BOARD OF STUDIES
NEW SOUTH WALES

2010

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 2–23

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 25–33

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 What is the most common rock type found in oceanic crust?

(A) Basalt

(B) Granite

(C) Mudstone

(D) Limestone

2 What is the major cause of earthquakes that occur on the Australian continent?

(A) Stress at convergent plate boundaries

(B) Continental volcanic activity

(C) Thermal uplift and rifting

(D) Intra-plate stress

3 Which of the following best describes the direction of the growth of the Australian continent over geological time?

(A) North to south

(B) South to north

(C) West to east

(D) East to west

4 Which of the following is true according to the convection current hypothesis of plate motion?

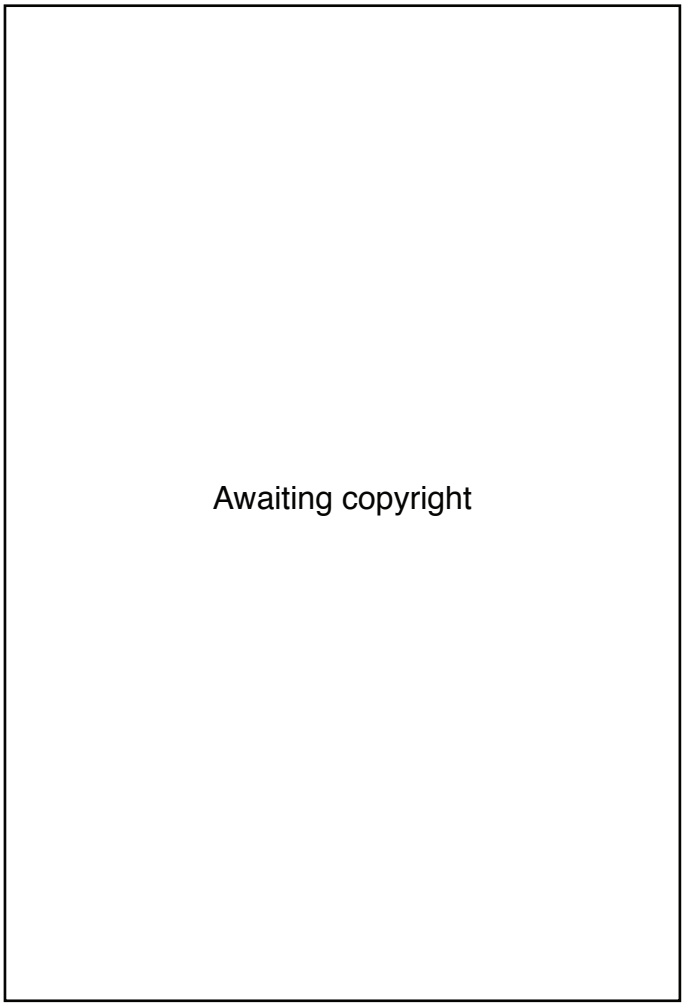
(A) Hot spots in the mantle cause lithospheric thickening.

(B) Down-welling in the mantle causes transform faults.

(C) Upwelling in the mantle pushes plates apart.

(D) Colder regions in the mantle attract plates.

5 The diagram shows the first stage of the plate tectonic supercycle.



What is the correct order for the remaining stages?

