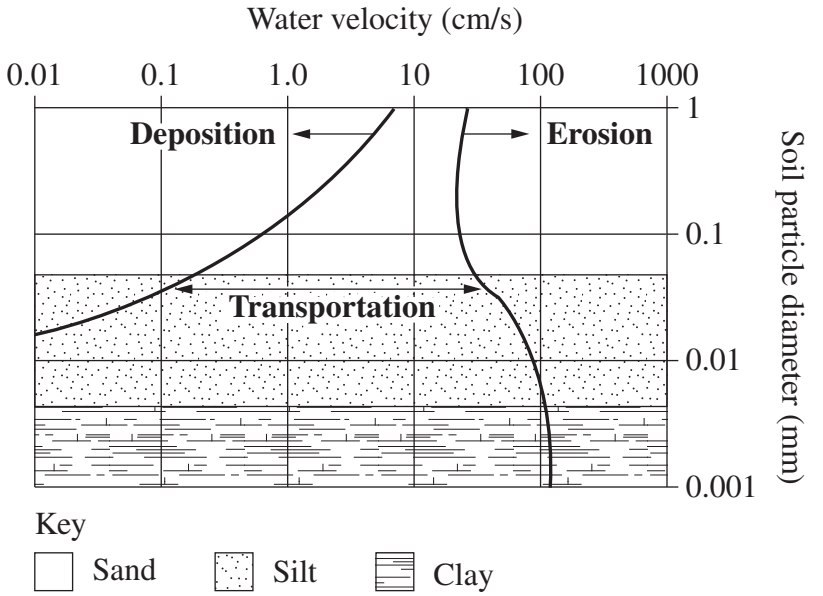
(A) Compaction of soil

(B) Decrease in permeability

(C) Increase in soil particle size

(D) Displacement of surface particles

15 The graph shows the relationship between water velocity and soil particle diameter.



Acknowledgement: © seafriends.org.nz

What happens to a 0.2 mm sand grain and a 0.05 mm silt grain when the water velocity is 0.5 cm/s?

	Sand	*Silt*
(A)	Deposited	Transported
(B)	Transported	Transported
(C)	Transported	Deposited
(D)	Deposited	Deposited

16 In which of the following do the chemicals react with each other to form a greenhouse gas?

(A) Hydrocarbons and oxygen

(B) Sulfur trioxide and water

(C) Nitrous oxides and water

(D) Iron and water

17 Which sequence of reactions reduces the amount of ozone in the stratosphere?

Chlorine atoms react with ozone to produce chlorine monoxide and oxygen gas

↓

Ultraviolet radiation produces chlorine atoms from chlorofluorocarbons

↓

Chlorine monoxide reacts with oxygen atoms to produce chlorine atoms and oxygen gas

(B)

Ultraviolet radiation produces chlorine atoms from chlorofluorocarbons

↓

Chlorine atoms react with ozone to produce chlorine monoxide and oxygen gas

↓

Chlorine monoxide reacts with oxygen atoms to produce chlorine atoms and oxygen gas

(C)

Ultraviolet radiation produces chlorine atoms from chlorofluorocarbons

↓

Chlorine monoxide reacts with oxygen atoms to produce chlorine atoms and oxygen gas

↓

Chlorine atoms react with ozone to produce chlorine monoxide and oxygen gas

(D)

Chlorine atoms react with ozone to produce chlorine monoxide and oxygen gas

↓

Chlorine monoxide reacts with oxygen atoms to produce chlorine atoms and oxygen gas

