BOARD OF STUDIES
NEW SOUTH WALES

2007

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 9, 13, 17 and 33

Total marks – 100

(**Section I**) Pages 2–19

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 16–27
- Allow about 1 hour and 45 minutes for this part

(**Section II**) Pages 21–29

25 marks
- Attempt ONE question from Questions 28–31
- Allow about 45 minutes for this section

Section I
75 marks

Part A – 15 marks
Attempt Questions 1–15
Allow about 30 minutes for this part

Use the multiple-choice answer sheet for Questions 1–15.

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1 If a large volcano erupted in the south-east Asian region, which of the following would have the greatest effect on the global climate?

  (A) Lahars

  (B) Fine ash

  (C) Lava flows

  (D) Shock waves

2 What is an essential requirement for ozone formation?

  (A) Oxygen molecules split before ozone can form.

  (B) Three oxygen molecules react to form one ozone molecule.

  (C) Two oxygen molecules directly react to form one ozone molecule.

  (D) Carbon dioxide molecules break down to form ozone in the stratosphere.

3 Which of the following illustrates the correct order of appearance of life forms throughout the Phanerozoic eon?
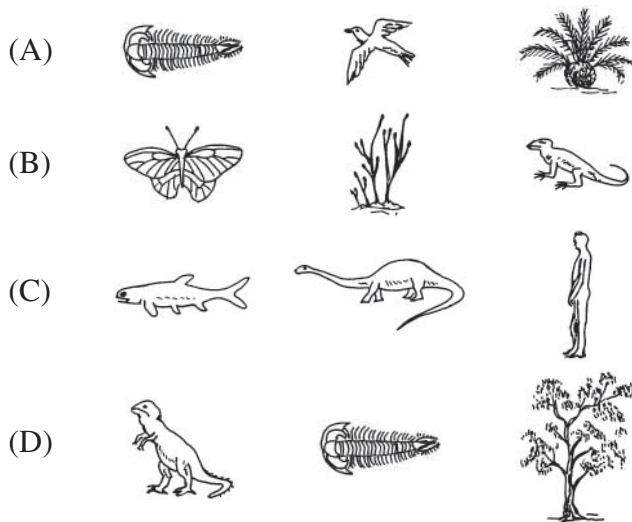
  (A)

  (B)

  (C)   DIAGRAMS NOT TO SCALE

  (D)

– 2 –

4 Earthquakes produce three types of seismic waves with *P* waves travelling fastest.

Which seismogram shows an earthquake with an epicentre closest to the seismic station?

Time

(A)

Surface

P *S*

(B)

Surface

P *S*

(C)

Surface

P *S*

(D)

Surface

S *P*

Physical Geology - Earth Revealed, David
McGeary, Charles C. Plummer
(c) The McGraw-Hill Companies, Inc.
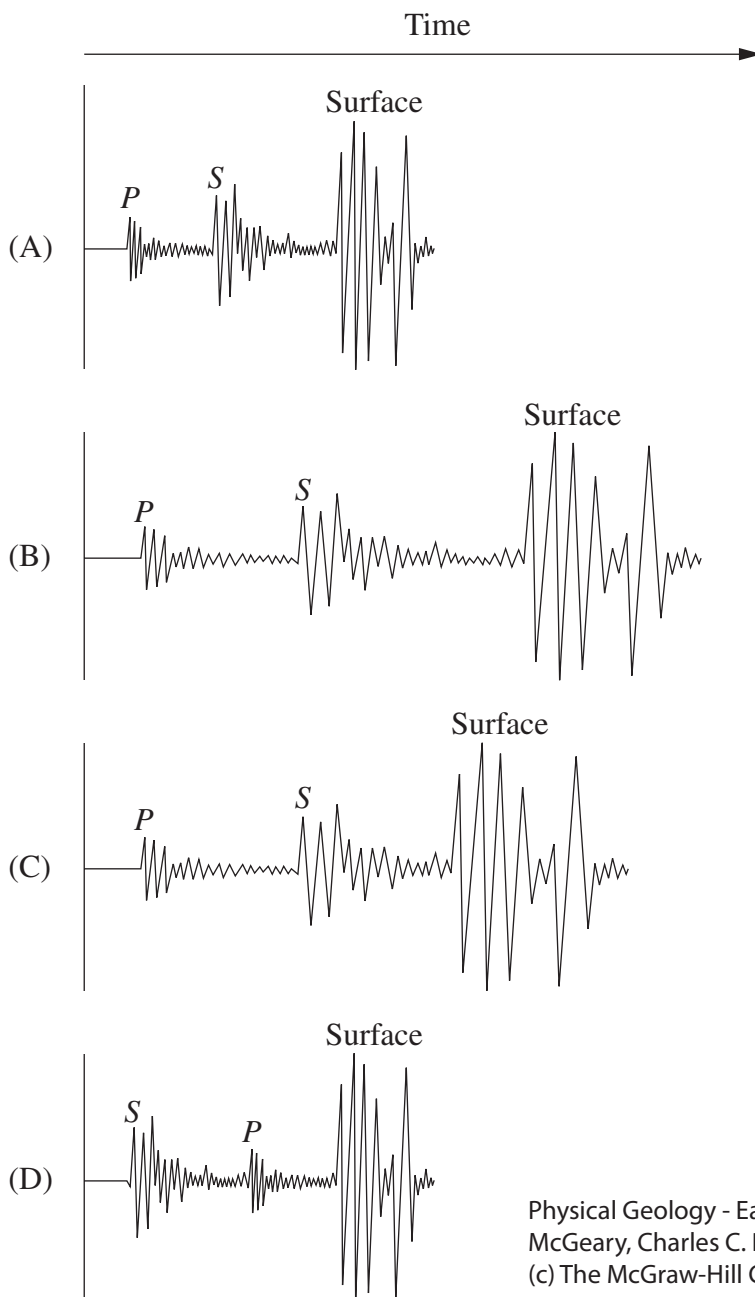
5 What condition is necessary for the formation of fossils?

