

BOARD OF STUDIES  
NEW SOUTH WALES

**2006**

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, 21, and 25

**Total marks – 100**

**Section I** Pages 2–27

**75 marks**

This section has two parts, Part A and Part B

Part A – 15 marks

- Attempt Questions 1–15
- Allow about 30 minutes for this part

Part B – 60 marks

- Attempt Questions 16–26
- Allow about 1 hour and 45 minutes for this part

**Section II** Pages 29–37

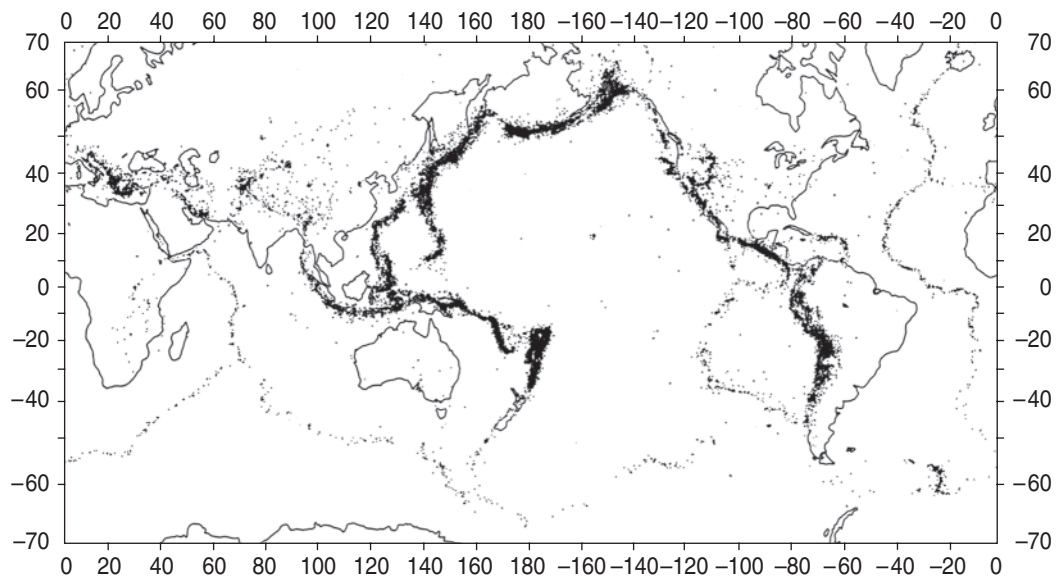
**25 marks**

- Attempt ONE question from Questions 27–30
- Allow about 45 minutes for this section



- 1** What are some of the main hazards associated with volcanoes?
- (A) Lahars, lava flows, thermal uplift
  - (B) Lahars, lava flows, poisonous gases
  - (C) Ash flows, fault movements, thermal uplift
  - (D) Ash flows, fault movements, poisonous gases
- 2** Which of the following explains why a change of climate occurs in the months following a major explosive volcanic eruption?
- (A) An increase in rainfall due to the loss of vegetation cover
  - (B) An increase in average temperature due to the heat released by the erupting volcano
  - (C) A decrease in average temperature due to the increase in fine particles reflecting solar radiation
  - (D) A decrease in average temperature due to increased carbon dioxide absorbing heat from the atmosphere
- 3** Which of the following best describes how continents can move large distances relative to each other over geological time?
- (A) Continental crust moves through oceanic crust due to mantle currents.
  - (B) Continental crust moves over the top of oceanic crust due to difference in densities.
  - (C) Lithospheric plates carrying continental crust collide at convergent margins causing mountain building.
  - (D) Lithospheric plates carrying continental crust move due to the creation and destruction of oceanic crust.

- 4 The map shows the distribution of epicentres of large-magnitude earthquakes.

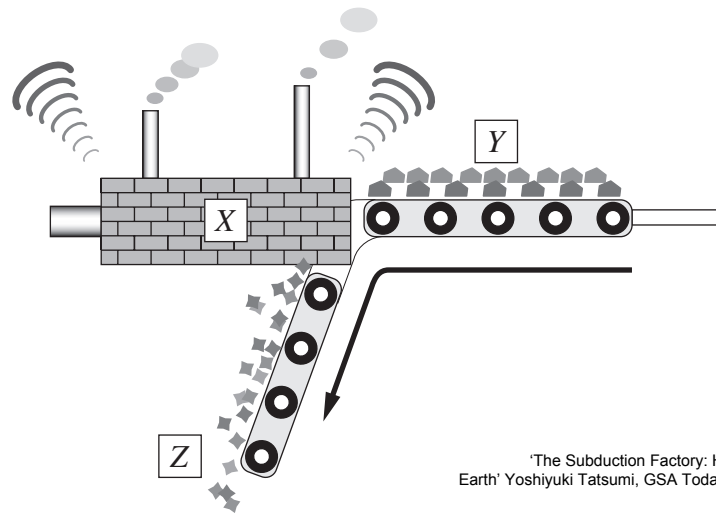


Barazangi & Dorman, 'World Seismicity Maps',  
Bulletin of the Seismological Society of America, 59, 369 (1969)

What does this distribution allow geologists to map?

