BOSTES BOARD OF STUDIES TEACHING & EDUCATIONAL STANDARDS NSW

2016 HIGHER SCHOOL CERTIFICATE EXAMINATION

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

Earth and Environmental Science

General Instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Write using black 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, 15, 17, 21 and 25

Total marks – 100

Section I Pages 2–28

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 21–31
- Allow about 1 hour and 40 minutes for this part

Section II Pages 29–39

25 marks

- Attempt ONE question from Questions 32–35
- 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.

---

1 Which rock is formed at a mid-ocean ridge?

(A) Basalt

(B) Granite

(C) Limestone

(D) Sandstone

2 Which eon has the greatest diversity of fossil species?

(A) Hadean

(B) Archaean

(C) Proterozoic

(D) Phanerozoic

3 In which part of the atmosphere is the ozone layer found?

(A) Ionosphere

(B) Mesosphere

(C) Stratosphere

(D) Troposphere

4 Which activity associated with a volcanic eruption is most likely to affect global climate?

(A) Lahars at the base of the volcano

(B) Volcanic ash clouds at an altitude of 1000 metres

(C) Large lava flows on the upper flanks of the volcano

(D) Sulfur dioxide emissions from the volcano at a high altitude

5 Many people live on the slopes of active volcanoes.

What is the main reason for this?

(A) The water vapour from eruptions condenses and thus increases rainfall.

(B) The rocks formed from the lava weather rapidly resulting in more fertile soils.

(C) Volcanic eruptions increase local temperatures and this promotes better crop growth.

(D) Technology allows eruptions to be predicted and people are able to leave the slopes of the volcanoes before eruptions.

6 Which of the following best describes cyanobacteria?

(A) Simple photosynthetic organisms

(B) Simple chemosynthetic organisms

(C) Complex photosynthetic organisms

(D) Complex chemosynthetic organisms

7 Relative and absolute dating methods can be used to date the layers of a stratigraphic sequence.

Which type of rock can be used to give an absolute age date?

(A) Pyroclastic tuff

(B) Volcanic basalt

(C) Sedimentary mudstone

(D) Fossiliferous limestone

8 In which division of the Geological Time Scale can both the 'end Permian' and the 'end Cretaceous' mass extinction events be found?