(A) A sedimentary environment

(B) An oxygen-rich environment

(C) The availability of moulds or casts

(D) The presence of radioactive sediments

6   Both fertile soils and low-fertility lateritic soils can form from basalts.

What causes the difference in fertility of these soils?

(A)   Long periods of erosion

(B)   The duration of weathering

(C)   The silica content of the soils

(D)   The iron content of the basalts

7   What is the most suitable method for reducing sediment content in run-off water from a home construction site?

(A)   Divert the run-off water into a storm water drain.

(B)   Plant trees across the slope to slow down the run-off.

(C)   Place hay bales around the construction site to filter the water.

(D)   Treat the run-off water with chemical flocculants to precipitate sediment.

8   The graphs show data on canola and wheat crop yields at different levels of soil salinity.
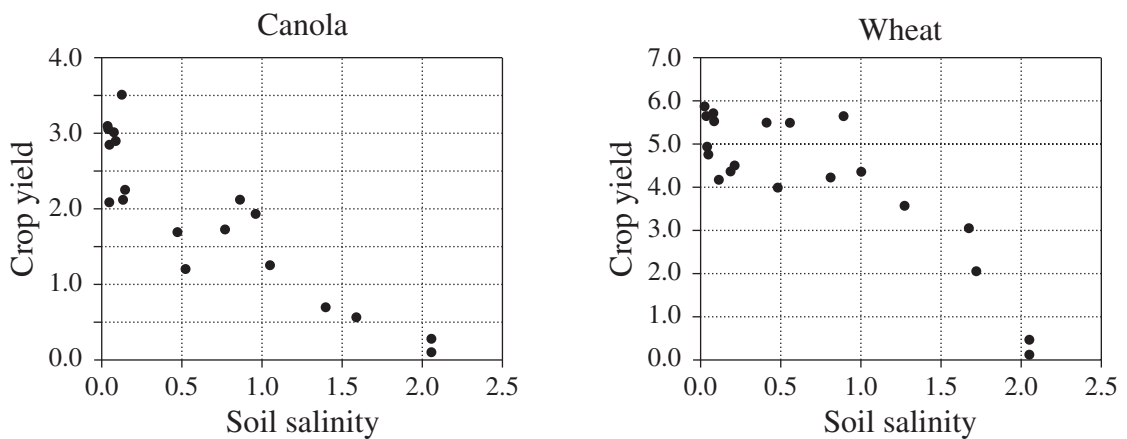
Which of the following conclusions is supported by these graphs?

(A)   Both crops have equal tolerances to saline soils.

(B)   Soil salinity levels have no effect on crop yields.

(C)   Crop yields decrease uniformly with increasing soil salinity.

(D)   At levels of soil salinity greater than 1.0 the crop yields are dramatically reduced.

9   Which practice may lead to a decrease in soil salinity?

   (A)   Compaction of soils by cattle

   (B)   Clearing of trees in valley floors

   (C)   Planting of trees on nearby hilltops

   (D)   Repeated use of saline river water for irrigation

10   Which of the following sets of conditions would be the most suitable when selecting a site for a waste dump?

	Slope	*Soil porosity*	*Geology*	*Rainfall*
(A)	High	High	Sandstone	Low
(B)	Low	Moderate	Limestone	High
(C)	Low	Low	Claystone	Low
(D)	High	High	Granite	Moderate

11   In which of the locations shown on the map of Australia are the oldest rocks found?

   (A)   *A*

   (B)   *B*

   (C)   *C*

   (D)   *D*

12   What is the cause of most earthquakes in central Australia?

(A)   Movement along faults

(B)   Stress on the Australasian Plate

(C)   Convergent plate margin movement

(D)   Subsidence caused by mining activities

13   Which of the following best explains the dramatic changes in the composition of the atmosphere that made conditions suitable for the eventual development of life on land?

(A)   Ozone was produced by primitive marine organisms.

(B)   Metazoans in the oceans produced atmospheric oxygen.

(C)   The amount of carbon dioxide in the atmosphere increased.

(D)   Photochemical reactions in the upper atmosphere formed ozone.

14   The diagram shows two lithospheric plates, *A* and *B*, and the depth to the focus of several earthquakes.
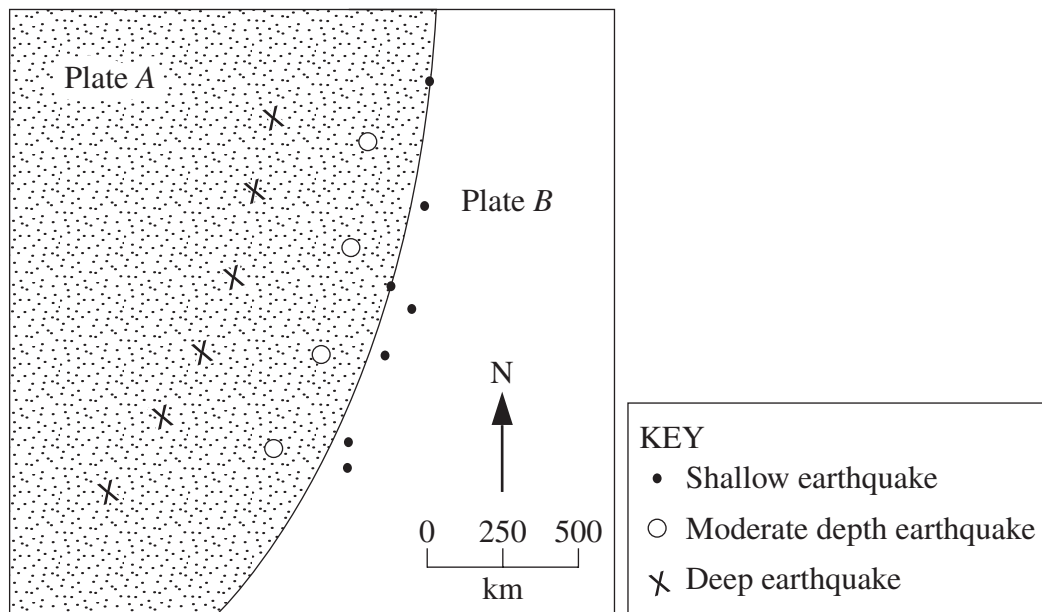
What is a valid conclusion that can be drawn from the diagram?