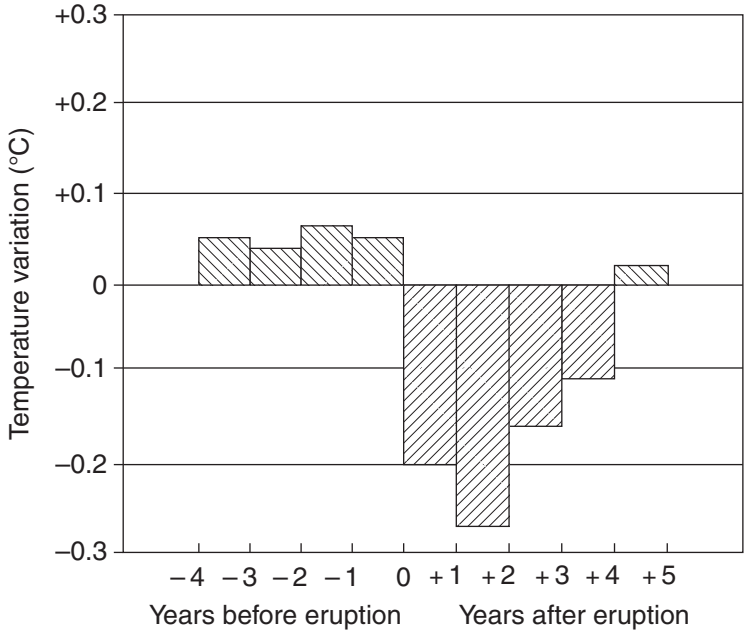
(A) 2, 3, 1, 4

(B) 2, 3, 4, 1

(C) 2, 1, 3, 4

(D) 2, 1, 4, 3

6 Scientists used temperature records to e xamine the ef fect of eight lar ge v olcanic eruptions during the past tw o centuries. The graph sho ws the a verage v ariation in temperature in the Northern Hemisphere before and after these eruptions.



Using the information in the graph, which of the follo wing hypotheses is correct?

(A) Volcanic eruptions influence global temperatures before and after an eruption.

(B) Volcanic eruptions cause a decrease in temperatures in the Northern Hemisphere after an eruption.

(C) Volcanic eruptions have no influence on temperatures in the Northern Hemisphere before or after an eruption.

(D) Volcanic eruptions cause an increase in global temperatures before an eruption and a decrease in temperatures after an eruption.

7 Which of the following is used to divide the major divisions of the Geological Time Scale after the Archaean?

(A) Major ice ages

(B) Megafauna extinctions

(C) Stratigraphic correlation

(D) Appearance and disappearance of significant fossils

8 Why was atmospheric ozone important for the evolution of early life?

(A) It led to a decrease in the oxygen concentration of the atmosphere.

(B) It led to an increase in the oxygen concentration of the atmosphere.

(C) It reduced the intensity of infrared radiation reaching Earth's surface.

(D) It reduced the intensity of ultraviolet radiation reaching Earth's surface.

9 Which of the following is the oldest life form?

(A) Algae

(B) Cyanobacteria

(C) Ediacaran metazoans

(D) Single-celled animals

10 Which of the following ratios is used to determine the existence of early life on Earth?

(A) Carbon-14 to carbon-12

(B) Carbon-13 to carbon-12

(C) Oxygen-18 to oxygen-16

(D) Carbon-14 to nitrogen-14

11 Which of the following was the critical evolutionary development that allowed animals to survive in terrestrial environments?

(A) An internal skeleton for support

(B) An efficient circulatory system

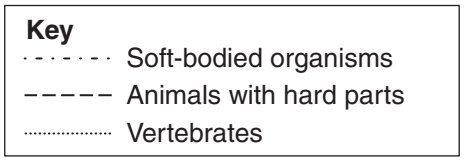
(C) An ability to minimise water loss

(D) An ability to regulate body temperature

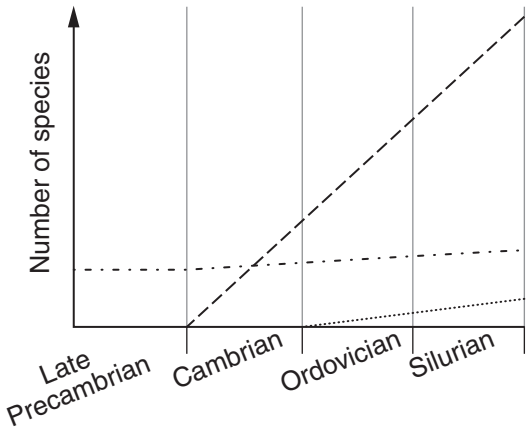
12 Which of the following potential causes best explain the extinction of the megafauna in Australia?

(A)	Volcanic eruptions	European settlement
(B)	European settlement	Climate change
(C)	Hunting by humans	Volcanic eruptions
(D)	Climate change	Hunting by humans

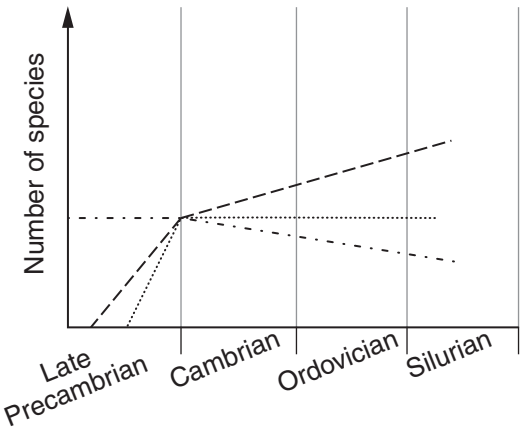
13 Which graph best sho ws the changes in the number of species before and after the Cambrian event?