- (A) The edge of the continental crust
- (B) The boundaries between lithospheric plates
- (C) The location of convergent plate margins only
- (D) The distribution of seismographs around the world

- 5 The diagram shows a model of a plate boundary represented as a ‘factory’.



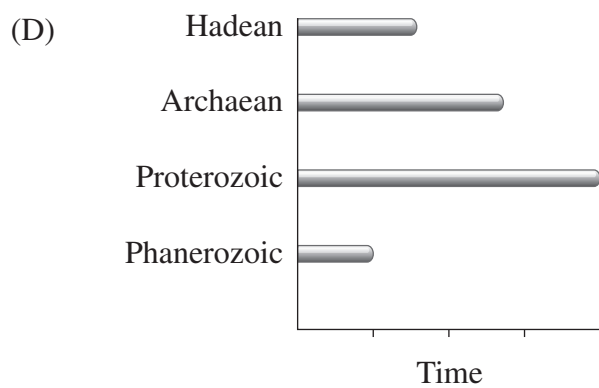
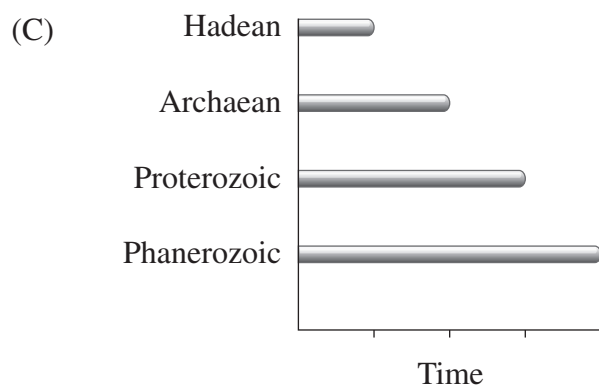
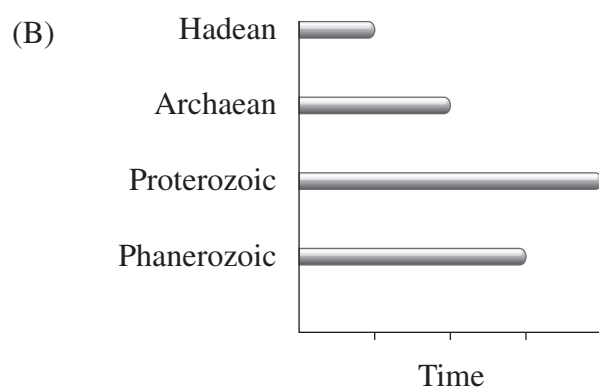
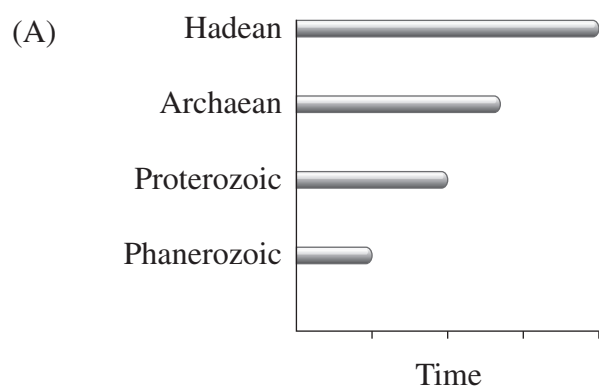
'The Subduction Factory: How it operates in the Evolving Earth' Yoshiyuki Tatsumi, GSA Today, V 15 no 7, July 2005 Page 4

Which of the following best identifies the aspects of the plate boundary depicted in the diagram?

Type of boundary	X	Y	Z
(A) Convergent	Continental lithosphere	Oceanic lithosphere	Mantle
(B) Divergent	Oceanic lithosphere	Crust	Core
(C) Conservative	Continental lithosphere	Oceanic lithosphere	Crust
(D) Convergent	Oceanic lithosphere	Continental lithosphere	Mantle

- 6 What does the principle of *natural selection* in the theory of evolution assume?
- (A) Organisms will adapt to their environment during the course of their lifespan.
  - (B) Complex organisms are more likely to survive changing environments than simple organisms.
  - (C) Organisms with adaptations best-suited to a changing environment will survive and reproduce.
  - (D) Organisms will compete with each other for space in an ecosystem until just one species remains.