(A)   Plate *B* is an oceanic plate subducting to the east.

(B)   A mid-ocean ridge would develop along the line of shallow earthquakes.

(C)   Basaltic oceanic crust would form under the moderate depth earthquakes.

(D)   Plate *B* is an oceanic plate subducting to the west under continental Plate *A*.

15 The length of fission tracks from the radioactive decay of uranium–238 found in the mineral zircon can be used to date volcanic ash beds that contain fossils. The graph shows the relationship between fission track length and the age of volcanic ash beds.
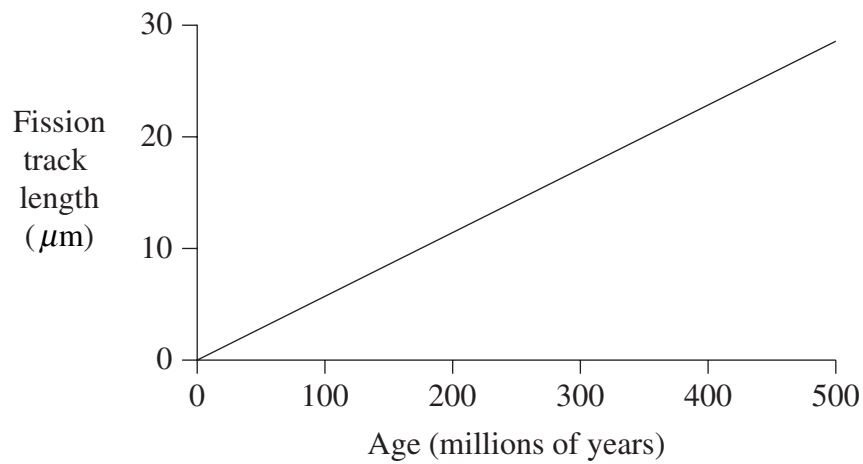
A volcanic ash bed contains zircon with an average fission track length of 10 μm.

From what geological period did fossils found in this volcanic ash bed originate?

(A) Jurassic

(B) Mesozoic

(C) Permian

(D) Phanerozoic

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Earth and Environmental Science

Centre Number

Section I (continued)

Student Number

Part B – 60 marks
Attempt Questions 16–27
Allow about 1 hour and 45 minutes for this part

Answer the questions in the spaces provided.

Marks

Question 16 (3 marks)

(a)   Identify ONE modern technology used to measure the relative motion of lithospheric plates.

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1

(b)   Describe how this technology is used to measure the relative motion.

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Please turn over

Question 17 (7 marks)

(a)   Construct a table to distinguish between the properties of a lithospheric plate   **4**
containing continental crust and a lithospheric plate containing oceanic crust. In
your answer, use THREE properties.

(b)   Describe ONE current hypothesis that explains how subduction drives plate   **3**
motion.

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Question 18 (6 marks)

(a)   (i)   Name ONE natural disaster associated with tectonic activity.   **1**

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(ii)   Describe the tectonic movement or process that caused this disaster.   **2**

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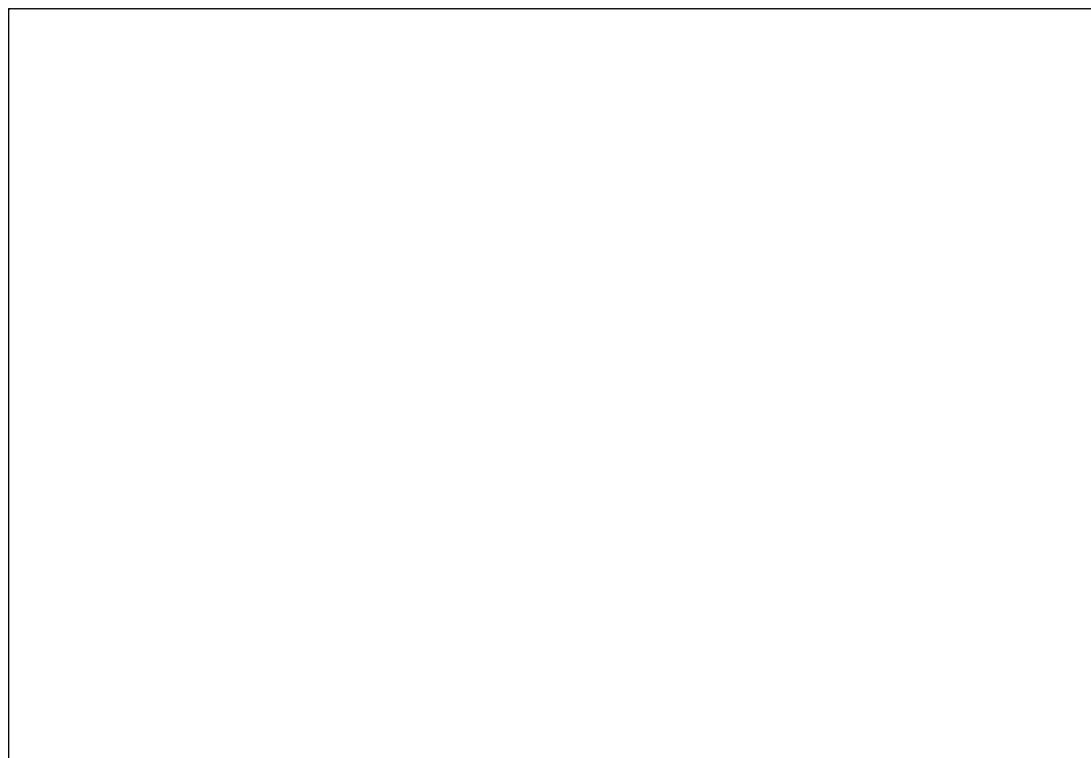
(b)   Explain why people risk farming in active volcanic regions.   **3**

