NSW Education Standards Authority

IMPORTANT:
This resource was developed to support a previous version of the syllabus. It may contain content that differs from the current syllabus.

2018 **HIGHER SCHOOL CERTIFICATE EXAMINATION**

Earth and Environmental Science

General Instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Write using black pen
- Draw diagrams using pencil
- Calculators approved by NESA may be used
- A Geological Time Scale is provided at the back of this paper

Total marks: 100

Section I – 75 marks (pages 2–28)

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 – 25 marks (pages 29–33)

- 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 Which eon covers the longest time interval on the Geological Time Scale?

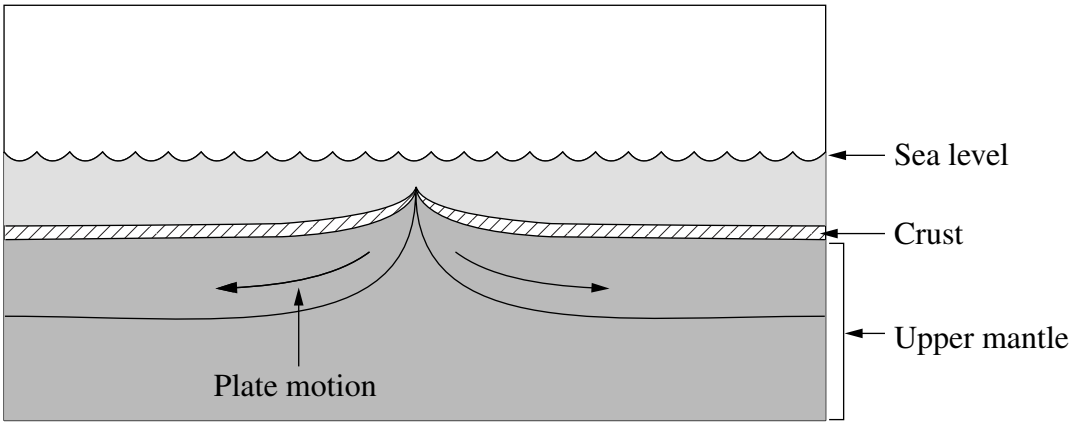
A. Archaean

B. Hadean

C. Phanerozoic

D. Proterozoic

2 A diagram of a boundary is shown.



What is the most common rock found in the crust?

A. Basalt

B. Peridotite

C. Rhyolite

D. Sandstone

3 Which row of the table correctly links the lithospheric plate to its features?

	Lithospheric plate	*Age* (millions of years)	*Average thickness* (km)	*Dominant rock type*
A.	Continental	0–4000	7	Felsic
B.	Continental	0–175	35	Felsic
C.	Oceanic	0–175	7	Mafic
D.	Oceanic	0–4000	35	Mafic

4 Which of the following statements is true for modern landfill design?

A. Capture, treatment and removal of leachates is required.

B. Clay liners prevent leachates from contaminating the waste.

C. Plastic liners are used to allow large volumes of methane to accumulate.

D. Compaction prior to sealing prevents water seepage into the surrounding rocks.

5 Which of the following would be classified as a mass extinction?

A. The loss of most of the Australian megafauna

B. The loss of a large number of land and ocean organisms

C. The loss of many classes and orders of land-based organisms

D. The loss of many classes and orders of land and ocean organisms

6 In which of the following are all the gases waste products in vehicle exhaust emissions?

A. Water vapour, methane, nitrogen oxides, carbon dioxide

B. Carbon monoxide, water vapour, nitrogen oxides, carbon dioxide

C. Carbon dioxide, water vapour, nitrogen oxides, chlorofluorocarbons

D. Nitrogen oxides, chlorofluorocarbons, water vapour, carbon monoxide

7 On the 30th anniversary of the Montreal Protocol, UN Secretary-General António Guterres stated that the Protocol was a 'milestone for all people and our planet'. He highlighted the positive impacts of the Montreal Protocol on human health, poverty eradication, climate change, and protecting the food chain.

Why did most industrialised countries sign this international protocol?