(A) Mesozoic Era

(B) Palaeozoic Era

(C) Proterozoic Eon

(D) Phanerozoic Eon

9 With which of the following concerns have carbon dioxide emissions been linked?

(A) Acid rain and climate change

(B) Ozone depletion and acid rain

(C) Climate change and bioaccumulation

(D) Bioaccumulation and ozone depletion

10 What is a lateritic soil?

(A) A red-coloured soil with a low level of nutrients

(B) A coarse-textured soil with a high level of nutrients

(C) A dark-coloured soil, rich in calcium and aluminium

(D) A fine-textured soil with a high humus and water content

11 In which areas did Cambrian metazoans benefit from the evolution of hard body parts?

(A) Predation, protection and reproduction

(B) Reproduction, defence and predation

(C) Protection, defence and reproduction

(D) Defence, predation and protection

12 What did Australian scientists discover that contributed to our understanding of the ozone layer?

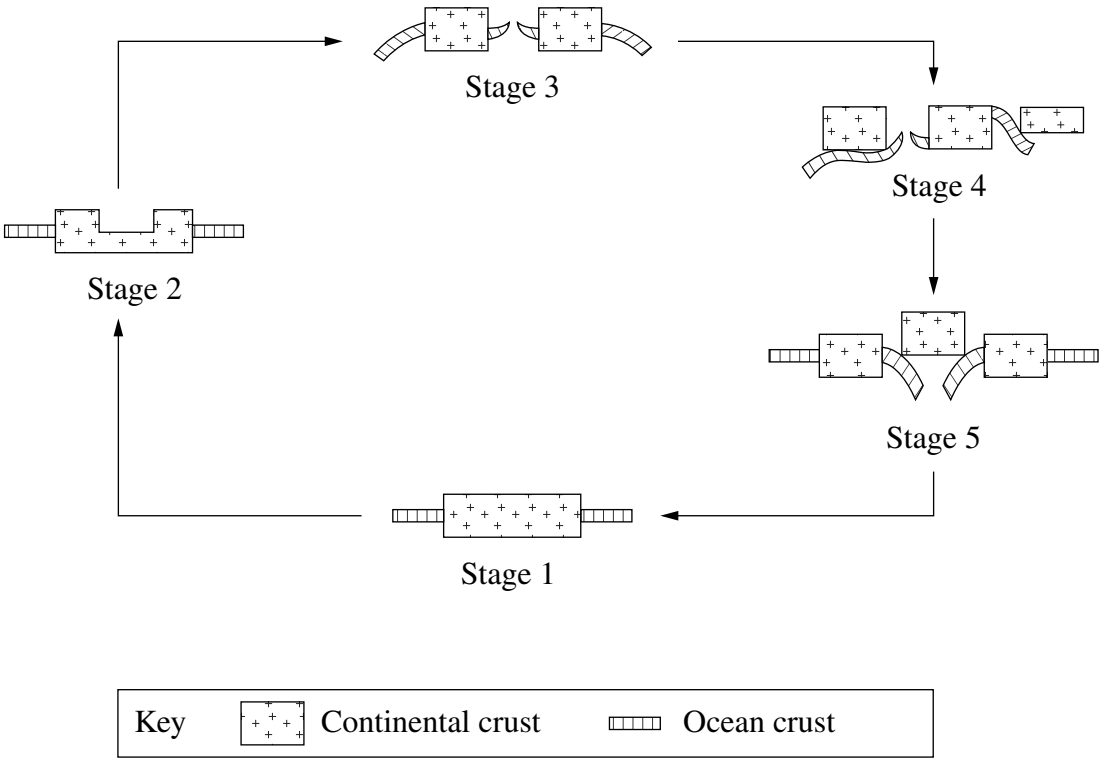
(A) A hole in the ozone layer over the Arctic

(B) A hole in the ozone layer over Antarctica

(C) The link between global warming and the depletion of the ozone layer

(D) The link between the use of CFCs and the depletion of the ozone layer

13 The diagram shows a model of the plate tectonic supercycle.



Which stage of the model best represents the formation of a rift valley?

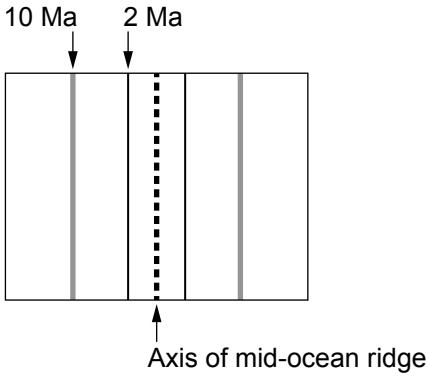
(A) Stage 2

(B) Stage 3

(C) Stage 4

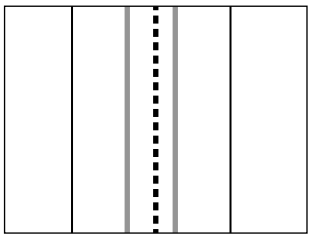
(D) Stage 5

14 The diagram represents part of an ocean basin. The present position of the axis of the mid-ocean ridge and the ages of two basalt flows are shown.

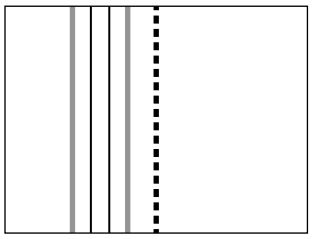


Which diagram represents the most likely configuration of the axis and basalt flows 4 million years ago?

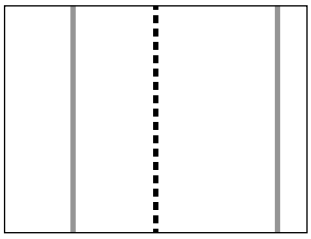
(A)



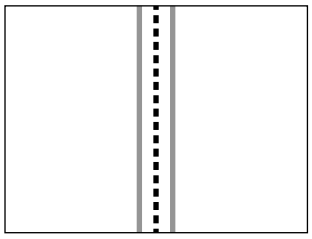
(B)



(C)



(D)