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Question 19 (3 marks)

Construct an appropriate scale diagram to show the relative duration of the eons throughout geological time.

3

Question 20 (3 marks)
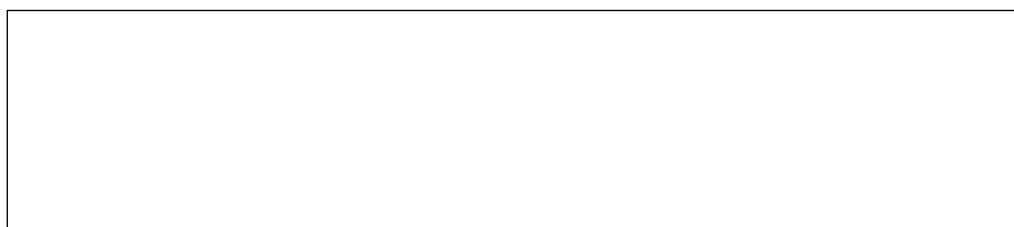
(a)   Identify TWO gaseous compounds found in vehicle exhaust emissions.

1

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(b)   Write a word equation to show how ONE of these gaseous compounds is formed.

2

Section I – Part B (continued)

Marks

Question 21 (5 marks)

The Phanerozoic eon began with the Cambrian 'explosion'.

(a) Why is the term 'explosion' used in relation to this event?   **1**

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(b) Contrast TWO features of the Ediacaran metazoans with the life-forms that   **2**
evolved in the Cambrian Period.

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(c) What are possible advantages that the Cambrian life-forms had over the earlier   **2**
metazoans?

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Question 22 (8 marks)

The diagram shows field notes describing a sequence of rocks at Meishan in south-east China. Similar sequences and the events leading to their formation have been recognised on all continents.

	Number of fossil species	Fossil abundance	Dominant fossil groups
Middle Triassic shale and siltstone	100	High	Bivalves, gastropods
Early Triassic shale and muddy limestone	25	Low	None
Two thin volcanic ash layers			
Permian limestone	333	High	Brachiopods

Analyse the information given to deduce possible events and processes that caused these changes to occur.

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Question 23 (5 marks)

How has technology improved our understanding of fossil life-forms? **5**

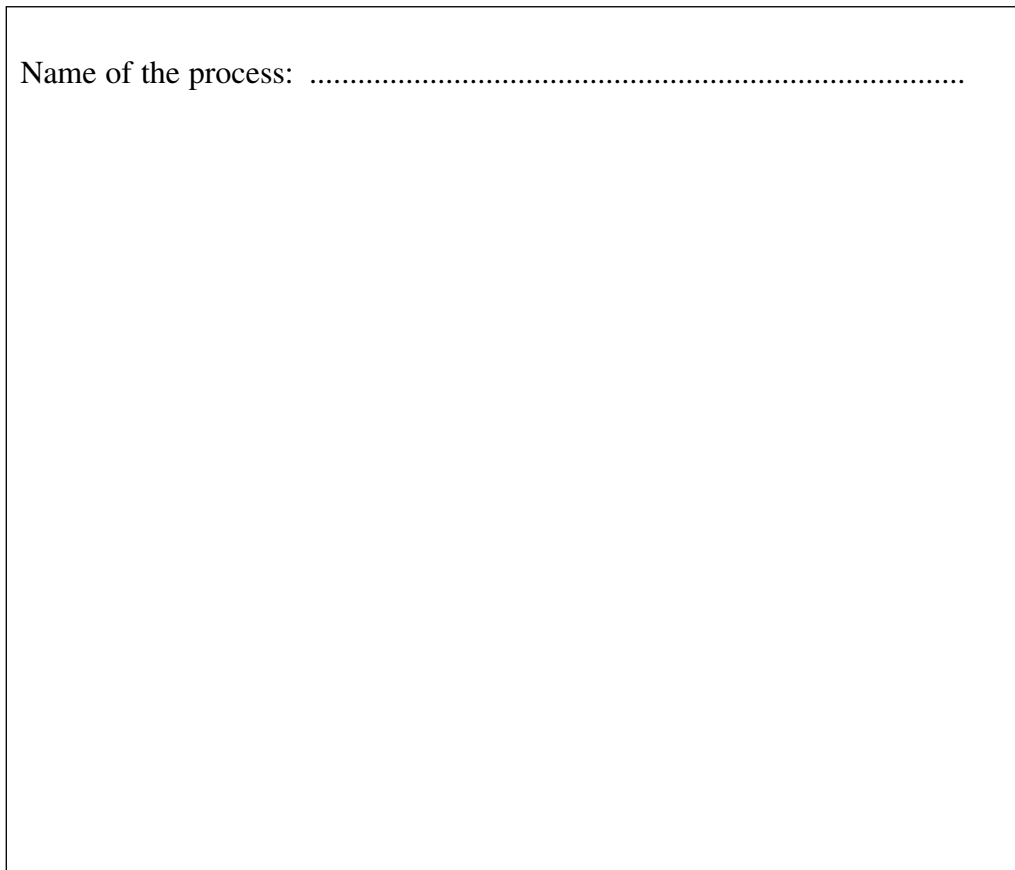..