↓

Ultraviolet radiation produces chlorine atoms from chlorofluorocarbons

18 Which of the following lists consists ONLY of gases found in the exhaust emissions of vehicles?

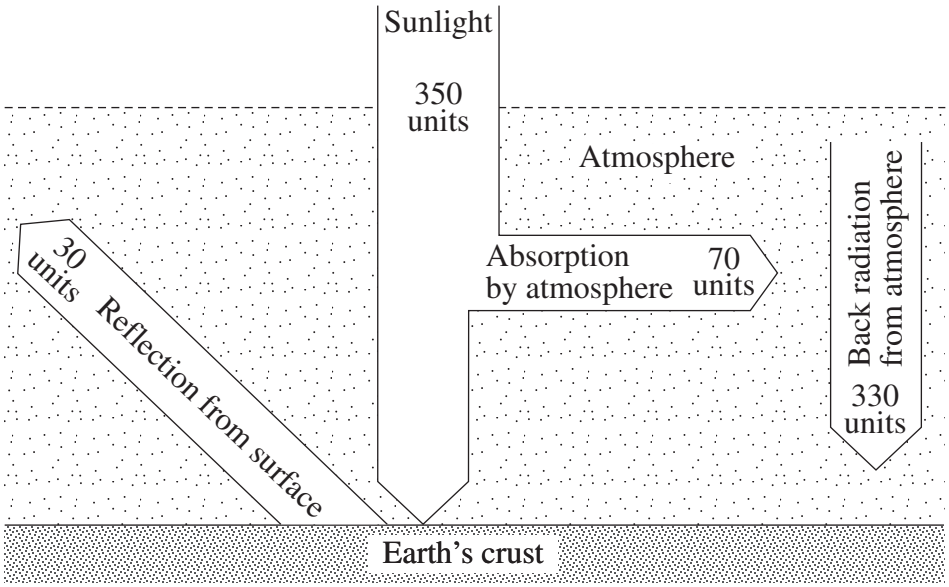
(A) Sulfur dioxide, carbon monoxide, methane

(B) Nitrogen dioxide, carbon monoxide, water

(C) Sulfur dioxide, nitrogen dioxide, oxygen

(D) Methane, oxygen, water

19 A model for some of the energy entering and leaving Earth's atmosphere in 2013 is shown. All components of the balanced energy budget are NOT shown.

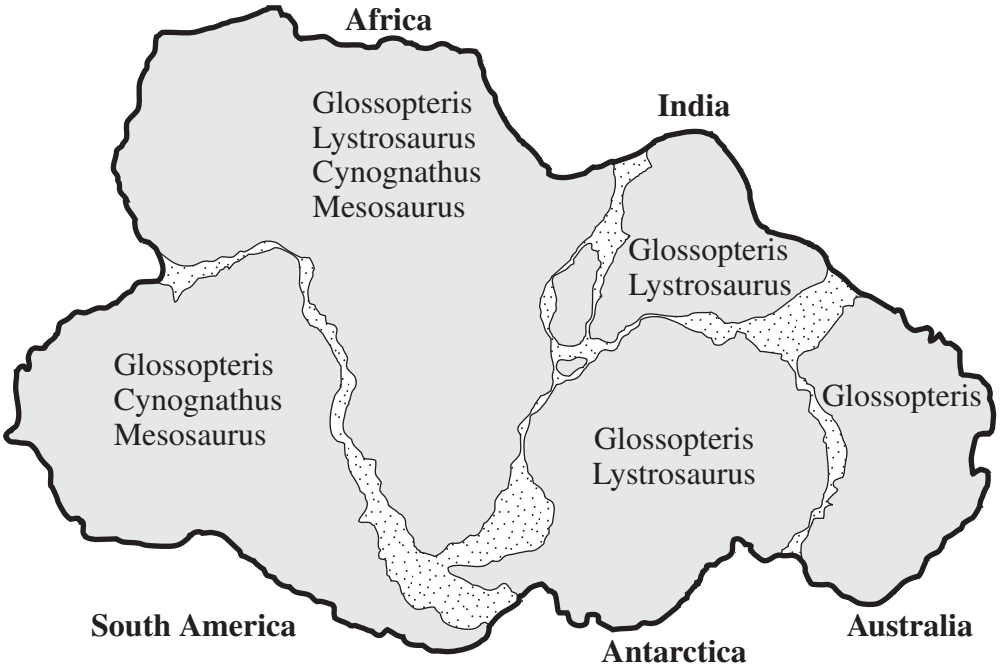


NOT TO SCALE

Which set of energy values would result in a reduction in global warming by 2050?

	Sun's radiation (units)	*Surface reflection* (units)	*Atmospheric absorption* (units)	*Back radiation* (units)
(A)	>350	>30	<70	>330
(B)	350	30	<70	<330
(C)	<350	30	>70	<330
(D)	350	<30	>70	>330

20 The diagram shows the present day continents that made up Gondwana before it broke up, and the distribution of fossils found on those continents.



Which of the following statements is supported by the information in the diagram?

(A) Glossopteris evolved after the break up of Gondwana but before the separation of South America from Africa.

(B) Mesosaurus evolved after the separation of South America from Africa but before the separation of Africa from Antarctica.

(C) Lystrosaurus evolved before the separation of South America from Africa and before the separation of India from Australia.