A. To reverse the damage caused to the ozone layer by industrial gases such as chlorofluorocarbons (CFCs)

B. To reverse the damage caused to the ozone layer by industrial gases such as carbon dioxide and hydrofluorocarbons (HFCs)

C. To limit the emissions of greenhouse gases such as chlorofluorocarbons (CFCs) and methane to minimise global warming

D. To limit the emissions of greenhouse gases such as carbon dioxide and chlorofluorocarbons (CFCs) to minimise global warming

8 Approximately 75% of the world's energy needs are produced by the combustion of fossil fuels.

Which equation summarises the combustion of fossil fuels?

A. Methane + oxygen $\longrightarrow$ carbon monoxide + water + energy

B. Hydrocarbons + carbon dioxide $\longrightarrow$ oxygen + water + energy

C. Hydrocarbons + oxygen $\longrightarrow$ carbon dioxide + water + energy

D. Methane + hydrocarbons + oxygen $\longrightarrow$ carbon dioxide + water + energy

9 At which plate boundary is explosive volcanism most likely to occur?

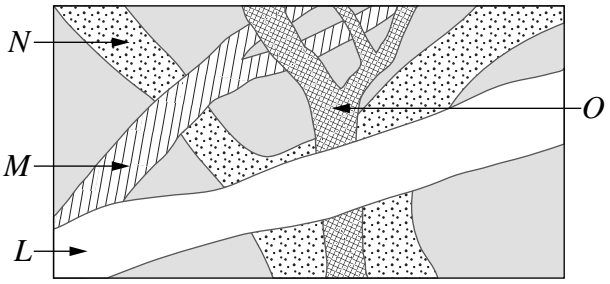
A. Ocean–ocean divergent

B. Continent–ocean convergent

C. Continent–continent divergent

D. Continent–continent convergent

10 The diagram shows veins in an outcrop of rock.



What is the correct order of formation, from oldest to youngest?

A. *N*, *M*, *O*, *L*

B. *N*, *M*, *L*, *O*

C. *L*, *O*, *M*, *N*

D. *L*, *M*, *N*, *O*

11 Which rocks formed before oxygen started to accumulate in Earth's atmosphere?

A. Sandstones in the Sydney Basin in New South Wales

B. Limestones in the Canning Basin in Western Australia

C. Granites in the New England Fold Belt in New South Wales

D. Banded Iron Formations in the Pilbara Region of Western Australia

12 The flow diagram shows the intended and actual pathways of the pesticide DDT to target and non-target species.



Based on the diagram, which row of the table shows the consequences of introducing pesticides into the environment?

	Consequence 1	*Consequence 2*
A.	Bioaccumulation in blueberries	Potential health impacts on humans
B.	Biomagnification in blueberries	Reduction in the caterpillar population
C.	Biomagnification in rivers and dams	Potential health impacts on livestock
D.	Biomagnification and bioaccumulation in rivers and dams	Reduction in fish populations

13 The equation shows one step in the formation of a substance found in Earth's atmosphere.

$$O_2 + \text{sunlight} \longrightarrow O + O$$

What is the substance?

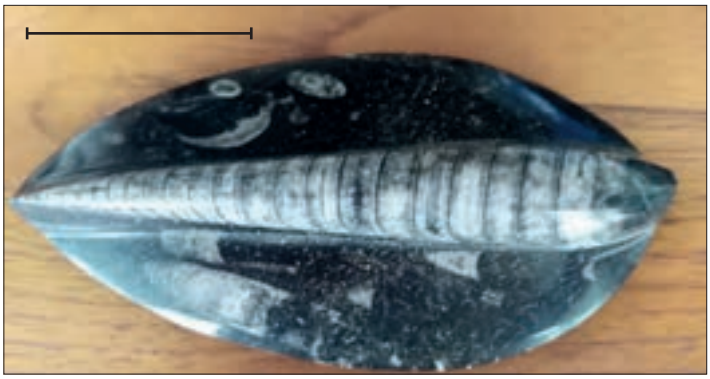
A. A gas that forms acid rain

B. A gas that filters ultraviolet radiation

C. A gas that contributes to global warming

D. An aerosol that causes a decrease in global temperature

14 A scientist went through a collection of fossil photos and found one without values on the scale bar. The specimen is 15 cm long.