7 Which graph best represents the relative length of the four eons?

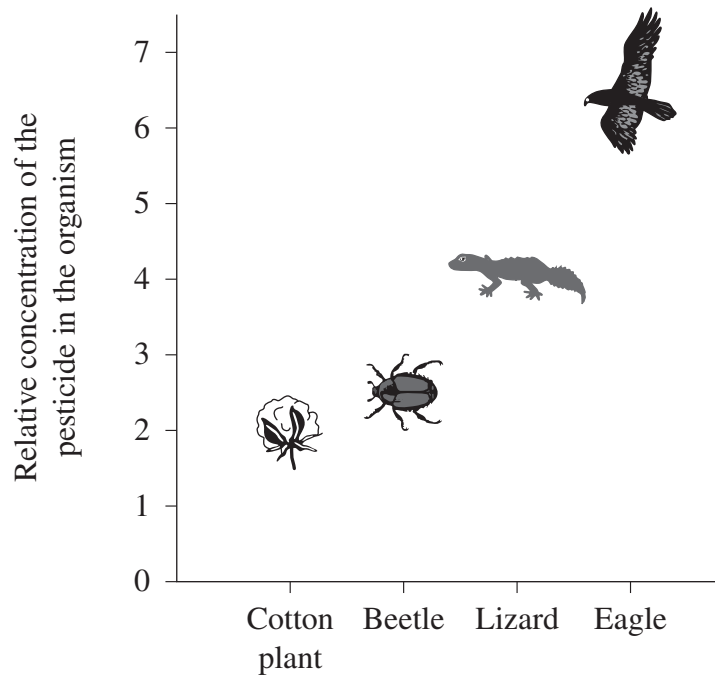


- 8** In producing a stratigraphic sequence for a large region, a geologist used both absolute (radiometric) and relative (fossil) age dating methods.

Why would both methods be used?

- (A) Most fossils span geological timeframes of less than 1000 years.
  - (B) Radiometric age dates can only be obtained from some rock types.
  - (C) Fossil occurrences are required to calibrate the radiometric age dating.
  - (D) Radiometric age dates are required to determine the relative age range of fossils.
- 9** Which isotopic ratio provides evidence of the existence of life in rocks as old as  $3.8 \times 10^9$  years?
- (A) carbon 13 : carbon 12
  - (B) carbon 14 : carbon 12
  - (C) potassium 40 : argon 40
  - (D) uranium 235 : lead 207
- 10** Which statement best describes how populations of organisms change immediately following a mass extinction?
- (A) The number of new species rapidly increases because of changed environmental conditions.
  - (B) The number of individuals in each species decreases but the number of species remains the same.
  - (C) The number of individuals in each surviving species decreases and becomes less widespread.
  - (D) The number of species continues to decline because conditions leading to mass extinctions last a long time.

- 11 The graph illustrates an effect of a pesticide on some organisms, following spraying of a cotton crop over a period of time.