(D) Cynognathus evolved before the separation of South America from Africa but after the separation of Africa and South America from the other continents.

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Centre Number

Student Number

Section I (continued)

Part B – 55 marks
Attempt Questions 21–30
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 (7 marks)

(a) A new volcanic island has formed in the South Atlantic Ocean, midway between South America and Africa. **3**

Name an igneous rock you would find on this island and describe the character of the volcanic eruption in which this rock was formed.

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(b) In 1815, the Indonesian volcano Mt Tambora erupted. In 1816, Western Europe and North America experienced unusually cold weather. **4**

Explain how the Mt Tambora eruption could have cooled Western Europe and North America in 1816.

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Question 22 (4 marks)

Describe how heat flow and gravity influence crustal movement at plate boundaries. **4**

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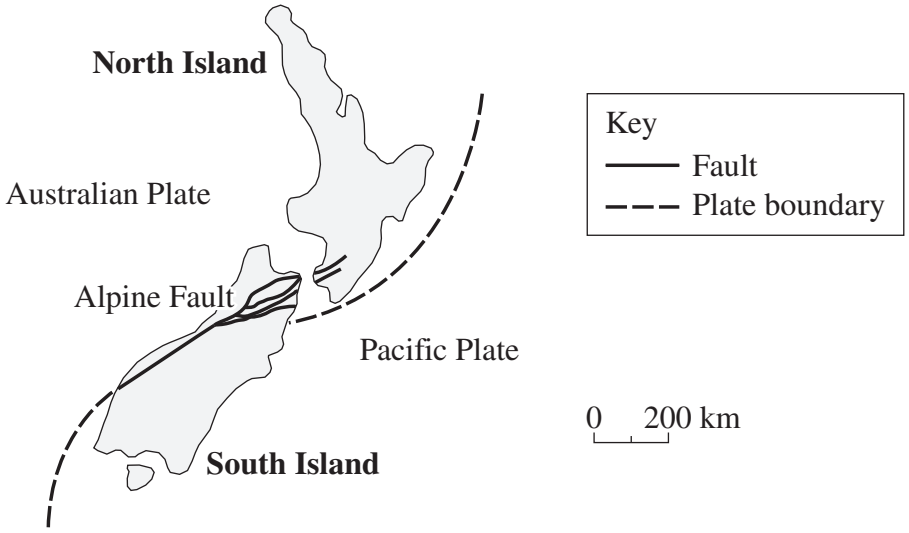
Question 23 (5 marks)

The map shows the tectonic environment of New Zealand.



(a) Name a geological hazard in the North Island of New Zealand and describe its origin. **2**

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(b) How might the effect of the geological hazard in part (a) be minimised when it occurs in the future? **3**

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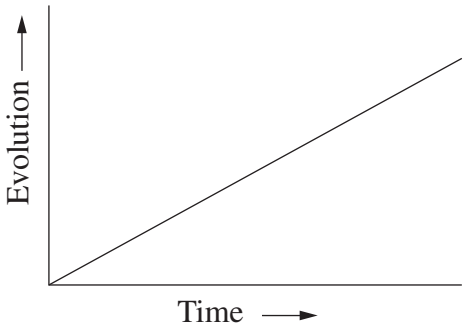
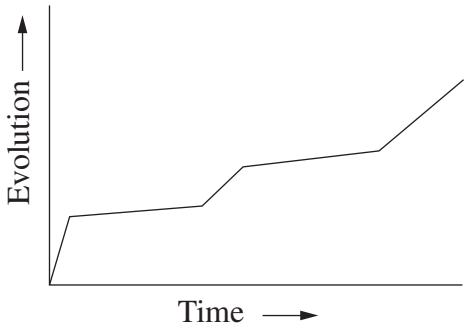
Question 24 (4 marks)

The graphs represent two different models of how life evolved on Earth.