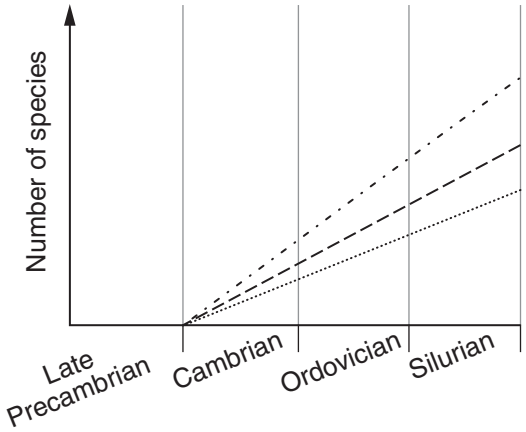
(A)



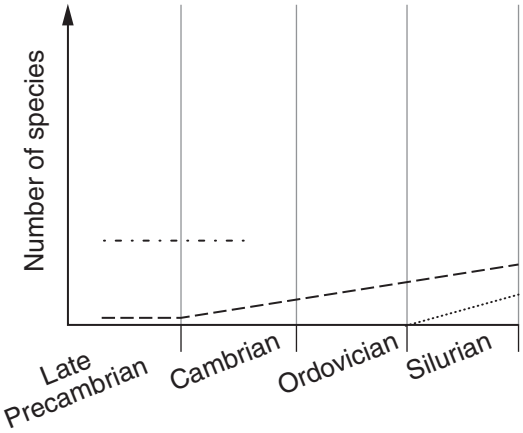
(B)



(C)



(D)



14 Four processes used in the treatment of se wage are:

I Removal of harmful micro-organisms
II Filtration/Screening
III Sedimentation
IV Bacterial digestion of organic matter

What is the correct sequence of these processes in the treatment of se wage?

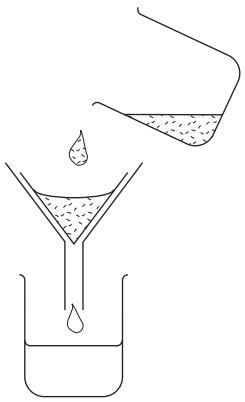
(A) II, I, III, IV

(B) II, III, IV, I

(C) III, IV, II, I

(D) III, II, IV, I

15 The diagram sho ws one step in an e xperiment to simulate the ef fectiveness of a w ater treatment process.



Which stage in a water treatment process was being simulated with this apparatus?

(A) Filtration

(B) Leaching

(C) Precipitation

(D) Sedimentation

16 In the last decade the water quality of the Murray River has been deteriorating.

What would be the most effective way of reversing this situation?

(A) Plant more trees

(B) Grant more irrigation licences

(C) Increase environmental flows in the Murray River

(D) Increase the number of artesian bores near the Murray River

17 Clearing vegetation for urbanisation can lead to increased exposure and compaction of soils, reduced infiltration of waters, and changed water flows.

What is the main consequence of these three changes?

(A) Decreased salinity

(B) Increased soil erosion

(C) Lowering of the water table

(D) Decreased sedimentation in rivers

18 Which of the following is likely to have caused an increase in stratospheric ozone?

(A) Using more nuclear power

(B) Developing more efficient engines

(C) Implementing the Kyoto Protocol

(D) Implementing the Montreal Protocol

19 The sequence summarises the first stages in the depletion of ozone in the stratosphere.

What is substance **X**?