The photograph of the specimen is not life-size.

How should the scale bar in the photograph be labelled?

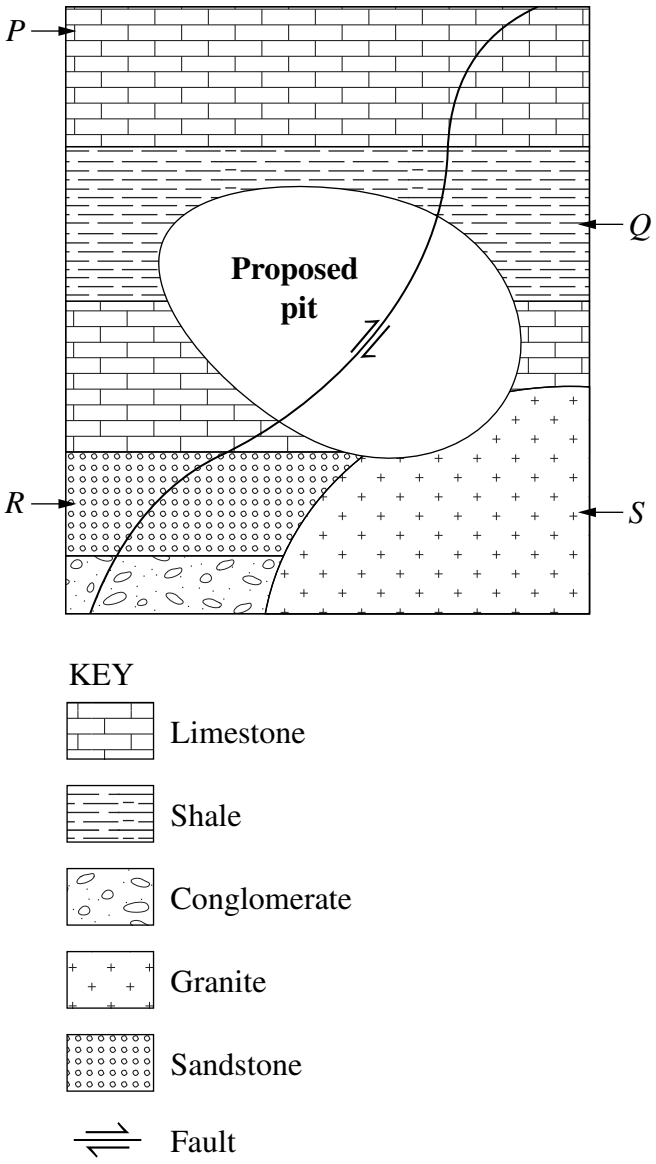
A. 0 ⊢——⊣ 1 cm

B. 0 ⊢——⊣ 3 cm

C. 0 ⊢——⊣ 5 cm

D. 0 ⊢——⊣ 15 cm

15 The diagram shows the geology of an area where an open-cut lead–zinc mine is proposed.



What is the best site for a tailings dam?

A. *P*

B. *Q*

C. *R*

D. *S*

16 Which of the following photos shows a normal fault?

A.

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'Commentary: Analogical Thinking in Geoscience Education' B Jee et al., Journal of Geoscience Education, V.58, n.1, Routledge, 2010

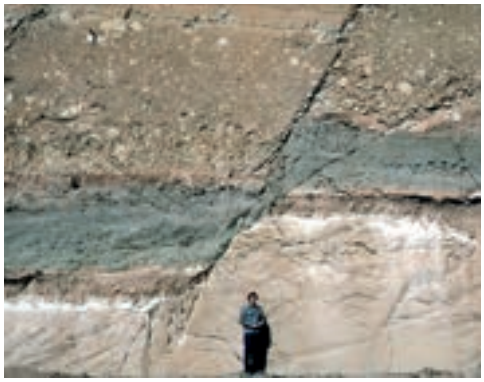
B.



C.



D.