Graph A



Graph B



Explain how each model illustrates the process of evolution. **4**

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Question 25 (6 marks)

Name ONE mass extinction event and ONE smaller extinction event and complete the table making comparisons between the two events. **6**

	Mass extinction event	*Smaller extinction event*
	Name:	Name:
Comparison 1		
Comparison 2		
Comparison 3		

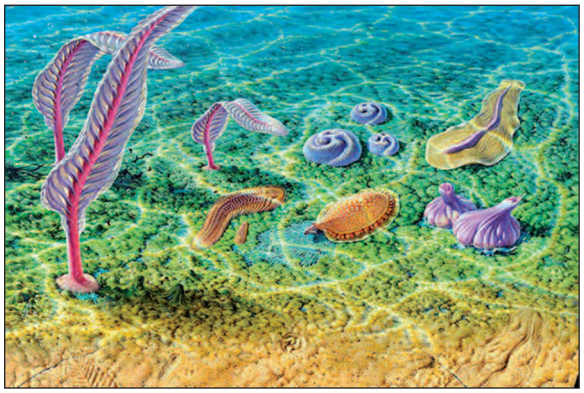
Question 26 (6 marks)

Please turn over

Question 26 (6 marks)

The images shown are models of scenes of past life on Earth's ocean floor, based on fossil evidence.

Image A – An Ediacaran Scene



Acknowledgement: Designer Peter Trusler, 2005,
© Australian Postal Commission

Image B – A Cambrian Scene

Reproduced with permission of Masanori Gakuhari

(a) (i) Describe TWO differences between the organisms in *Image A* and those in *Image B*. **2**

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(ii) How did ONE feature of an organism shown in *Image B* give it an evolutionary advantage over an organism shown in *Image A*? **2**

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(b) Why are models and simulations useful for studying past life forms? **2**

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End of Question 26

Centre Number

Student Number

Section I – Part B (continued)

Question 27 (4 marks)

Assess the effectiveness of one pest control management strategy that does not require the use of pesticides. **4**

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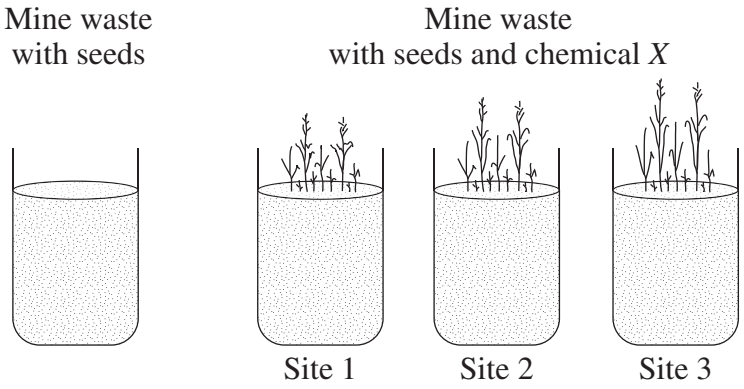
Question 28 (5 marks)

When chemical *X* is added to contaminated mine waste, toxic metals are bound to the waste particles and vegetation growth is promoted.

The results of a trial of chemical *X* are shown below in the diagram.



(a) Outline ONE reason why the results of this trial may NOT be valid. **1**

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(b) How could the use of chemical *X* reduce the problems associated with abandoned mine sites? **4**

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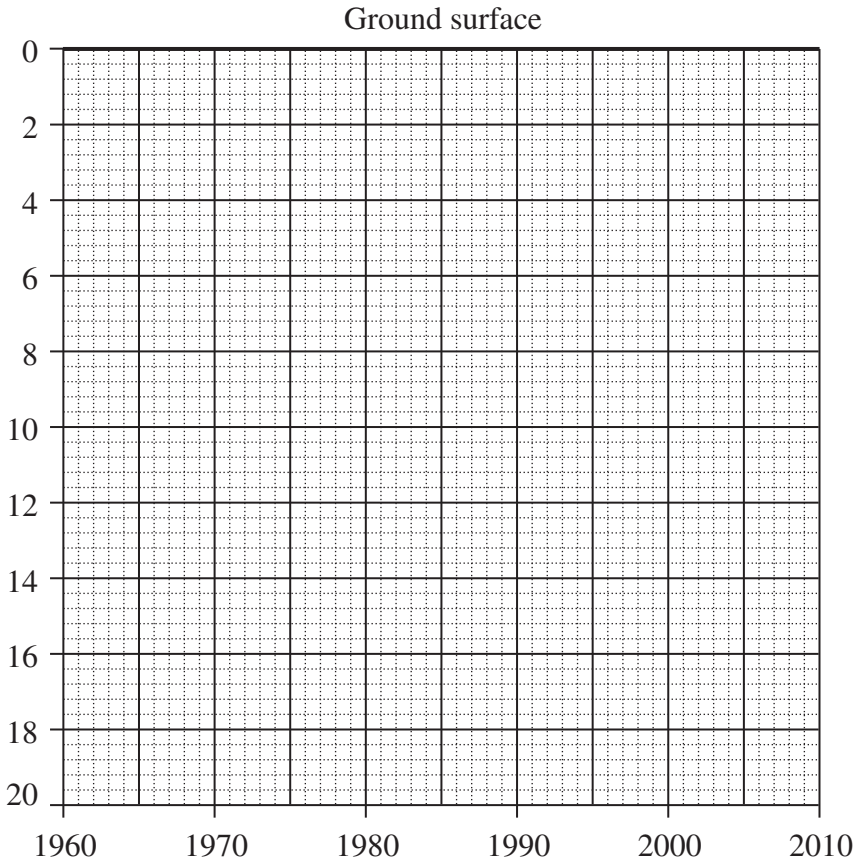
Question 29 (7 marks)