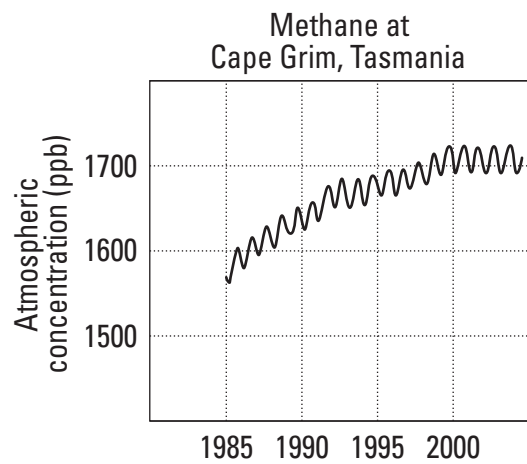
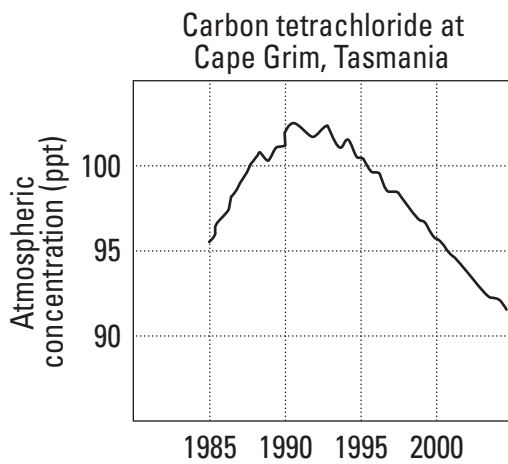
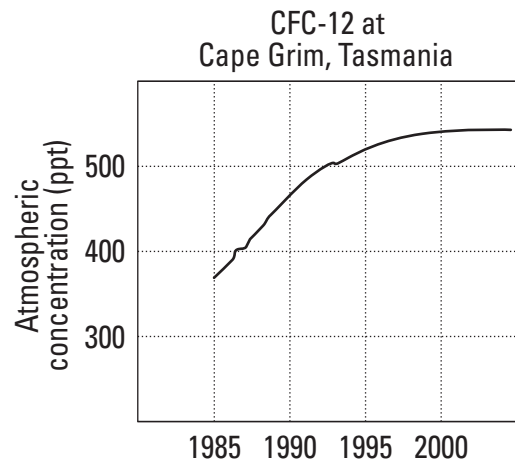
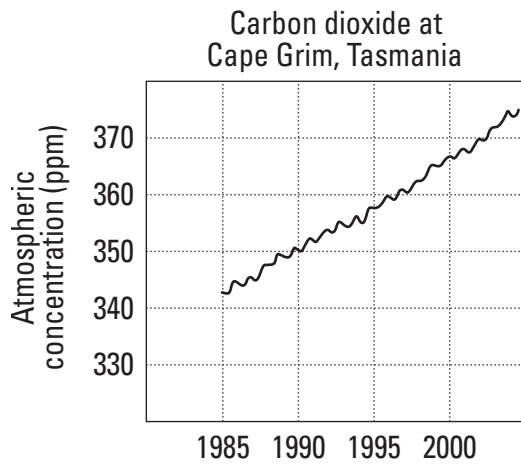


Which process identifies this effect?

- (A) Bioaccumulation
  - (B) Bioconsumption
  - (C) Biodegradation
  - (D) Biomagnification
- 12 Acid rain is mainly produced by the interaction of atmospheric moisture with which of the following?
- (A) Chlorofluorocarbons
  - (B) Nitrous oxides
  - (C) Ozone
  - (D) Sulfur dioxide



- 13 The graphs show variation in atmospheric concentration of some gases over the last 25 years.



Which of the following explains the changes in the concentrations of these gases since the early 1990s?

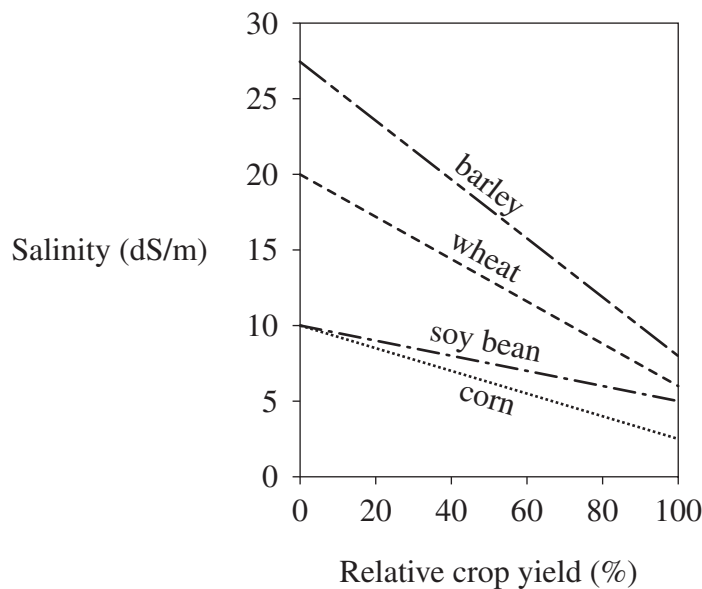
- (A) The introduction of the Kyoto Agreement
- (B) The introduction of the Montreal Protocol
- (C) The introduction of alternatives to pesticides
- (D) The introduction of catalytic converters in motor cars

- 14 Despite drought conditions, the Sydney Catchment Authority releases millions of litres of water per day from Warragamba Dam into the Nepean River.

What is the main environmental purpose for this release?

- (A) To maintain natural processes in surface waters
- (B) To reduce the level of salinity of the dam water
- (C) To maintain the amount of sedimentation in the river
- (D) To reduce the possibility of erosion of the river banks

- 15 The graph shows the relationship between soil salinity and yield for four different crops in a region of NSW.



What conclusion can be drawn from the information presented in the graph?

- (A) Crop yields are not affected by relative salinity levels below 10%.
- (B) Salinity levels of 20 dS/m produce a 0% relative yield in all four crops.
- (C) All four crops require a certain level of salinity to produce a 100% relative yield.
- (D) Soy beans can produce a greater relative percentage yield than barley at high salinity levels.