J K Nakata, United States Geological Survey

17 What is the most likely reason for deep focus earthquakes occurring?

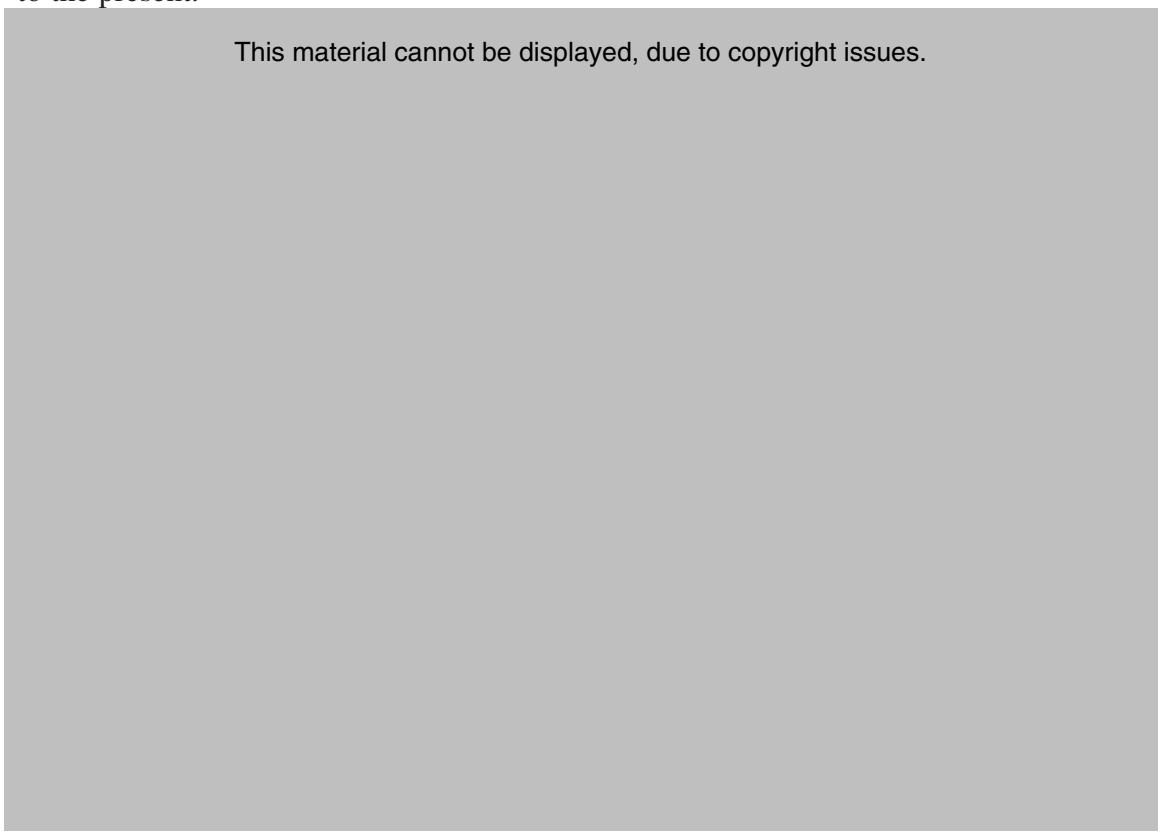
A. Movement of two plates along a fault line

B. Convergence of an oceanic plate and a continental plate

C. Built-up stress due to two plates sliding past each other

D. Mountain building due to collision of two continental plates

18 The graph shows the number of families and the carbon dioxide levels from 600 Ma BP to the present.



Which of the following inferences could be made based on data in the graph?

A. The Permian extinction followed large volcanic eruptions.

B. The Cretaceous–Tertiary extinction followed large volcanic eruptions.

C. The radiations of new families after the late Devonian extinction is related to carbon dioxide levels.

D. The number of families in the late Cambrian is due to higher carbon dioxide levels in the atmosphere.

19 The graph shows the breakdown of recycled versus landfill quantities from 2011 to 2016 in Capel, WA.



Based on the graph, the biggest influence on the overall recycling rate from 2011/12 to 2015/16 can be attributed to which activity?