The table shows the average depth to the water table from the ground surface.

Year	*Depth to water table* (m)
1960	18
1970	15
1980	14
1990	10
2000	8
2010	5

(a) Plot the data from the table. Label the axes. **2**



Question 29 continues on page 24

Question 29 (continued)

(b) Account for the changes in the depth to the water table over time. **2**

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(c) Explain how a specific strategy could be used to reverse the changes in the depth to the water table. **3**

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End of Question 29

Centre Number

Student Number

Section I – Part B (continued)

Question 30 (7 marks)

Assess whether Australia's resources and environments would be more sustainable if the concepts of earth and environmental science were more widely understood and applied. **7**

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Earth and Environmental Science

Section II

25 marks
Attempt ONE question from Questions 31–34
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.

Question 31 — Introduced Species and the Australian Environment (25 marks)

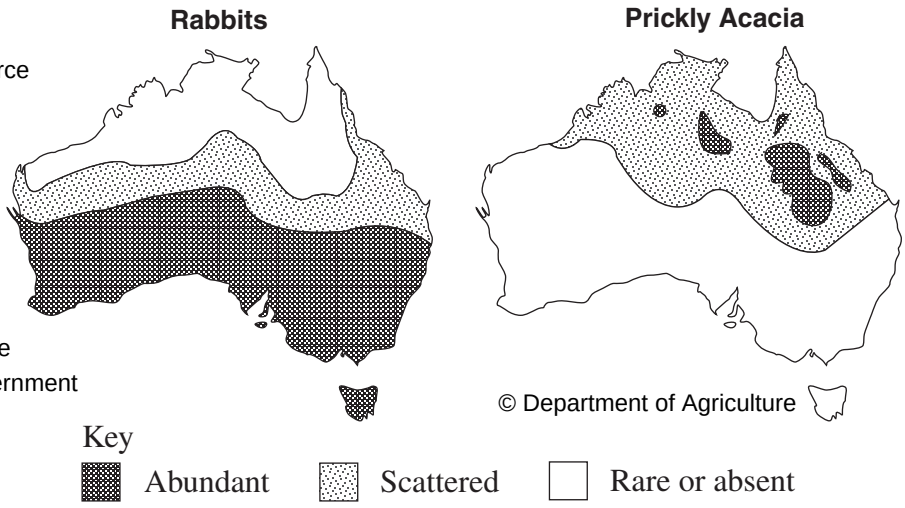
Answer parts (a)–(c) in Section II Answer Booklet 1.

(a) (i) Define the term *non-indigenous*. **1**

(ii) Give reasons why species have been introduced to Australia from overseas. **2**

(b) Discuss a strategy being used to rehabilitate an ecosystem damaged by an introduced species. In your answer, identify both the ecosystem and the species. **4**

(c) The maps show the distributions of rabbits and prickly acacia in Australia.



Source: Bureau of Resource Science and CSIRO. From Williams K, Parer I, Coman B, Burley J, and Braysher M (1995) Managing Vertebrate Pests: Rabbit, Bureau of Resource Science and CSIRO Division of Wildlife Ecology, Australian Government Publishing Service, Canberra, p24.