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Centre Number

Section I (continued)

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Student Number

Part B – 60 marks

Attempt Questions 16–26

Allow about 1 hour and 45 minutes for this part

Answer the questions in the spaces provided.

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Marks

Question 16 (4 marks)

The graph shows the changes in global mean sea level (GMSL) for the years 1890–2000, and the timing of major volcanic eruptions during this period. Changes in water temperature can cause short-term changes in GMSL.



- (a) Identify the overall trend shown for the GMSL data between 1890 and 2000. **1**

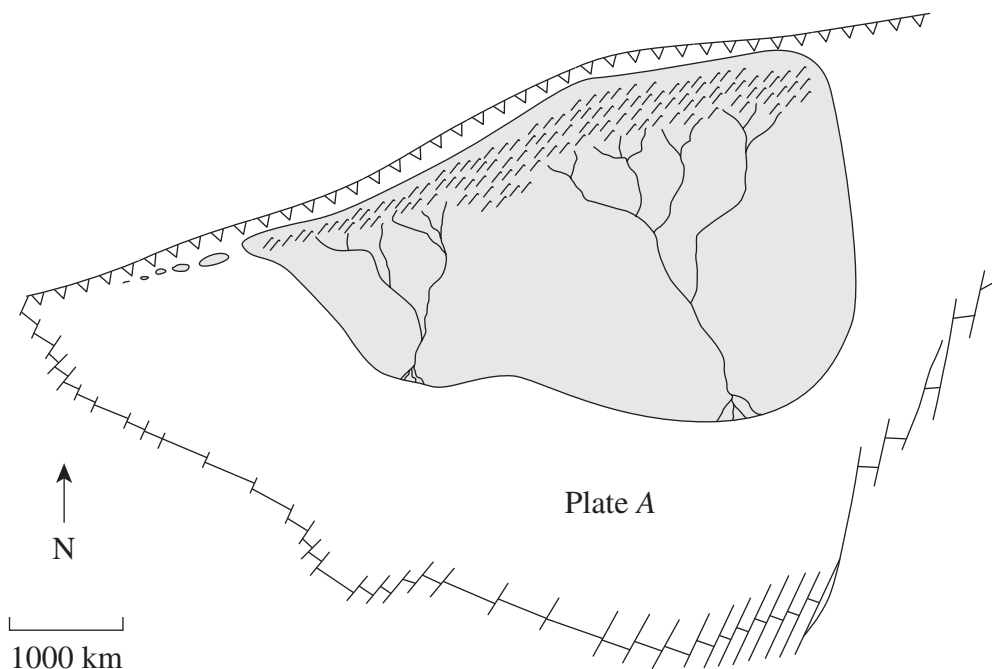
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- (b) Explain the impact of major volcanic eruptions on global climate using information from the graph to support your answer. **3**

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**Question 17** (5 marks)

The diagram shows the outline of a lithospheric plate (Plate A) containing a single continent.



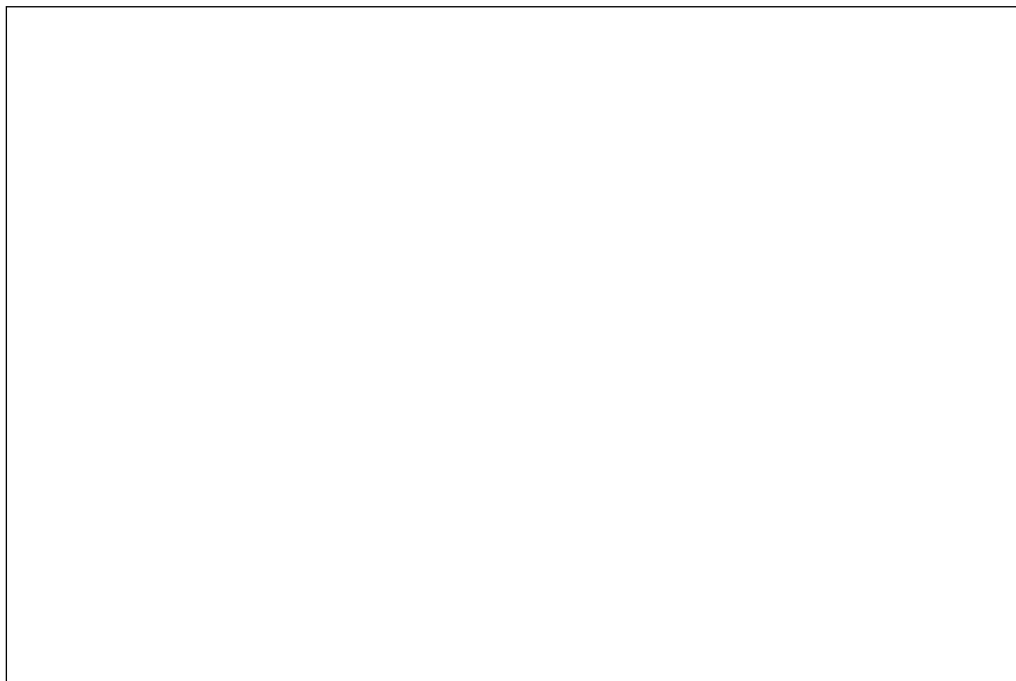
Key			
	Ocean trench		Direction of plate motion
	Ocean ridge		Very young oceanic crust
	Mountains		Volcanoes erupting andesite lava
	Rivers		
	Continental crust		