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Please turn over

Question 24 (6 marks)

(a) Identify a waste treatment process, and draw a labelled diagram showing how   **3**
the process was simulated in a school laboratory.

Name of the process: ....

(b) Evaluate the success and limitation of your simulation for treating waste.   **3**

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Centre Number

Section I – Part B (continued)

Student Number

Marks

Question 25 (6 marks)

The halide, methyl bromide, is a highly effective pesticide. In 1991 methyl bromide was identified as a chemical that contributes to the depletion of the ozone layer.

(a)   Name a non-chemical alternative to using pesticides.   **1**

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(b)   Why is it important to stop ozone depletion?   **1**

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(c)   How can halides reduce ozone levels in the stratosphere?   **2**

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(d)   Outline research into ozone depletion by an Australian scientist or scientific organisation.   **2**

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Question 26 (5 marks)

Discuss the effects of continually introducing new pesticides into the environment.

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Question 27 (3 marks)

The following is an extract of an article that appeared in *The Australian*, Wednesday, 31 January 2007.

Reef may benefit from global warming

ON Friday in Paris the UN's Intergovernmental Panel on Climate Change will launch a new report, *Climate Change 2007: The Physical Science Basis*, with an up-to-date assessment of likely temperature rises because of global warming. Three related reports will be released later in the year, including a report on the likely effects of the rise in temperature. The report on impacts is likely to include a chapter on Australia and a warning that corals on the Great Barrier Reef could die as a consequence of global warming.

The idea that the Great Barrier Reef may be destroyed by global warming is not new, but it is a myth. The expected rise in sea level associated with global warming may benefit coral reefs and the Great Barrier Reef is likely to extend its range further south. Global threats to the coral reefs of the world include damaging fish practices and pollution, and the UN should work harder to address these issues.

Most of the world's great reefs are tropical because corals like warm water. Many of the species found on the Great Barrier Reef can also be found in regions with much warmer water, for example around Papua New Guinea. Corals predate dinosaurs and over the past couple of hundred million years have shown themselves to be remarkably resistant to climate change, surviving both hotter and colder periods.

Interestingly, scientific studies show that over the past 100 years, a period of modest global warming, there has been a statistically significant increase in growth rates of coral species on the Great Barrier Reef. There have also been periods of coral bleaching, but no conclusive evidence to suggest that either the frequency or severity has increased.

Dr Jennifer Marohasy, Senior Fellow at the Institute of Public Affairs, Melbourne

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How would you assess the reliability of this article?

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2007 HIGHER SCHOOL CERTIFICATE EXAMINATION

Earth and Environmental Science

Section II

25 marks
Attempt ONE question from Questions 28–31
Allow about 45 minutes for this section

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

Question 28 — Introduced Species and the Australian Environment (25 marks)

(a) (i) Define the term *biological control*. **1**

(ii) Describe, giving an example, ONE type of biological control used in Australia. **2**

(b) The graph shows the total number of mammal species introduced into Australia since the arrival of Europeans.

Conservation Biology for the Australian Environment, Mark A. Burgman & David B. Lindenmayer, Surrey Beatty & Sons 1998
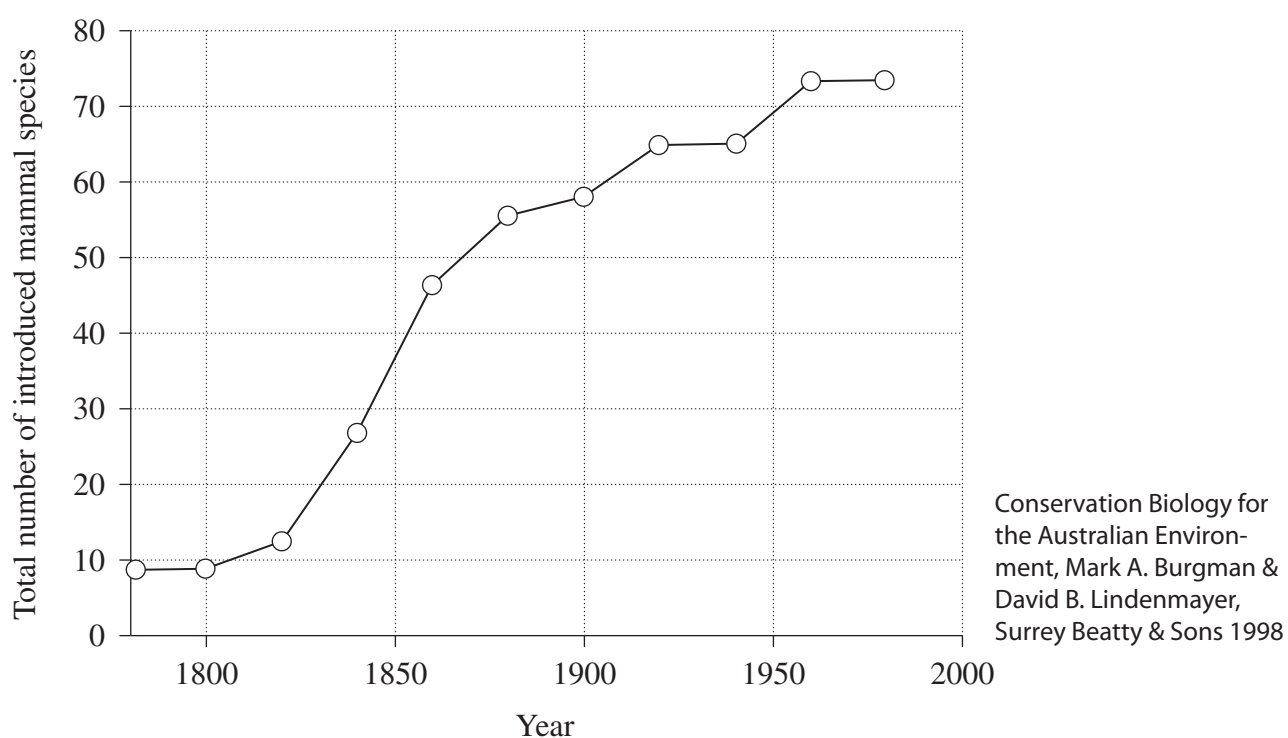
(i) Explain the trend in the number of mammal species introduced into Australia between 1800 and 1860. **2**