15 Why is the extinction of some of the Australian megafauna considered to be a smaller extinction event?

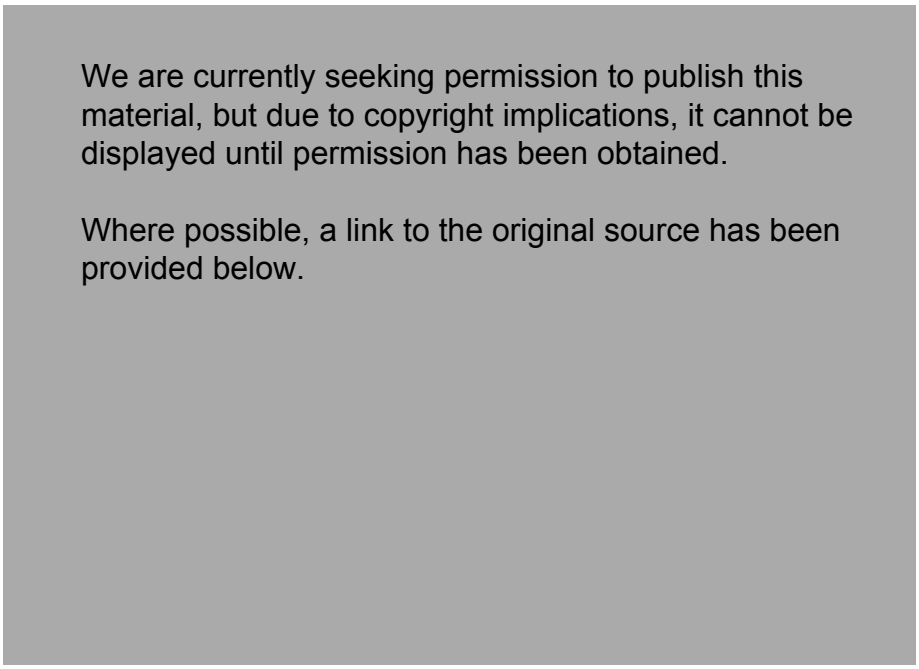
(A) Entire classes and orders were lost.

(B) Several species of megafauna were lost.

(C) Many megafauna were lost as a result of human activity.

(D) Many megafauna were lost as a result of climate change.

16 This diagram is a version of the Geological Time Scale.



Which of the following is a correct assessment of the diagram?

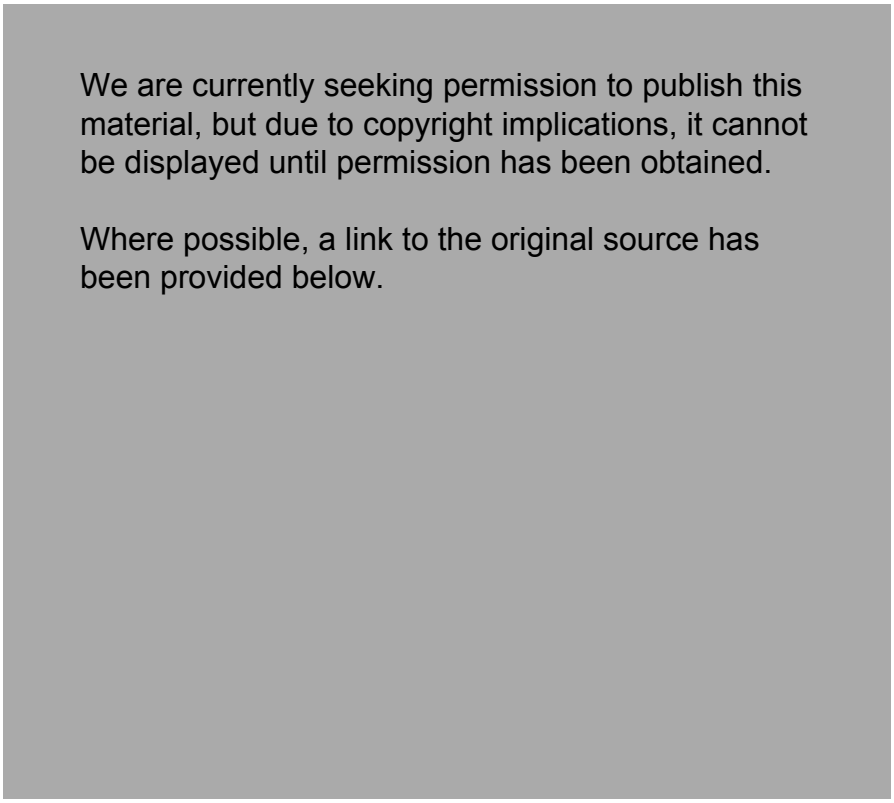
(A) Valid and reliable

(B) Valid but not reliable

(C) Reliable but not valid

(D) Neither reliable nor valid

17 The photos show stormwater entering a drain and, later, being discharged.



Before discharge of the stormwater, which processes must have occurred?