A. Kerbside recycling

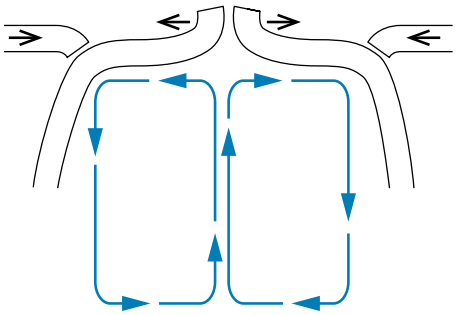
B. Kerbside organic waste

C. Waste transfer station recycling

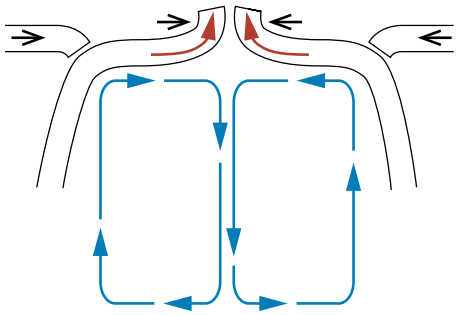
D. Council clean-up of non-recyclable waste

20 Which diagram best illustrates the driving forces of a 'slab pull' model?

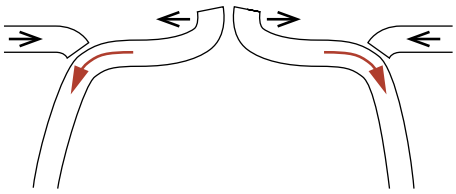
A.



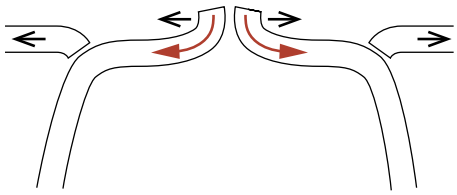
B.

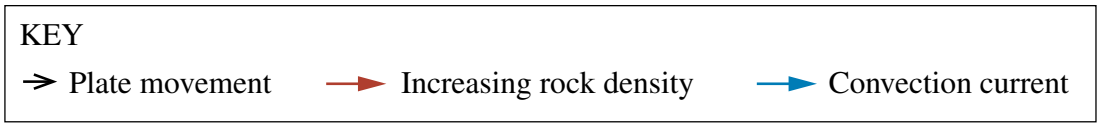


C.



D.





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2018 HIGHER SCHOOL CERTIFICATE EXAMINATION

Centre Number

Student Number

Earth and Environmental Science

Section I Part B
Answer Booklet

55 marks
Attempt Questions 21–30
Allow about 1 hour and 40 minutes for this part

Instructions

- Write your Centre Number and Student Number at the top of this page.
- Answer the questions in the spaces provided. These spaces provide guidance for the expected length of response.
- Extra writing space is provided at the back of this booklet. If you use this space, clearly indicate which question you are answering.

Please turn over

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Question 21 (5 marks)

Mount Mayon is the most active volcano in the Philippines.



© Dexbaldon

(a) Identify TWO hazards that are typical of volcanic regions such as that around Mount Mayon. **2**

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(b) Explain why people live in high risk environments such as that around Mount Mayon. **3**

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Question 22 (5 marks)

The table gives data for several impact craters.

Impact crater	*Size* (km)	*Age* (Ma BP)	*Location*
Red Wing	9	200	North Dakota, USA
Puchezh–Katunki	80	175	Russia
Gosse Bluff	24	142.5	Northern Territory, Australia
Chicxulub	170	65	Yucatan, Mexico
Popigai	100	36	Russia

(a) Which crater was formed at the same time as a mass extinction? **1**

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(b) Explain how the impact of a meteor can cause a mass extinction. **4**

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Question 23 (5 marks)

Carbon dioxide, methane and sulfur dioxide are gases which contribute to increases in either greenhouse gas levels or acid rain.

(a) Identify a local or global strategy aimed at achieving a decrease in the emissions for EACH of these THREE gases. **3**

Gas	*Local or global strategy to decrease emissions of gas*
Carbon dioxide	....
Methane	....
Sulfur dioxide	....