(ii) Describe TWO possible mechanisms that have resulted in the accidental introduction of species into Australia. **2**

Question 28 continues on page 23

Question 28 (continued)

(c) In your study of this option, you performed a first-hand investigation to account for the presence of non-indigenous flora and fauna.

    (i) State a suitable hypothesis for your investigation. **1**

    (ii) Outline a simple procedure that tested this hypothesis. **2**

    (iii) Explain ONE safe work practice that was used during the investigation. **2**

(d) Analyse the effect of a named introduced species on the biotic and abiotic components of the Australian environment it has invaded. **6**

(e) The data in the table gives the density of rabbits and native plant seedlings for a semi-arid ecosystem over a 12-year period.

Density \ Year	1	2	3	4	5	6	7	8	9	10	11	12
Rabbits (No. per hectare)	4	6	8	2	1	1.5	2.5	1	1.5	3	1	3
Native plant seedlings (No. per 100 m^2)	20	16	20	22	30	32	34	36	20	21	24	16

    (i) Detach the graph paper on page 33. Plot BOTH the density of rabbits and native plant seedlings over the 12-year period. **4**

    (ii) State the relationship between the density of rabbits and the number of native plant seedlings. **1**

    (iii) Outline TWO conditions required for an introduced animal such as a rabbit to become a pest. **2**

End of Question 28

Question 29 — Organic Geology – a Non-renewable Resource (25 marks)

(a)   (i)   Identify TWO renewable resources as alternatives to fossil fuels.   **1**

      (ii)   Outline the future potential of ONE of these renewable resources.   **2**

(b)   The graph shows the energy yield and carbon content for petrol and several types of coal.
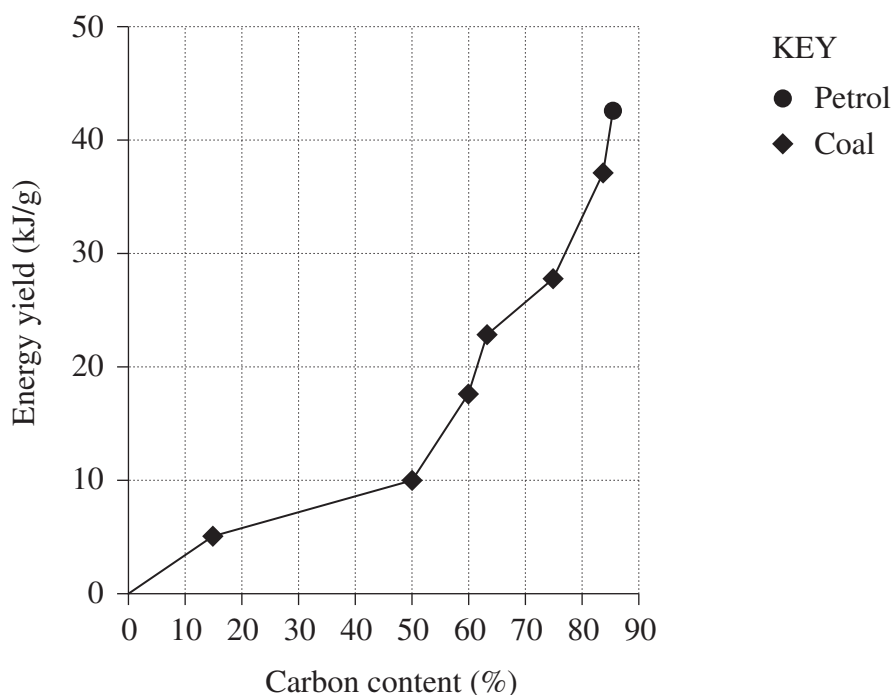
      (i)   Explain the trend in energy yield of coal relative to carbon content.   **2**

      (ii)   Describe TWO advantages that petrol has over coal as a transport fuel.   **2**

(c)   In your study of this option, you performed a first-hand investigation to test the energy efficiency of several non-fossil fuels.

      (i)   State a suitable hypothesis for your investigation.   **1**

      (ii)   Outline a simple procedure that tested this hypothesis.   **2**

      (iii)   Explain ONE safe work practice that was used during the investigation.   **2**

Question 29 (continued)

(d) Evaluate methods for conserving energy through architectural design for the benefit of the individual and the environment.

6

(e) The temperature and rock density at the bottom of twelve boreholes in an oil field were measured.

Depth (m)	95	600	900	1350	1776	2079	2637	2910	3389	4120	4607	4950
Temperature (°C)	4	18	23	32	41	47	54	73	76	100	116	120
Rock density (g/cm^3)	2.3	2.4	2.5	2.6	2.7	2.7	2.7	2.8	2.9	2.9	3.1	3.1

(i) Detach the graph paper on page 33. Plot BOTH the temperature and rock density against depth.

4

(ii) State the relationship between temperature and depth.

1

(iii) Outline how temperature and rock density influence oil migration.