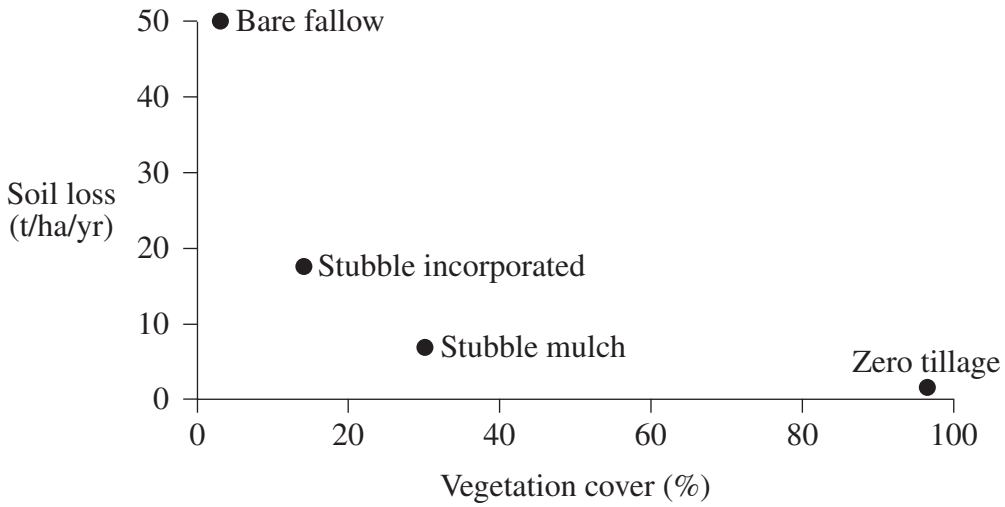
(A) CFCs

(B) Ozone

(C) Oxygen

(D) Carbon dioxide

20 The graph displays results for management strategies used in wheat paddocks in western NSW.



Management strategy	*Treatment*
Bare fallow	Burn wheat after harvesting
Stubble incorporated	Plough paddock after harvesting
Stubble mulch	Cut stubble to ground but leave it on the ground
Zero tillage	Leave stubble standing

Using the data given, which of the following treatments would lead to least soil erosion in a wheat paddock?

(A) Leave stubble standing

(B) Burn wheat after harvesting

(C) Plough paddock after harvesting

(D) Cut stubble to ground but leave it on the ground

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Earth and Environmental Science

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 pro vided. These spaces pro vide guidance for the e xpected length of response.

Question 21 (6 marks)

Mount Merapi is a large composite volcano in central Java, Indonesia. More than half a million people li ve in to wns and villages close to the v olcano. Agriculture is the main land use in the area.

(a) Name and describe TW O physical hazards that e xist for or ganisms li ving near volcanoes such as Mount Merapi. **2**

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(b) Name and explain how TWO features of volcanic regions such as Mount Merapi benefit agriculture. **4**

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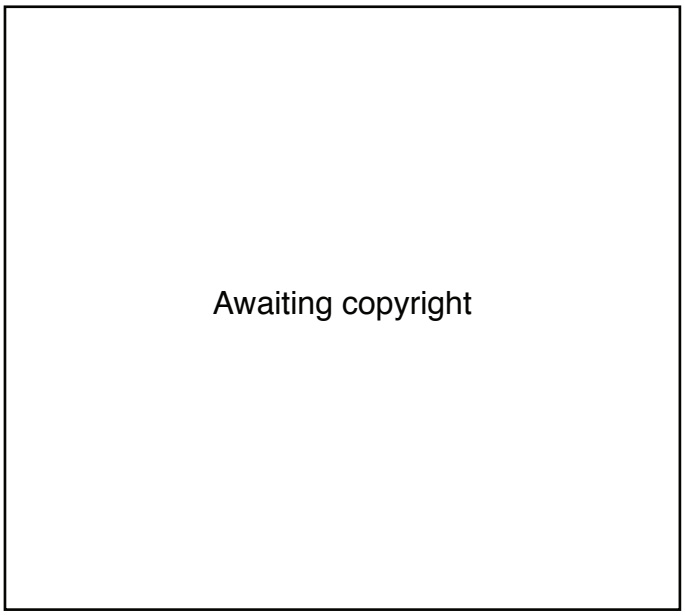
Question 22 (8 marks)

The diagram shows the location of major earthquakes and active volcanoes in the northern Pacific Ocean over the last 20 years.



(a) Identify the type of plate boundary at **Y** and describe the relative motion of the plates on each side of the boundary. **2**

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Question 22 continues on page 15

Question 22 (continued)

(b) Draw a labelled cross-section across the plate boundary from **A** to **B**. **3**

(c) Account for the lower number of volcanoes on the west coast of North America near **Y** compared to the western Pacific region. **3**

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End of Question 22

Question 23 (5 marks)

Examples of a trilobite species are found in rocks from the be ginning of the Ordovician Period to the end of the De vonian Period.