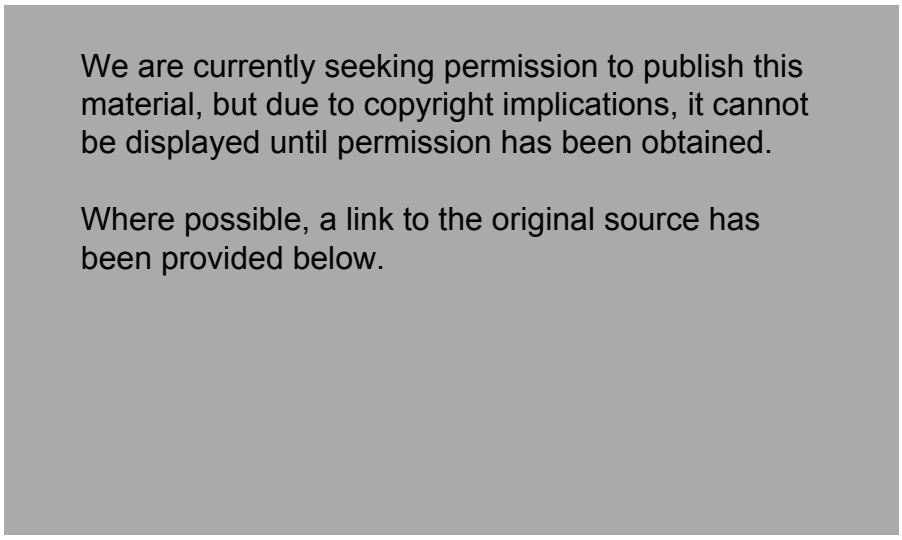
(A) Filtration and sterilisation

(B) Sedimentation and aeration

(C) Filtration and sedimentation

(D) Sedimentation and sterilisation

18 The diagram shows the Australian Plate and the adjacent plates.



What is likely to happen to the Australian Plate over the next one million years?

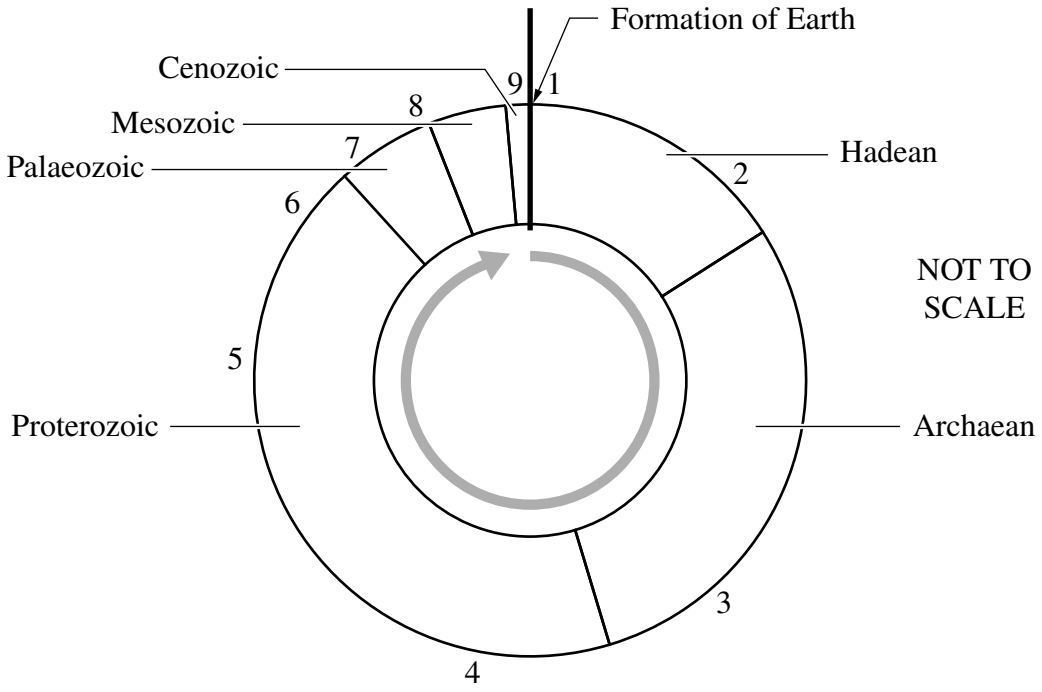
(A) The Australian Plate will collide with the Pacific and Eurasian Plates as it continues to move north.

(B) The Australian Plate will stop moving away from the Antarctic Plate as its rate of movement slows down.

(C) The eastern edge of the Australian Plate will change to a conservative boundary as the Australian Plate moves east.

(D) The Australian Plate will be subducted under the Pacific and Eurasian Plates, causing volcanic and seismic activity to cease.