(i) Describe the distributions shown in the maps. **2**

(ii) Explain the distribution of rabbits and prickly acacia in Australia. **4**

Question 31 continues on page 29

Question 31 (continued)

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

(d) Write a hypothesis and describe a method that could be used to conduct a valid and reliable investigation of the effect of an introduced species on one abiotic component of an environment. **6**

(e) Explain how major advances in scientific understanding and technology have been used to prevent the introduction of new species as well as to restrict the spread of those already introduced. Include examples in your answer. **6**

End of Question 31

Question 32 — Organic Geology – a Non-renewable Resource (25 marks)

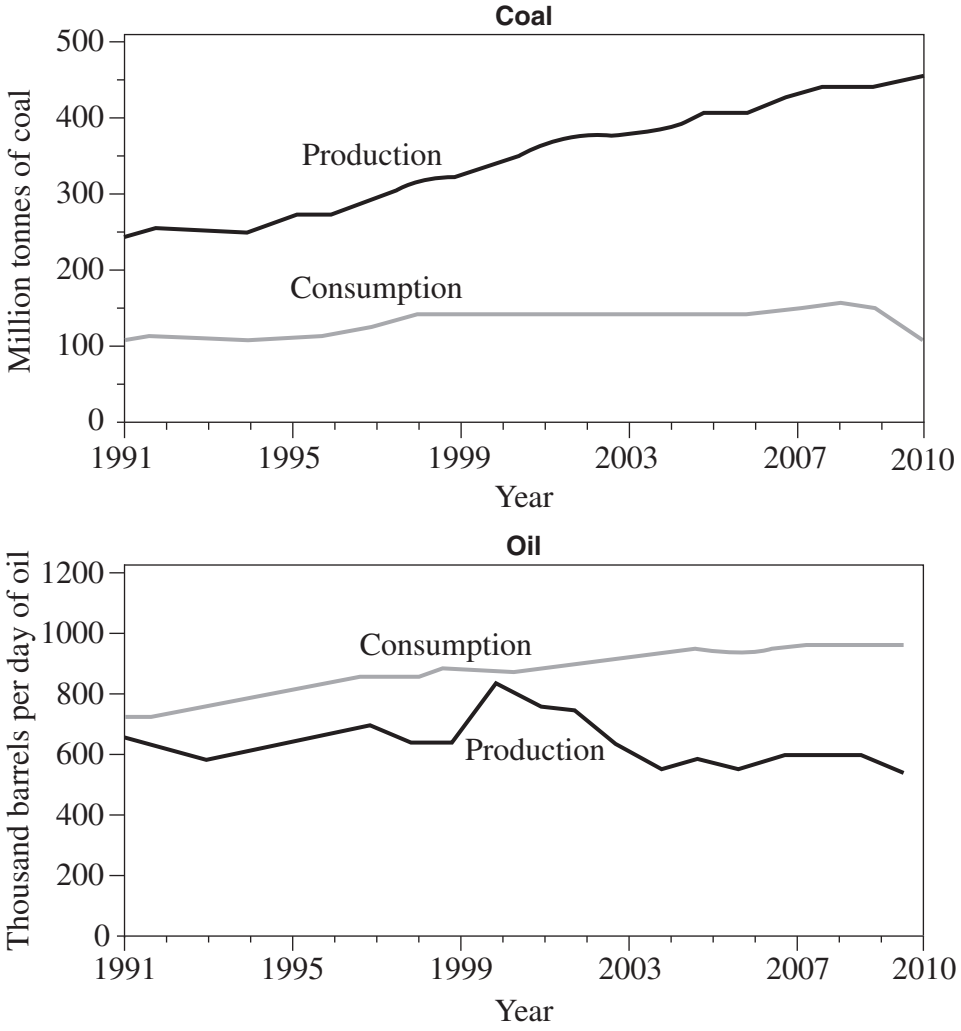
Answer parts (a)–(c) in Section II Answer Booklet 1.

(a) (i) Why are oil and natural gas regarded as non-renewable resources? **1**

(ii) Outline differences in the environments in which oil and natural gas are formed. **2**

(b) Compare the properties of structural petroleum traps and stratigraphic petroleum traps. **4**

(c) The graphs show the production and consumption of coal and oil in Australia from 1991–2010.



(i) Describe the trends in each graph. **2**

(ii) Explain the trends in each graph. **4**

Question 32 continues on page 31

Question 32 (continued)

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

(d) Write a hypothesis and describe a method that could be used to conduct a valid and reliable investigation of the energy efficiency of a non-fossil fuel resource. **6**

(e) Explain how major advances in scientific understanding and technology have been used to improve the effectiveness of fossil fuel exploration programs. Include examples in your answer. **6**

End of Question 32

Question 33 — Mining and the Australian Environment (25 marks)