2

End of Question 29

Question 30 — Mining and the Australian Environment (25 marks)

(a) (i) Define the term *ore*. **1**

  (ii) Outline ONE Australian government policy that affects the sustainability of mining operations. **2**

(b) The graph shows ore production for a mine's first 12 years of operation.
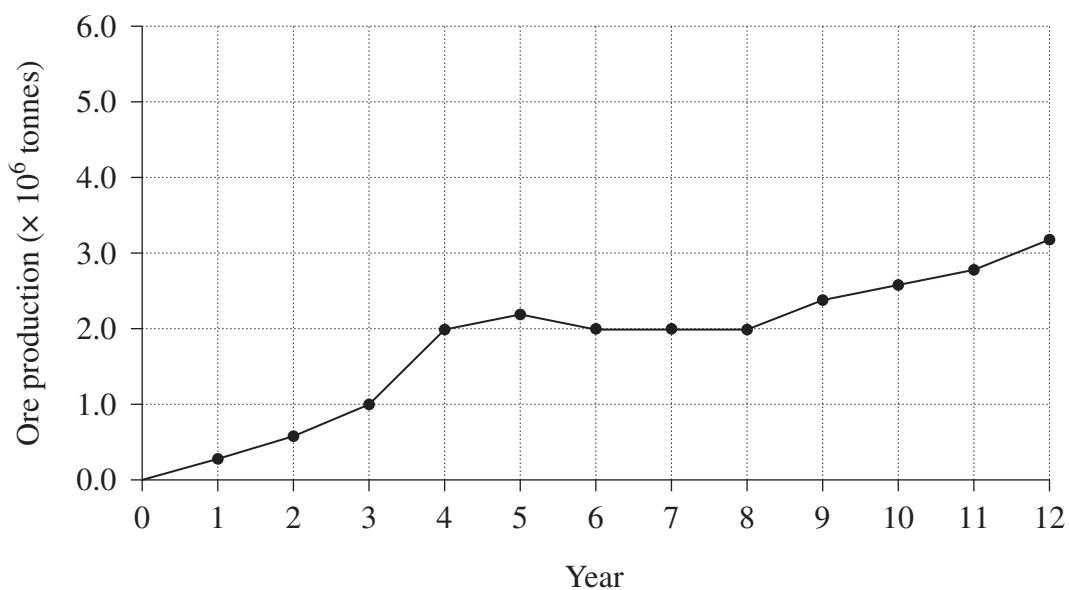
  (i) Explain the trend in ore production. **2**

  (ii) Describe TWO factors that affect the relationship between ore production and income. **2**

(c) In your study of this option, you performed a first-hand investigation to test for the presence of ore minerals or metals.

  (i) State a suitable hypothesis for your investigation. **1**

  (ii) Outline a simple procedure that tested this hypothesis. **2**

  (iii) Explain ONE safe work practice that was used during the investigation. **2**

Question 30 (continued)

(d) Evaluate the need for an environmental impact statement for a company wishing to open a new mine.

6

(e) The concentration of TWO metals was measured along a traverse.

Distance from start of traverse (m)	*Copper concentration* (%)	*Lead concentration* (%)
0	0.1	0.1
10	0.1	0.1
20	0.5	4.0
30	2.2	4.5
40	2.3	4.1
50	2.1	4.0
60	2.2	4.2
70	2.4	4.5
80	0.6	2.0
90	0.1	0.1
100	0.1	0.1

(i) Detach the graph paper on page 33. Plot the concentrations of BOTH copper and lead against distance from the start of the traverse.

4

(ii) If the cutoff (or economic) grades for copper and lead are 0.5% and 4.0% respectively, what is the width of the ore body that would be mined?

1

(iii) Outline TWO possible rehabilitation practices that could be used after mining this ore body.

2

End of Question 30

Question 31 — Oceanography (25 marks)

(a)   (i)   Identify TWO types of sediment of biological origin that are found in   **1**
         deep ocean basins.

      (ii) Outline how manganese nodules form on the deep ocean floor.   **2**

(b)   The graph shows changes in water temperature at different depths in an ocean.
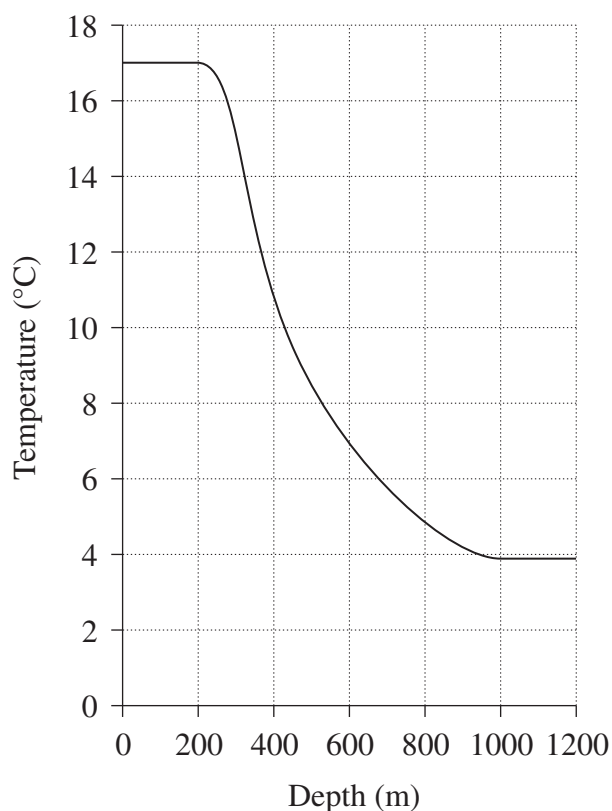
      (i)   Explain the trend in temperature for the top 200 metres of the ocean.   **2**

      (ii) Describe TWO factors, other than temperature, that change with depth in   **2**
           modern oceans.