19 The diagram shows a Geological Time Scale with some eons and eras labelled.



Which row of the table correctly matches the named events and the order in which they occurred?

	Eruption of Eastern Australian Basalts	*Deposition of Tasman Fold Belt Limestones*	*Cratonisation of the Yilgarn Block*	*Intrusion of the New England Granites*
(A)	8	6	1	9
(B)	9	7	3	8
(C)	1	5	4	6
(D)	2	4	5	7

20 The four photographs show experiments commonly used to demonstrate separation techniques.

I

We are currently seeking permission to publish this material, but due to copyright implications, it cannot be displayed until permission has been obtained.

Where possible, a link to the original source has been provided below.

II

We are currently seeking permission to publish this material, but due to copyright implications, it cannot be displayed until permission has been obtained.

Where possible, a link to the original source has been provided below.

III



© Dr Daniel A. Straus

IV

We are currently seeking permission to publish this material, but due to copyright implications, it cannot be displayed until permission has been obtained.

Where possible, a link to the original source has been provided below.

Which TWO photographs simulate separation methods that could be used to remove a dissolved contaminant from sewage?

(A) I and II

(B) I and IV

(C) II and III

(D) III and IV

BLANK PAGE

© 2016 Board of Studies, Teaching and Educational Standards NSW

Centre Number

Student Number

Section I (continued)

Part B – 55 marks
Attempt Questions 21–31
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 (8 marks)

(a) Explain how intraplate and plate margin earthquakes occur. **4**

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(b) Explain why some buildings can be damaged by earthquakes whereas others are not damaged. **4**

.....

.....

.....

.....

.....

.....

.....

.....

Question 22 (4 marks)

(a) Describe ONE method that is used to predict volcanic eruptions. **2**

.....

.....

.....

.....

.....

.....

(b) Give TWO reasons for continuing research into the prediction of volcanic eruptions. **2**

.....

.....

.....

.....

.....

.....

© 2016 Board of Studies, Teaching and Educational Standards NSW

Question 23 (4 marks)

Draw a labelled diagram to show how a convection cell model explains subduction and divergence at plate boundaries. **4**

Question 24 (4 marks)

(a) Outline ONE type of evidence that shows how life forms changed during the Cambrian event. **1**

.....

.....

.....

(b) Assess the validity of using computer simulations OR photographs to examine the changes in life forms during the Cambrian event. **3**

.....

.....

.....

.....

.....

.....

.....

.....

© 2016 Board of Studies, Teaching and Educational Standards NSW

Centre Number

Section I – Part B (continued)

Student Number

Question 25 (4 marks)

Explain why Banded Iron Formations show that life existed in primitive oceans. **4**

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Question 26 (8 marks)

(a) Distinguish between *diversity of fossils* and *numbers of fossils* at a fossil site. **2**

.....

.....

.....

.....

Use the source below to answer Question 26 (b).

Fossil sites near Sydney

Fossils have been found at many sites near Sydney. Some of these are no longer accessible but coastal exposures still give the amateur collector ample chance of finding good fossils. All of the fossils found near Sydney are from Triassic rocks around 240 million years old. Shale quarries have produced well preserved amphibian, fish, invertebrate and plant fossils. Very few quarries exist today so they are no longer a good source of fossils.

The coastal exposures of Triassic shales, particularly northwards from Turimetta Head have in the past produced, and still have the potential to produce, good fossil plant specimens. Rock-falls from the cliffs are usually the best places to look. Recent rock-falls are dangerous due to the higher probability of further falls so they should be avoided for reasons of safety.

Splitting boulders of grey shales in old rock-falls is often the best way to find good specimens. Never dig or excavate into a cliff as this could cause the cliff to collapse. Beware: the coastal exposures can be dangerous places because of falling rocks or rough seas and waves. There are often warning signs and you collect fossils here at your own risk.

© Australian Museum

Question 26 continues on page 19

Question 26 (continued)

(b) Before undertaking a first-hand investigation of a fossil site it is useful to look at secondary sources.

(i) Justify the use of the secondary source on page 18 in planning an investigation of a fossil site near Sydney. **2**

.....

.....

.....

.....

.....

.....

(ii) Describe the depositional environment of the Triassic rocks near Sydney. **2**

.....

.....

.....

.....

.....

.....

(iii) What information from the source would support your answer in part (b) (ii) above? **2**

.....

.....

.....

.....

.....

.....