(b) Choose TWO gases from part (a). **2**

Explain how the strategy identified reduces the emissions of each gas.

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Question 24 (6 marks)

(a) Describe how a named technology measures the movement of Earth's crust. **2**

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(b) Assess the effectiveness of technology in predicting events that cause natural disasters. **4**

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Question 25 (7 marks)

(a) Identify the first type of organism that produced oxygen. **1**

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(b) The deposition of Banded Iron Formations is a cyclic process in which iron-rich and iron-poor layers are deposited. **4**

Draw a labelled diagram to show the environmental conditions needed for the deposition of each layer.

Iron-rich layer	*Iron-poor layer*

(c) Why are Banded Iron Formations no longer forming? **2**

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Question 26 (6 marks)

A Victorian irrigator wants to rehabilitate land affected by salt and erosion.

The table shows a shortlist of tree species and their tolerance to salinity and waterlogging.

This material cannot be displayed, due to copyright issues.

(a) (i) Name TWO species from the table that would be most suitable to rehabilitate the salt-affected land. **1**

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(ii) Justify your choice of each species in part (a) (i) with reference to the table. **2**

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Question 26 continues on page 20

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Question 26 (continued)

(b) The irrigator is also concerned about the effects of erosion on the land. **3**

Name a strategy to combat soil erosion and explain how it can assist in rehabilitating the irrigator's land.

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End of Question 26

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Question 27 (5 marks)

Information about three types of shock waves that are produced during an earthquake is shown in the table. **5**

Type of wave	*Approximate speed* (km/s)	*Where they travel*	*Movement* (action)
Primary	10	Through the solid and liquid layers of Earth	Backwards and forwards in the same direction the wave is travelling
Secondary	5	Only through the solid layers of Earth, not the liquid parts	Backwards and forwards at right angles to the direction the wave is travelling
Surface	4	Along the surface of Earth	Rolling up and down

Using the information in the table, explain the impacts of shock waves on natural and built environments.

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Question 28 (4 marks)

Complete the table to show how FOUR features of early reptiles gave them an advantage over amphibians in a terrestrial environment. **4**

Feature	*How the feature gave reptiles an advantage over amphibians in a terrestrial environment*
1	....
2	....
3	....
4	....

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Question 29 (5 marks)

A mining rehabilitation working group has two goals. **5**

1. Decrease the time that disturbed areas are left without temporary or final cover, recognising that different mining operations are at different points in rehabilitation.
2. Achieve a consistent level of best practice, quality, integrated rehabilitation, both within the industry and with future land uses.

Assess the effectiveness of rehabilitating mine sites with reference to the goals above.

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Question 30 (7 marks)

The diagram shows the relationship between four of Earth's spheres over the Permian and Triassic Periods.

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Question 30 continues on page 25

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Question 30 (continued)

Analyse the role of the plate tectonic super-cycle in the extinction and evolution of new species during the Permian and Triassic Periods. Use data from the diagram to support your analysis. **7**

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End of Question 30

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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)–(e) of one question in the Section II Writing Booklet. Extra writing booklets are available.

Pages

Question 31 Introduced Species and the Australian Environment 30

Question 32 Organic Geology – a non-renewable Resource 31

Question 33 Mining and the Australian Environment 32

Question 34 Oceanography 33

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

Answer parts (a), (b) and (c) of the question on pages 2–4 of the Section II Writing Booklet. Start each part of the question on a new page.

(a) Describe how a predator has been used to successfully control prickly pear. **3**

(b) Construct a table to contrast the use of the Bradley method of bush regeneration with one other method of bush regeneration. **4**

(c) (i) Outline TWO quarantine procedures Australia has in place to prevent the introduction of new species. **2**

(ii) Discuss the effectiveness of quarantine procedures that prevent the spread of new species. **4**

Answer parts (d) and (e) of the question on pages 6–8 of the Section II Writing Booklet. Start each part of the question on a new page.