Question 31 (continued)

(c) In your study of this option, you performed a first-hand investigation to compare the solubility of common salts in water at different temperatures.

    (i) State a suitable hypothesis for your investigation.   **1**

    (ii) Outline a simple procedure that tested this hypothesis.   **2**

    (iii) Explain ONE safe work practice that was used during your investigation.   **2**

(d) Assess the importance of laws about the ocean for our world society.   **6**

(e) Data recorded at an ocean-monitoring buoy are shown in the table.

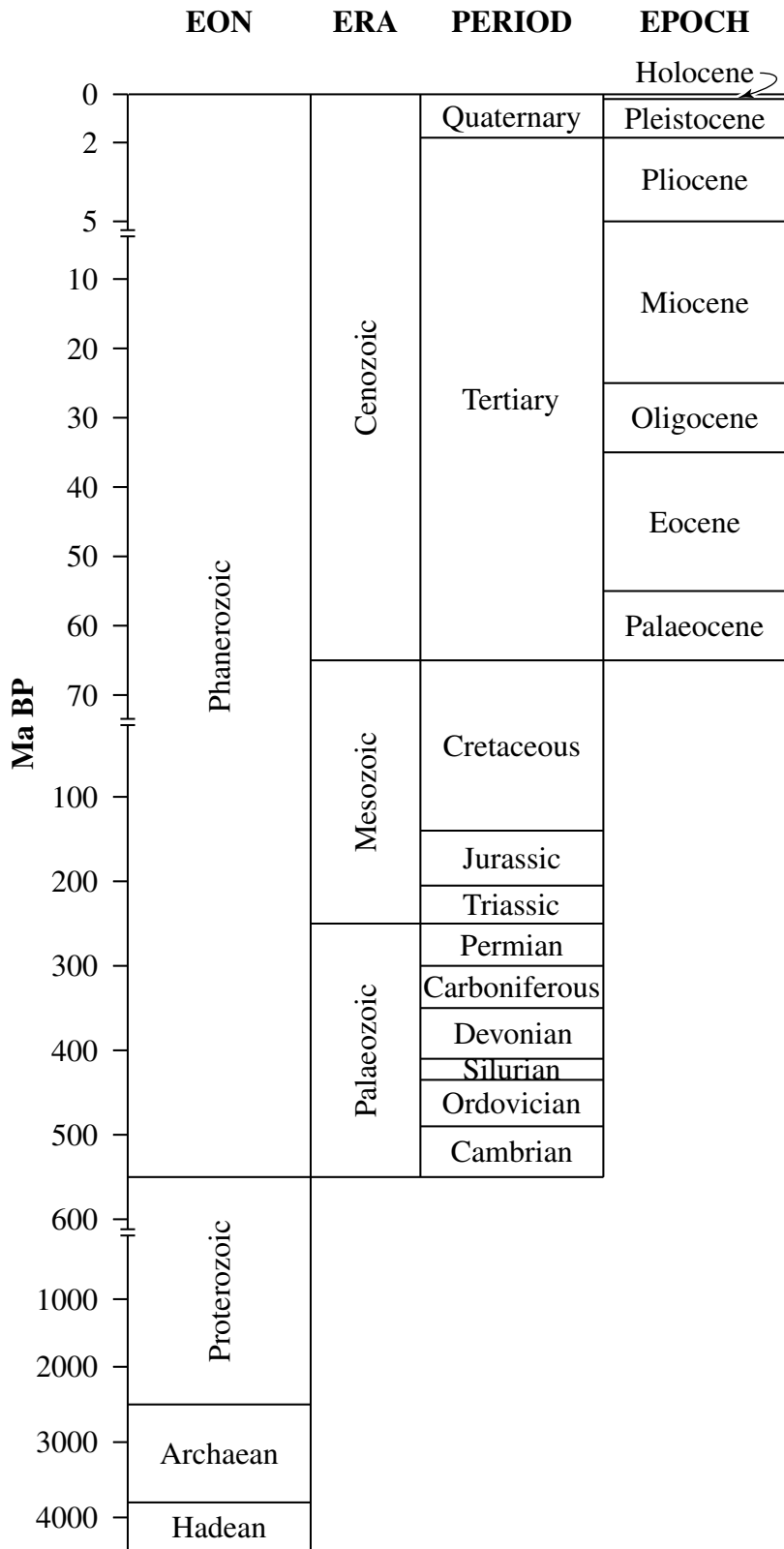| Month	Average temperature (°C)	Phosphorus concentration (ppm)
January	26	100
February	25	110
March	25	120
April	24	100
May	24	80
June	20	20
July	20	20
August	23	20
September	23	20
October	24	30
November	25	80
December	26	100

    (i) Detach the graph paper on page 33. Plot BOTH the average temperature and phosphorus concentration over the 12 months.   **4**

    (ii) State the relationship between average temperature and phosphorus concentration.   **1**

    (iii) Outline TWO conditions for hydrothermal waters to scavenge elements from rocks.   **2**

End of paper

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Geological Time Scale

EON	ERA	PERIOD	EPOCH

Ma BP

Ma BP	EON	ERA	PERIOD	EPOCH
0	Phanerozoic	Cenozoic	Quaternary	Holocene
2				Pleistocene
5				Pliocene
10			Tertiary	Miocene
20				
30				Oligocene
40				Eocene
50				
60				Palaeocene
70		Mesozoic	Cretaceous	
100				
200			Jurassic	
			Triassic	
300		Palaeozoic	Permian	
			Carboniferous	
400			Devonian	
			Silurian	
			Ordovician	
500			Cambrian	
600	Proterozoic			
1000				
2000				
3000	Archaean			
4000	Hadean			

Earth and Environmental Science

Centre Number

Student Number

This page is to be detached, completed and attached to the inside front cover of your writing booklet for the option question you have completed.

Question attempted

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