End of Question 26

BLANK PAGE

© 2016 Board of Studies, Teaching and Educational Standards NSW

Question 27 (3 marks)

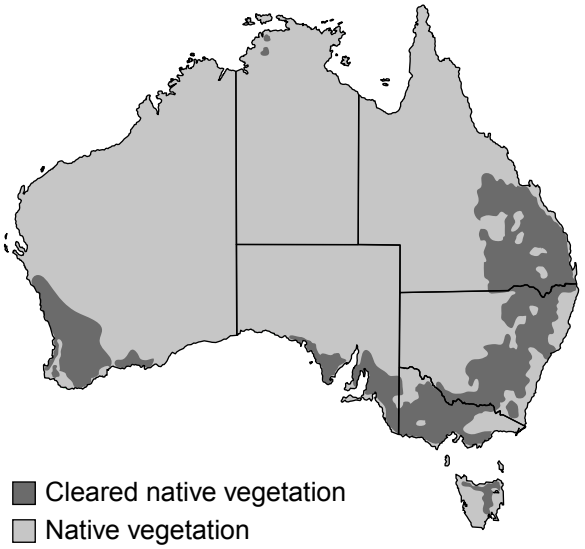
Complete the table to summarise ONE program OR strategy used to treat soil erosion at an agricultural site in NSW. **3**

Cause of soil erosion	....
Outline of program/strategy to overcome soil erosion	....
Evaluation of the program/ strategy	....

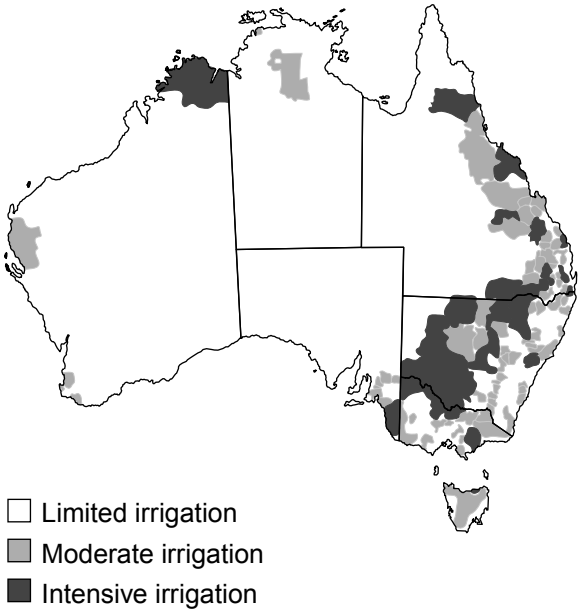
Question 28 (4 marks)

The maps show areas of land clearing, irrigation and soil salinity risk in Australia. **4**

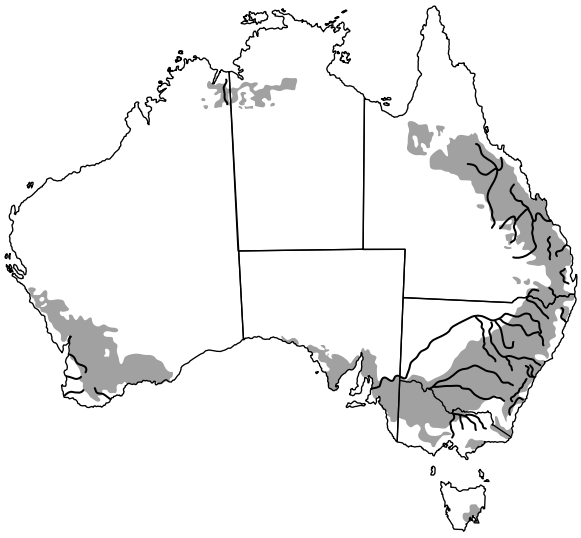
Map 1: Land clearing



Map 2: Irrigation areas



Map 3: Soil salinity risk in Australia



Adapted from the Australian Bureau of Statistics, 1997. National Land and Water Resources Audit 2001 © Commonwealth of Australia, 2001

Question 28 continues on page 23

Question 28 (continued)

Using information from the maps, analyse the relationships between the risk of soil salinity and the farming practices of land clearing and irrigation.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

End of Question 28

Question 29 (4 marks)

Justify the need to ban a specific pesticide in terms of its impacts on non-target species and human health. **4**

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

© 2016 Board of Studies, Teaching and Educational Standards NSW

Question 30 (5 marks)

The graph shows sources of methane emissions.

We are currently seeking permission to publish this material, but due to copyright implications, it cannot be displayed until permission has been obtained.

Where possible, a link to the original source has been provided below.