- (a) Using the symbols provided in the key, clearly show on the diagram: 3
- (i) the direction of relative movement of Plate A;
  - (ii) a location where volcanoes would typically erupt andesite lava; and
  - (iii) a location where there is very young oceanic crust.

**Question 17 continues on page 15**

Question 17 (continued)

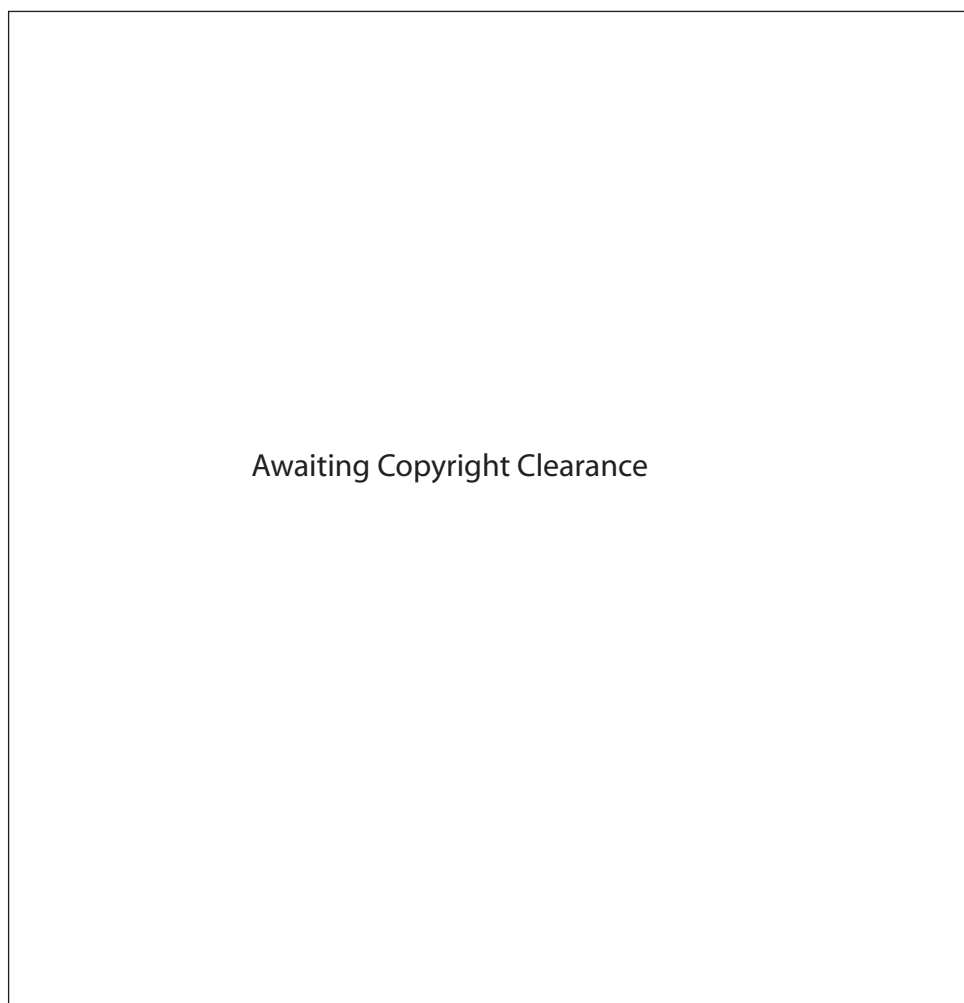
- (b) Draw and label a diagram of a fault or fold that you would expect to find in the northern part of Plate A. **2**



**End of Question 17**

**Question 18** (7 marks)

The diagram shows the position of the continents in the Permian and the present.