(d) The table gives data for an introduced plant species *X* and an indigenous plant species *Y* along a transect away from a disturbed area. Data was gathered to determine the relationship between the distance from disturbance and the population of each species.

Distance from disturbed area (m)	*Introduced species X* (number of plants)	*Indigenous species Y* (number of plants)
10	18	1
20	16	2
30	13	3
40	12	15
50	11	5
60	10	6

(i) Plot the data and draw lines of best fit. **4**

(ii) Account for the data for both species at 40 m. **2**

(e) Evaluate the role of science in developing and implementing control strategies for an introduced animal species in the Australian environment. Include examples in your answer. **6**

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

Answer parts (a), (b) and (c) of the question on pages 2–4 of the Section II Writing Booklet. Start each part of the question on a new page.

(a) Describe how an energy source, other than fossil fuels, could provide electricity to local communities. **3**

(b) Construct a table to compare characteristics of the environments in which coal and petroleum are formed. **4**

(c) (i) Outline TWO types of information that drilling provides in petroleum exploration. **2**

(ii) Discuss why another method should be used, in conjunction with drilling, in petroleum exploration. **4**

Answer parts (d) and (e) of the question on pages 6–8 of the Section II Writing Booklet. Start each part of the question on a new page.

(d) The table gives the percentage of ash and the percentage of sulfur in a drill core that intersected several coal seams. Data was gathered to determine the relationship between depth and the percentages of ash and sulfur.

Depth (m)	*Percentage ash* (%)	*Percentage sulfur* (%)
10	18	1
20	16	2
30	13	3
40	12	15
50	11	5
60	10	6

(i) Plot the data and draw lines of best fit. **4**

(ii) Account for the data for both ash and sulfur at 40 m. **2**

(e) Evaluate the role of science in addressing the economic and environmental problems regarding the use of fossil fuels. Include examples in your answer. **6**

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

Answer parts (a), (b) and (c) of the question on pages 2–4 of the Section II Writing Booklet. Start each part of the question on a new page.

(a) Describe how rehabilitation methods have been used at a mine site you have studied. **3**

(b) Construct a table to compare the features of TWO mineral provinces in Australia. **4**

(c) (i) Outline TWO reasons for carrying out an Environmental Impact Statement for a proposed mine site. **2**

(ii) Using examples, discuss the role of government in modern mining operations. **4**

Answer parts (d) and (e) of the question on pages 6–8 of the Section II Writing Booklet. Start each part of the question on a new page.

(d) The table gives the percentages of zinc and copper in a drill core. Data was gathered to determine the relationship between depth and the percentages of copper and zinc.

Depth (m)	*Percentage zinc* (%)	*Percentage copper* (%)
10	18	1
20	16	2
30	13	3
40	12	15
50	11	5
60	10	6

(i) Plot the data and draw lines of best fit. **4**

(ii) Account for the data for both metals at 40 m. **2**

(e) Evaluate the role of science in assessing the economic viability of mining ore bodies. Include examples in your answer. **6**

Question 34 — Oceanography (25 marks)

Answer parts (a), (b) and (c) of the question on pages 2–4 of the Section II Writing Booklet. Start each part of the question on a new page.

(a) Describe how both temperature and salinity influence circulation in the ocean. **3**

(b) Construct a table to compare the adaptations of deep ocean organisms with those that live in the top 30 metres. **4**

(c) (i) Outline TWO characteristics of oozes. **2**

(ii) Discuss the origin and environmental conditions required for the deposition of a sediment other than oozes found in the Pacific Ocean Basin. **4**

Answer parts (d) and (e) of the question on pages 6–8 of the Section II Writing Booklet. Start each part of the question on a new page.

(d) The table gives the numbers of two fish species at various distances from a sewage outlet. Data was gathered to determine the relationship between distance from a sewage outlet and the populations of fish species *X* and fish species *Y*.