(a) Describe ONE local and ONE global strategy that would decrease methane emissions caused by human activity. Use information from the graph in your answer. **3**

.....

.....

.....

.....

.....

.....

.....

.....

Question 30 continues on page 26

Question 30 (continued)

(b) The graph shows that wetlands are the highest contributor to methane emissions. Why would it be unwise to target wetlands to reduce total methane emissions? **2**

.....

.....

.....

.....

End of Question 30

Question 31 (7 marks)

The diagram is a model of climate change and human occupation as potential causes of the extinction of some fauna in Australia and North America over the last 40 000 years. **7**

A model of potential causes of extinction

We are currently seeking permission to publish this material, but due to copyright implications, it cannot be displayed until permission has been obtained.

Where possible, a link to the original source has been provided below.

Using this model and ONE other model, assess the role of modelling as a tool to better understand natural and human processes studied in Earth and Environmental Science.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Question 31 continues on page 28

Question 31 (continued)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

End of Question 31

© 2016 Board of Studies, Teaching and Educational Standards NSW

Earth and Environmental Science

Section II

25 marks
Attempt ONE question from Questions 32–35
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.

Pages

Question 32 Introduced Species and the Australian Environment 30–31

Question 33 Organic Geology – a Non-renewable Resource 32–34

Question 34 Mining and the Australian Environment 35–37

Question 35 Oceanography 38–39

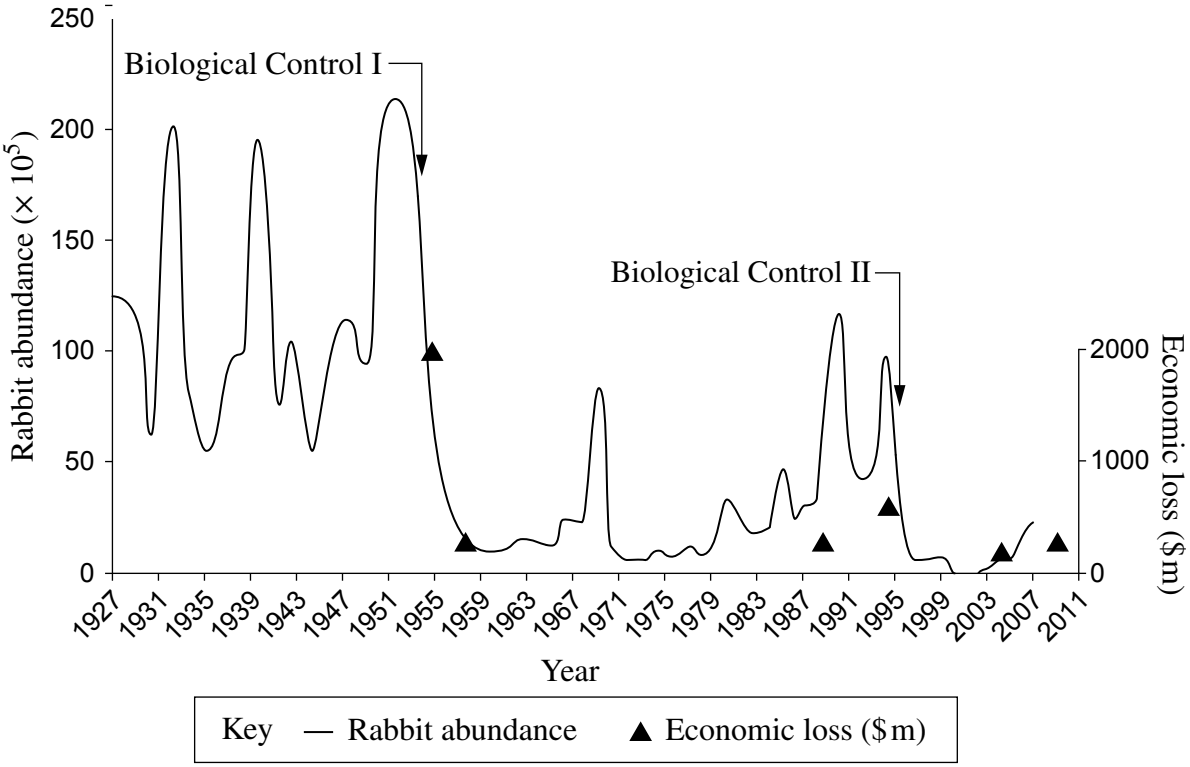
Question 32 — Introduced Species and the Australian Environment (25 marks)

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

(a) Describe TWO impacts of introduced species on the Australian environment. **3**

(b) Explain how a named introduced species can become well-established if it has high reproductive capacity and well-developed dispersal mechanisms. **4**

(c) The graph shows how rabbit abundance has varied over time in response to the release of biological control agents, and the estimated Australia-wide economic losses due to rabbits.