- (a) Describe TWO tectonic processes that have occurred during rearrangement of the continents from the Permian to the present. **4**

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**Question 18 continues on page 17**



Question 18 (continued)

- (b) Use your knowledge of the plate tectonic super-cycle to predict a possible arrangement of the continents 100 million years in the future. Justify your predictions. **3**

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**End of Question 18**

**Question 19** (6 marks)

In your study of Earth and Environmental Science you presented a case study of a natural disaster associated with tectonic activity.

**6**

Analyse the relationship between the tectonic event that caused the natural disaster and the impacts on the environment. In your answer, you should name the tectonic event.

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Centre Number

Section I – Part B (continued)

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Student Number

**Marks**

**Question 20** (7 marks)

- (a) Outline the main evolutionary changes that would be required for animals to survive in terrestrial environments. **3**

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- (b) (i) The abundance and distribution of modern stromatolites is more limited than that of ancient stromatolites. **1**

Identify ONE piece of evidence that provides support for this statement.

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- (ii) Explain the change in distribution and abundance of stromatolites. **3**

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**Question 21** (5 marks)

- (a) Outline TWO hypotheses used to explain the extinction of the Australian megafauna. **2**

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- (b) Assess ONE hypothesis used to explain the mass extinction at the end of the Permian. **3**

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**Question 22** (6 marks)

- (a) Describe the diversity and number of organisms from a named fossil locality that you have researched. **3**

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- (b) Complete the following table by placing a ✕ in the era of the Phanerozoic in which each of the life forms first appeared. **3**

<i>Eon</i>	<i>Era</i>	<i>Life Form</i>					
		Land Plants	Vertebrates	Flowering Plants	<i>Homo sapiens</i>	Dinosaurs	Amphibians
<i>Phanerozoic</i>							
	Cenozoic						
	Mesozoic						
	Palaeozoic						

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Section I – Part B (continued)

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**Marks**

**Question 23** (3 marks)

Discuss an alternative management practice to the use of pesticides.

**3**

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**Question 24** (4 marks)

Assess a management strategy or a technology used to treat stormwater in order to maintain natural processes in surface water.

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**Earth and Environmental Science**

**Section II**

**25 marks**

**Attempt ONE question from Questions 27–30**

**Allow about 45 minutes for this section**

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

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	Pages
Question 27    Introduced Species and the Australian Environment .....	30–31
Question 28    Organic Geology – a Non-renewable Resource .....	32–33
Question 29    Mining and the Australian Environment .....	34–35
Question 30    Oceanography .....	36–37

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

- (a) In this option you have gathered and analysed material from secondary sources to summarise the quarantine methods used in Australia to control the introduction of new species.
- (i) Outline the process by which you gathered relevant information, identifying sources that you used. **2**
- (ii) Describe how you were able to assess the reliability of the information from these sources. **3**
- (b) (i) Construct a flow-diagram to outline how the Bradley method of bush regeneration might be used to restore a site. **3**
- (ii) On a field trip to a local ecosystem, a group of students collected the following data in an area of 1 km<sup>2</sup>.
- Gully 18°C, 150 lantana bushes in gully, 10 lantanas on slope. Slope 28°C, humidity in gully 70%, 50 wattle trees on slope, humidity on slope 10%, 5 gum trees in gully, soil moisture content 30 g/kg in gully, 30 gum trees on slope, soil moisture content on slope 1 g/kg, light intensity in gully 50 lux, native grass 50 clumps on slope, 5 bitou bushes on slope, 25 bitou bushes in gully.
- (1) Identify the abiotic factors in the data. **1**
- (2) Using the data, explain the distribution of introduced species in this ecosystem. **2**

**Question 27 continues on page 31**

Question 27 (continued)

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|-----|---|----------|
| (c) | Justify methods, other than quarantine, for controlling the spread of introduced animal species in Australia. | <b>7</b> |
| (d) | (i) Identify TWO quarantine methods used in Australia to prevent the introduction of new species.             | <b>1</b> |
|     | (ii) Explain how ONE of these quarantine methods operates.  | <b>2</b> |
|     | (iii) Assess the methods identified in part (i) on the prevention of introduction of exotic species.          | <b>4</b> |

**End of Question 27**

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

- (a) In this option you have gathered and analysed material from secondary sources to outline the methods and technologies used to locate fossil fuel reserves.
- (i) Outline the process by which you gathered relevant information, identifying sources that you used. **2**
- (ii) Describe how you were able to assess the reliability of the information from these sources. **3**
- (b) (i) Construct a flow-diagram to outline the refining of petroleum, including distillation and catalytic cracking. **3**
- (ii) The table shows the prices of oil and coal, and the amounts used for electricity generation in an industrial country between 1970 and 2005.