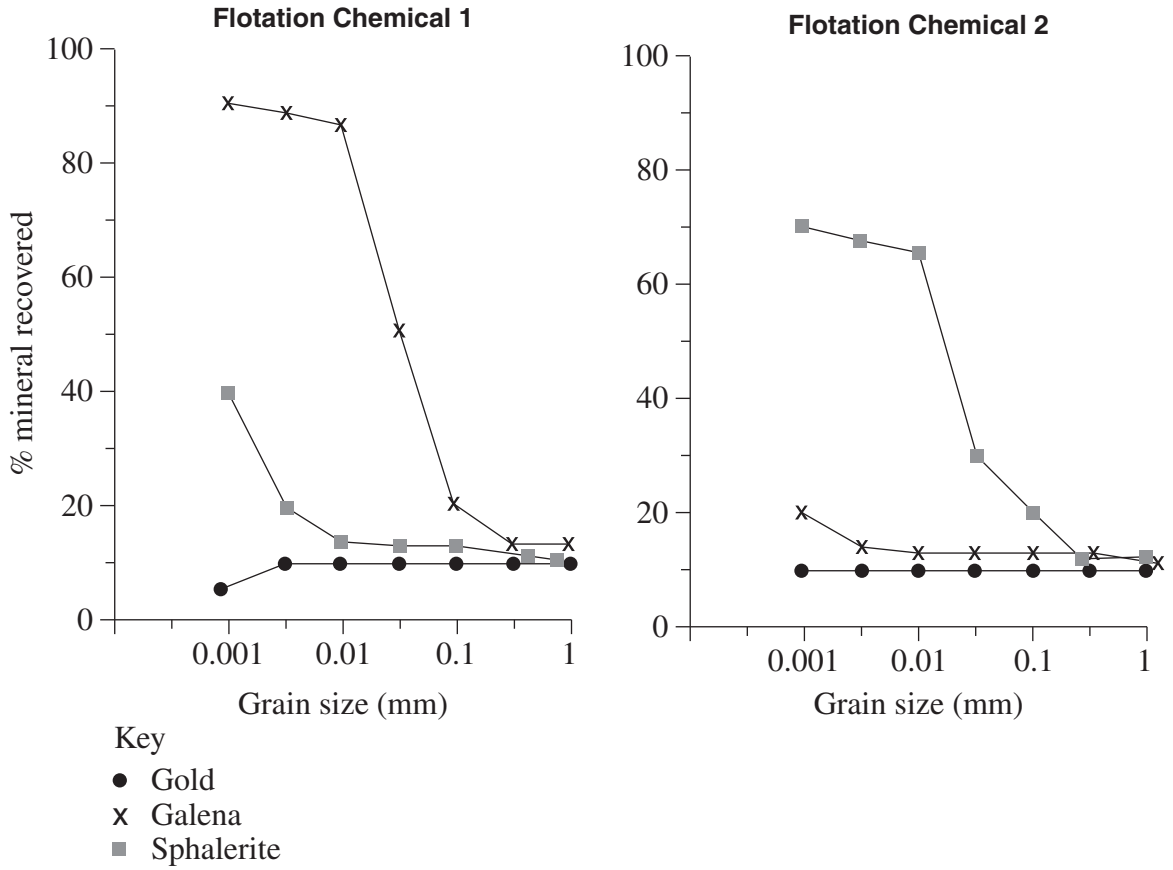
Answer parts (a)–(c) in Section II Answer Booklet 1.

(a) (i) What is an *ore*? **1**

(ii) Outline reasons why a mining company has to produce an Environmental Impact Statement before mining commences. **2**

(b) Give the main geological features of an Australian metal-producing locality in an island arc terrane. **4**

(c) The graphs show the recovery rates when a sulfide ore containing 3% galena, 10% sphalerite and 2 g/tonne gold is treated with two different flotation chemicals.



(i) Describe the trends for galena and sphalerite in both graphs. **2**

(ii) Describe a method that could be used to concentrate each of the three ore minerals in the sulfide ore. **4**

Question 33 continues on page 33

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

(d) Write a hypothesis and describe a method that could be used to conduct a valid and reliable investigation to test for ore minerals in a rock using a geophysical method. **6**

(e) Explain how major advances in scientific understanding and technology have been used to improve the effectiveness of mineral exploration programs. Include examples in your answer. **6**

End of Question 33

Question 34 — Oceanography (25 marks)

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

(a) (i) Define the term *ocean salinity*. **1**

(ii) Outline the origin of salinity in Earth's oceans. **2**

(b) Describe the evidence to support the theories that the ocean basins are younger than the continents and that the sea floor area has changed over time. **4**

Question 34 continues on page 35

(c) The diagram shows five main layers or zones in an ocean and the graphs show the changes in light intensity, salinity, temperature and oxygen concentration with increasing depth in that ocean.