(a) Using the Geological T ime Scale on page 36, calculate ho w long this trilobite species lived on Earth. **1**

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(b) Contrast the use of relati ve and absolute dating techniques for determining the age of this trilobite species. **4**

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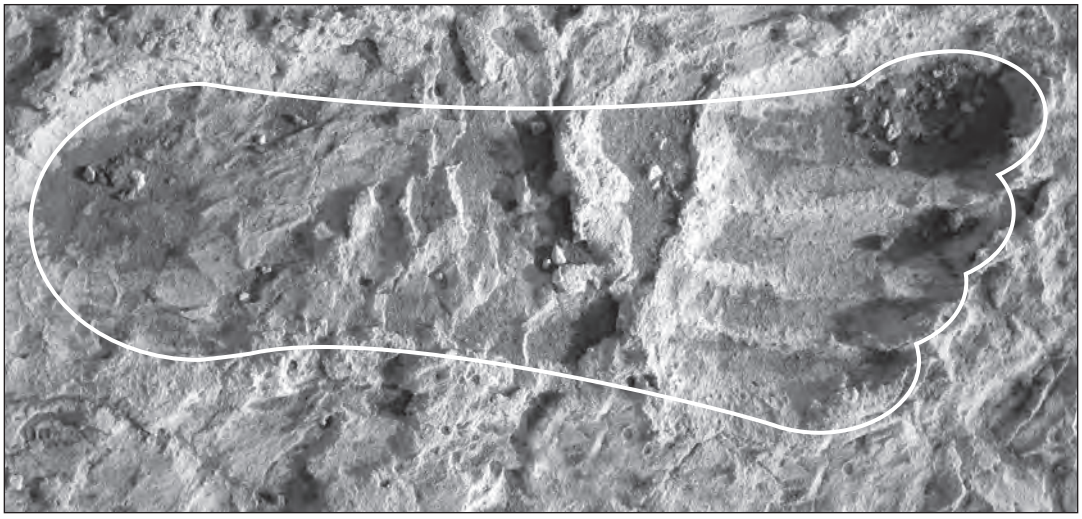
Question 24 (4 marks)

The picture shows a fossil human footprint at Lake Mungo, dated at 20 000 years old (20ka).



Showing at least THREE stages, draw a flowchart to describe how this fossil was formed. **4**

Question 25 (6 marks)

(a) Identify ONE impact of saline soils on the biotic en vironment. **1**

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(b) (i) Outline ONE rehabilitation strate gy that could be used to o vercome a salinity problem in a salt-affected area. **2**

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(ii) Explain the scientif ic basis for the use of the strate gy proposed in part (b) (i). **3**

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Question 26 (9 marks)

Mass extinctions occurred at the end of the Cretaceous and Permian periods.

(a) Identify TWO valid hypotheses for the causes of each mass extinction. **2**

	Hypothesis 1	*Hypothesis 2*
Cretaceous mass extinction		
Permian mass extinction		

(b) Assess the evidence for ONE of these four hypotheses. **4**

Extinction event: .....

Hypothesis: .....

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(c) How does the theory of evolution explain the development of new species after a mass extinction? **3**

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Question 27 (4 marks)

Design an investigation to determine the effect of either compaction or tracking on a soil. **4**

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Question 28 (3 marks)