Year	Price of crude oil (\$/barrel)	Price of coal (\$/tonne)	Relative consumption of fossil fuel for electricity generation	
			Oil	Coal
1970	3	5	2.1	7
1975	10	11	3.9	8
1980	25	24	4.2	11
1985	28	33	2.5	14
1990	17	27	2.8	16
1995	17	26	2.7	18
2000	25	24	0.9	21
2005	65	22	0.4	30

- (1) What is meant by the term *fossil fuel*? **1**
- (2) Using data from the table, explain the trends in the use of oil versus coal in electricity generation. **2**

**Question 28 continues on page 33**



	<b>Marks</b>
Question 28 (continued)	
(c) Evaluate the continued use of fossil fuels in Australia.	<b>7</b>
(d) (i) Identify the difference between diagenesis and catagenesis in the maturation of petroleum.	<b>1</b>
(ii) Explain how petroleum accumulates.	<b>2</b>
(iii) Assess methods for conserving energy.	<b>4</b>

**End of Question 28**

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

- (a) In this option you have gathered and analysed material from secondary sources to identify the geological setting and main features of a mineral province.
- (i) Outline the process by which you gathered relevant information, identifying sources that you used. **2**
- (ii) Describe how you were able to assess the reliability of the information from these sources. **3**
- (b) (i) Construct a flow-diagram to outline the methods used in the extraction and concentration of ore from a NAMED mineral deposit. **3**
- (ii) The table shows some data for the BNF Gold Mine over 2004–2005.

**BNF Gold Mine Production**

<i>Quarter ending</i>	<i>Ore mined (t)</i>	<i>Average grade (g/t)</i>	<i>Gold recovery (%)</i>	<i>Total gold production (kg)</i>
September 2004	55 549	19.4	98.0	1086
December 2004	65 207	18.2	93.6	1106
March 2005	64 325	14.9	95.1	905
June 2005	55 604	15.6	96.6	833
September 2005	59 587	13.7	91.0	743

- (1) State what is meant by the term *grade*. **1**
- (2) Using data from the table, explain the variation in total gold production over the time shown. **2**

**Question 29 continues on page 35**

Question 29 (continued)

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|-----|--|----------|
| (c) | Evaluate the continuation of mining ore deposits in Australia. In your answer you should refer to both the environmental and economic impacts. | <b>7</b> |
| (d) | (i) Identify the difference between ore minerals and gangue minerals in an ore deposit.  | <b>1</b> |
|     | (ii) Explain how changes in technology could affect the economic value of a mineral deposit.   | <b>2</b> |
|     | (iii) Assess the impact of infrastructure on determining the feasibility of mining of a NAMED ore deposit.                                     | <b>4</b> |

**End of Question 29**

**Question 30 — Oceanography (25 marks)**

- (a) In this option you have gathered and analysed material from secondary sources to map and describe the range of temperatures and salinity levels in vertical and horizontal zones of the Pacific Ocean.
- (i) Outline the process by which you gathered relevant information, identifying sources that you used. **2**
- (ii) Describe how you were able to assess the reliability of the information from these sources. **3**
- (b) (i) Construct a flow-diagram to illustrate the movement of water, carbon and oxygen between the oceans and the atmosphere. **3**
- (ii) The table shows the concentration of O<sub>2</sub> and CO<sub>2</sub>, temperature, and range in wavelength of light, at different depths in the ocean.

<i>Depth</i> (m)	<i>Dissolved Carbon dioxide</i> (mL/L)	<i>Dissolved Oxygen</i> (mL/L)	<i>Temperature</i> (°C)	<i>Wavelength of Light</i> (nm)
0	4.2	46.0	17.0	400–680
200	1.0	49.0	17.0	420–600
400	0.5	50.0	10.0	450–550
600	0.7	50.5	7.0	–
800	0.7	51.1	5.0	–
1000	2.1	51.6	4.0	–
1200	2.4	51.8	4.0	–

- (1) What is meant by the phrase *attenuation of light*? **1**
- (2) Using data from the table, explain why different communities of organisms live at different depths in the ocean. **2**

**Question 30 continues on page 37**

Question 30 (continued)

- |     |  |          |
|-----|--|----------|
| (c) | Evaluate why the abiotic characteristics of hydrothermal vents have resulted in unique biotic communities. | <b>7</b> |
| (d) | (i) Identify TWO types of sediment found in deep ocean environments far away from continental margins.     | <b>1</b> |
|     | (ii) Explain how long-lived synthetic chemicals can be transported great distances in the sea.             | <b>2</b> |
|     | (iii) Assess whether international laws about the oceans are necessary.                                    | <b>4</b> |

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## Geological Time Scale