Figure 1

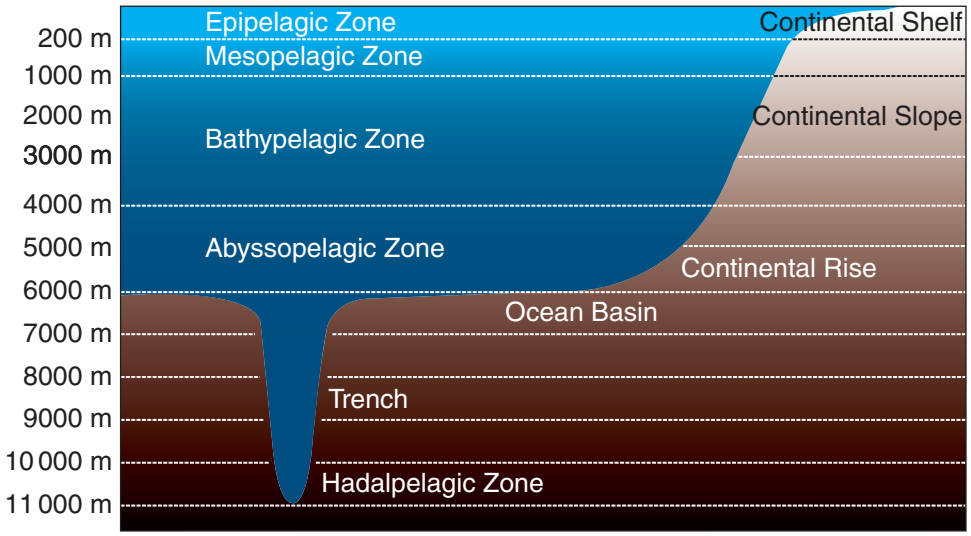


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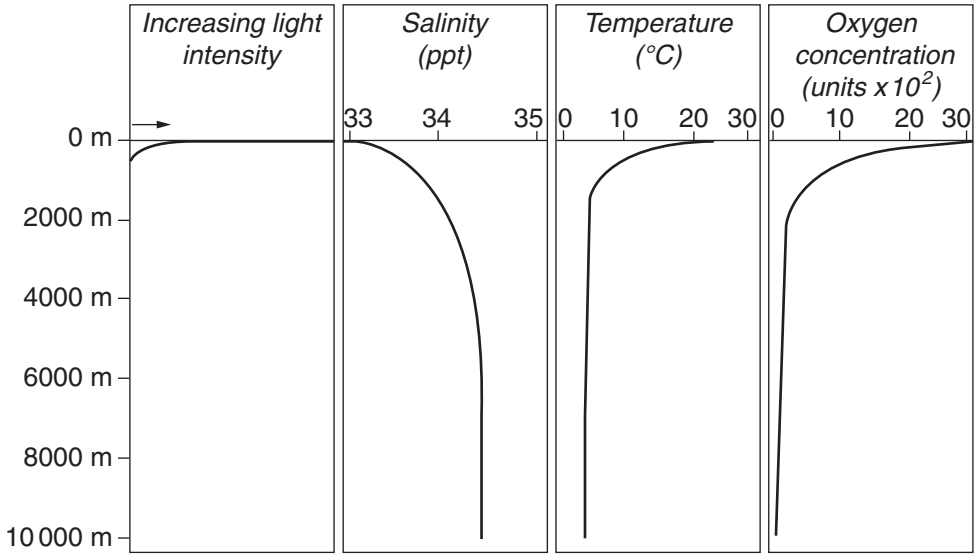
Figure 2



(i) Describe the trend in each of the graphs in Figure 2. **2**

(ii) Explain how depth determines the nature of communities that live in TWO of the zones in Figure 1. In your answer, refer to specific types of organisms found in each community. **4**

Question 34 continues on page 36

Question 34 (continued)

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

(d) Write a hypothesis and describe a method that could be used to conduct a valid and reliable investigation to test the effect of the surface area to volume ratio of solids on their cooling rate in water. **6**

(e) Explain how major advances in scientific understanding and technology have been used to increase our knowledge of the oceans. Include examples in your answer. **6**

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Geological Time Scale