Account for the low fertility of most Australian soils. **3**

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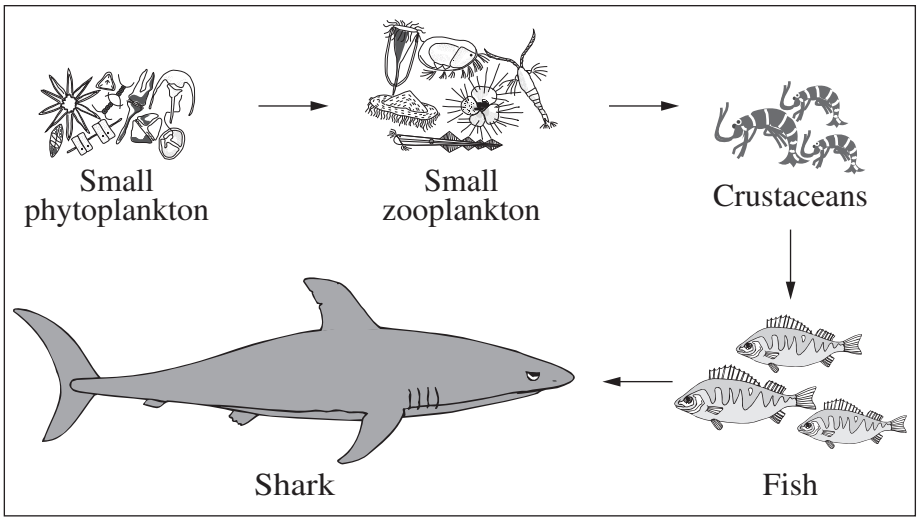
Question 29 (2 marks)

The diagram shows a food chain for a river estuary.



Describe the impact that pesticides may have on the river estuary food chain shown. **2**

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Question 30 (8 marks)

Earth's climate has varied since the Earth formed.

Analyse the influence of geological processes over time, and human activity since the Industrial Revolution, on climate. **8**

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

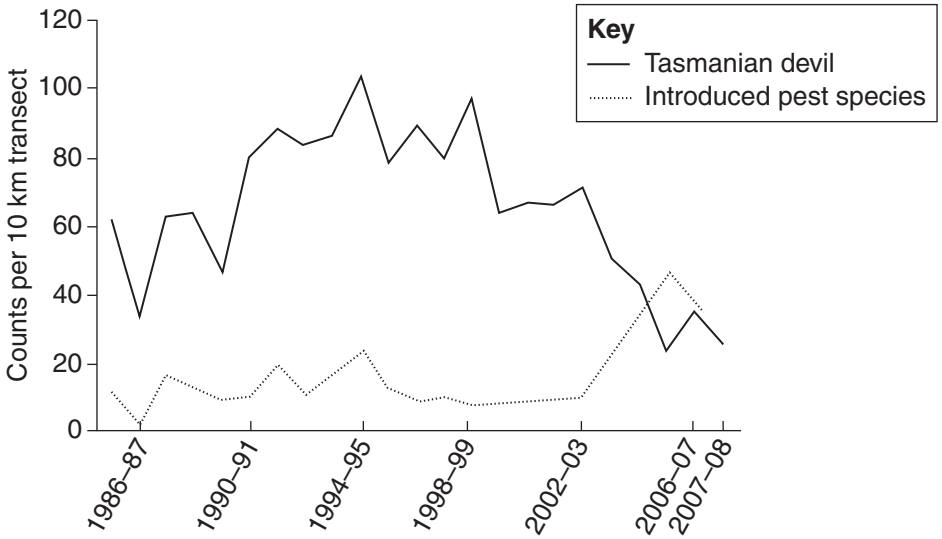
Pages

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

Answer parts (a)–(c) in a writing booklet.

(a) Describe TWO methods used by Australian quarantine agencies to prevent the introduction of a new species into Australia. **4**

(b) The graph shows the numbers of Tasmanian devils and an introduced animal pest in Tasmania.



Courtesy of Gregory J. Hocking, Department of Primary Industries, Parks, Water and Environment

(i) Describe the trends in the graph for the Tasmanian devil from 1999 to 2006. **1**

(ii) Why has the population of the introduced pest species increased in Tasmania? **3**

(c) A sensitive area of bush has been invaded by lantana and bitou bush. Only a small number of the native plants still survive. The area is to be rehabilitated. **4**

Compare the Bradley method of regeneration with ONE other method of bush regeneration suitable for this area.

Question 31 continues on page 27

Answer parts (d)–(f) in a SEPARATE writing booklet.

(d) The table presents data from an investigation of an environment where an introduced plant species grows.