Distance from sewage outlet (m)	*Number of fish species X*	*Number of fish species Y*
10	18	1
20	16	2
30	13	3
40	12	15
50	11	5
60	10	6

(i) Plot the data and draw lines of best fit. **4**

(ii) Account for the data for both species at 40 m. **2**

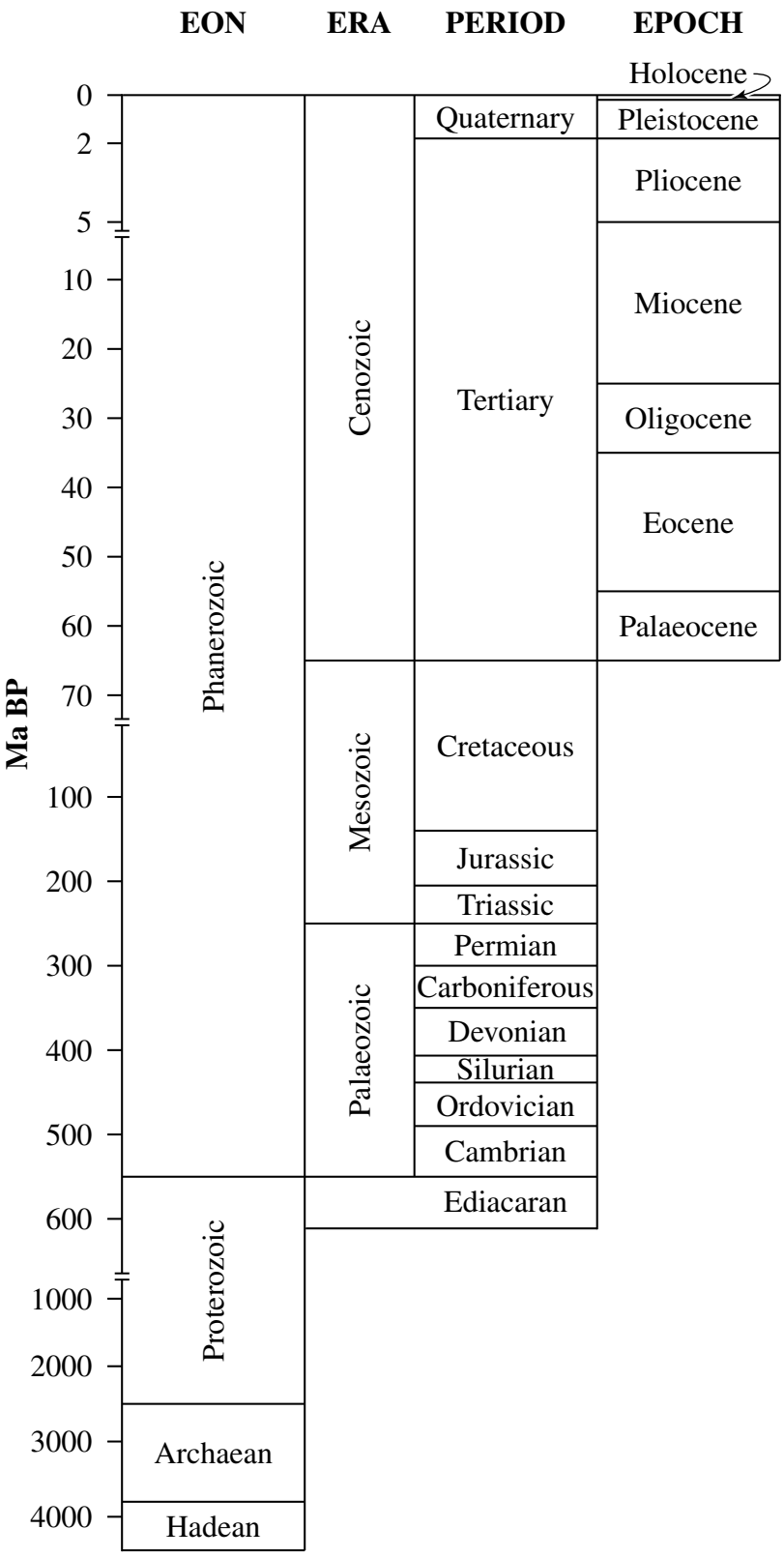
(e) Evaluate the role of science in locating and managing the world's oceanic resources. Include examples in your answer. **6**

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Geological Time Scale



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