Sample area	*Soil moisture (%)*	*Number of introduced plants (per 100 m^2)*
1	1.0	3
2	2.5	5
3	3.2	8
4	4.6	16
5	5.2	31

(i) Using the information in the table, give a valid hypothesis for the relationship between soil moisture and the number of introduced plants. **1**

(ii) Design an experiment you could carry out to test the hypothesis you gave in part (i). **4**

(e) Outline ONE successful method used to control the introduced species prickly pear. **2**

(f) Evaluate the impact of introduced species on Australian environments. Use examples in your answer. **6**

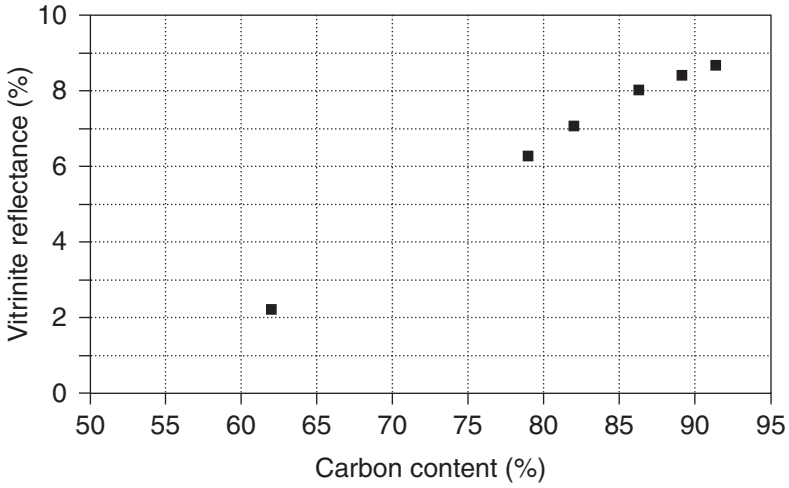
End of Question 31

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

Answer parts (a)–(c) in a writing booklet.

(a) Name ONE renewable and ONE non-renewable resource. Describe how each is used as an energy source. **4**

(b) The graph sho ws the relationships between vitrinite reflectance and carbon content of a coal.



(i) Describe the trend in the graph for vitrinite reflectance. **1**

(ii) What c hanges, a part from vitrinite reflectance, occur during coalification? **3**

(c) (i) Identify ONE geophysical method used to locate potential hydrocarbon deposits. **1**

(ii) How does petroleum accumulate? **3**

Question 32 continues on page 29

Question 32 (continued)

Answer parts (d)–(e) in a SEPARATE writing booklet.

(d) The table presents data for an investigation carried out to test the energy yield of various fuel types.

Fuel type	*Carbon content (%)*	*Energy output (MJ/kg)*
Wood	45	16
Black coal	68	26
LPG	82	48
Petroleum	85	49
Alcohol	88	50

(i) Using the information in the table, give a valid hypothesis for the relationship between carbon content and energy output. **1**

(ii) Design an experiment you could carry out to test the hypothesis you gave in part (i). **4**

(iii) Outline TWO ways of limiting emissions from the combustion of fossil fuels. **2**

(e) Evaluate the potential of other energy sources as alternatives to fossil fuels. Use examples in your answer. **6**

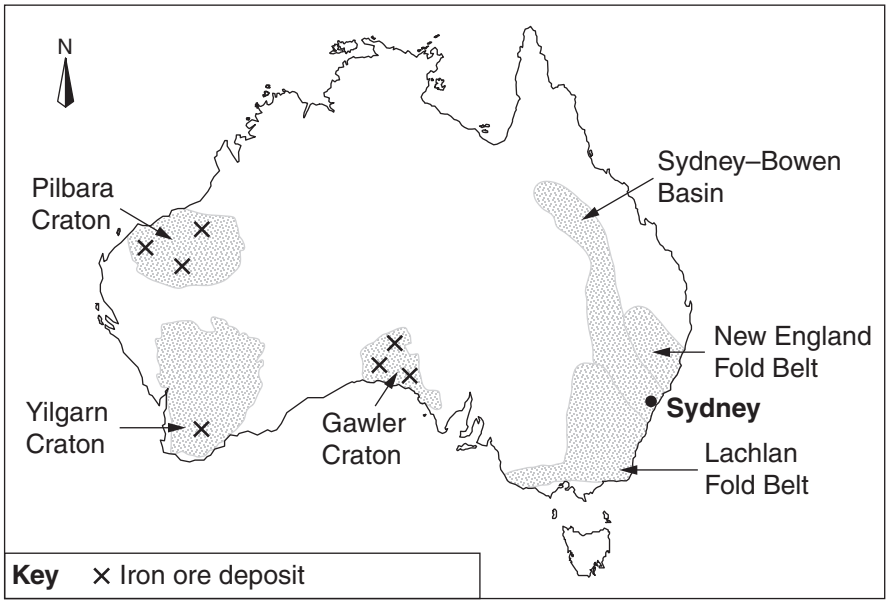
End of Question 32

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

Answer parts (a)–(c) in a writing booklet.

(a) Name and describe TWO geophysical methods for locating ore deposits. **4**

(b) The map shows the location of iron ore deposits and several mineral provinces in Australia.



(i) State the relationship between the location of the iron ore deposits and the age of the enclosing rocks. **1**

(ii) Outline ONE model for the genesis of iron ore. **3**

(c) (i) Define the terms *waste rock* and *ore*. **2**

(ii) Outline TWO ways in which gangue minerals may become economically viable. **2**

Question 33 continues on page 31

Question 33 (continued)

Answer parts (d)–(f) in a SEPARATE writing booklet.

(d) Samples of ore from a mine containing an iron mineral and silicates were tested with a magnetometer. Results of the tests are given in the table.

Ore sample	*Iron content (%)*	*Magnetic intensity (SI units)*
1	0.01	1
2	0.5	6
3	1	12
4	6	71
5	13	150

(i) Using the information in the table give a valid hypothesis for the relationship between iron content and magnetic intensity. **1**

(ii) Design an experiment you could carry out to test the hypothesis you gave in part (i). **4**

(e) Why is an Environmental Impact Statement carried out before mining a mineral deposit? **2**

(f) Evaluate the role of non-geological factors in determining the future expansion of the mining industry in Australia. Use examples in your answer. **6**

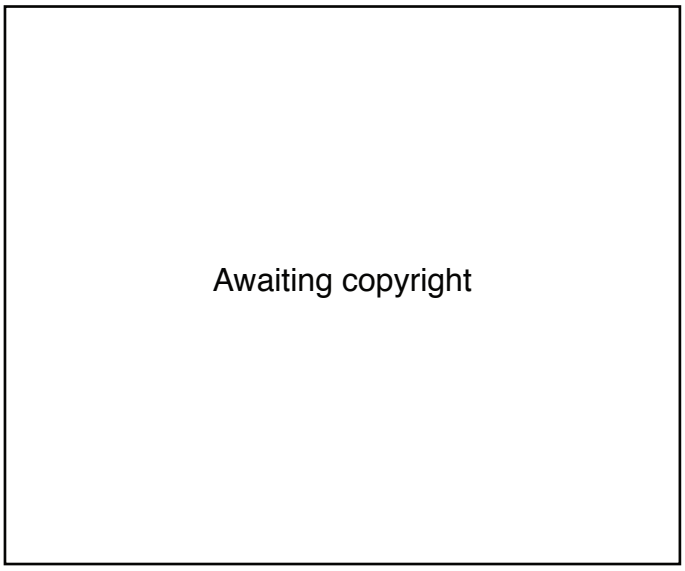
End of Question 33

Question 34 — Oceanography (25 marks)

Answer parts (a)–(c) in a writing booklet.

(a) Describe deep-sea and continental margin sediments in the Pacific Ocean. **4**

(b) The diagram shows major currents in the Pacific, Indian and Atlantic Oceans.



(i) Describe the main circulation pattern of water in the Pacific Ocean. **1**

(ii) Outline how the oxygen supply on the ocean floor is renewed. **3**

(c) (i) Explain why the margins of ocean basins are older than their centres. **2**

(ii) Outline how ONE technological development has improved our understanding of the age of the sea floor. **2**

Question 34 continues on page 33

Question 34 (continued)

Answer parts (d)–(e) in a SEPARATE writing booklet.

(d) The table presents data for a region in the Southern Ocean.

Sample	*Water temperature* (°C)	*Potassium chloride solubility* (g/L)
1	1.0	5
2	2.5	10
3	3.2	16
4	4.6	20
5	5.2	39

(i) Using the information in the table, give a valid hypothesis for the relationship between water temperature and potassium chloride solubility. **1**

(ii) Design an investigation you could carry out to test the hypothesis you gave in part (i). **4**

(iii) Apart from temperature, outline how TWO other factors affect salinity in oceans. **2**

(e) Evaluate the impact of laws to regulate society's use of the oceans. Use examples in your answer. **6**

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Geological Time Scale