Cooke BD, Chudleigh P, Simpson S & Saunders G (2013). Economic benefits of the biological control of rabbits in Australia. Figure prepared by Brian Cooke as Lead Author on Paper.

(i) Describe TWO trends shown in the graph. **2**

(ii) Predict the effectiveness of using biological controls for rabbit management, in terms of sustainability of the ecosystem and economic loss. Use data from the graph in your answer. **4**

Question 32 continues on page 31

Question 32 (continued)

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

(d) (i) Propose a plan for a first-hand investigation to identify, classify and account for the presence of non-indigenous species in a named ecosystem. **4**

In your plan include:

- the ecosystem to be investigated
- the type of data to be collected
- the equipment and materials you would use
- the method of recording your data for your results.

(ii) Outline the main features of the Bradley method which is used to remove non-indigenous species in bush regeneration. **2**

(e) To what extent has Australian society changed its attitude to introduced species over time? Justify your answer using examples. **6**

End of Question 32

Question 33 — Organic Geology – a Non-renewable Resource (25 marks)

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

(a) Describe TWO methods of building design that conserve energy. **3**

(b) The photograph shows coal exposed in a cliff face. **4**



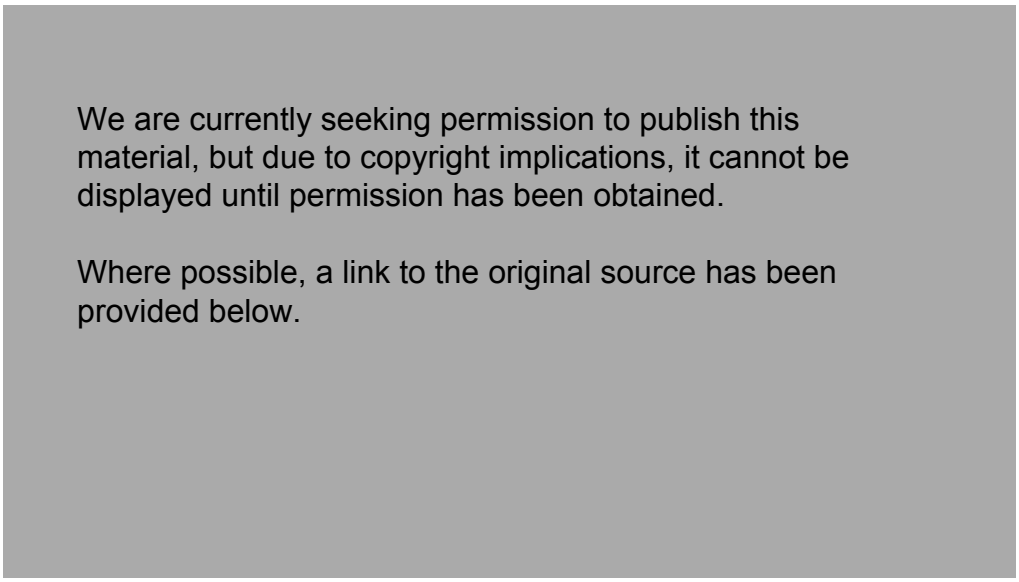
Discuss how an exploration program that includes drilling could be used to determine whether these coal layers have the potential to be mined.

Question 33 continues on page 33

Question 33 (continued)

(c) The graph shows the production and consumption of oil and coal in Australia, 1990 to 2012.

Production and consumption of oil and coal



(i) Describe TWO trends shown in the graph. **2**

(ii) Predict the long-term sustainability of fossil fuel resources in Australia. Use data from the graph in your answer. **4**

Question 33 continues on page 34

Question 33 (continued)

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

(d) (i) Propose a plan for a first-hand investigation to test the energy efficiency of alternative energy sources. **4**

In your plan include:

- the type of data to be collected
- the equipment and materials you would use
- the method of recording your data for your results.

(ii) Outline TWO uses of coal as a raw material for industry. **2**

(e) To what extent has Australian society changed its attitude over time to using alternative energy sources instead of fossil fuels? Justify your answer using examples. **6**

End of Question 33

Question 34 — Mining and the Australian Environment (25 marks)

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

(a) Describe ONE model used to explain mineralisation in an island arc terrane. **3**

(b) The photograph shows an abandoned tin mine. **4**

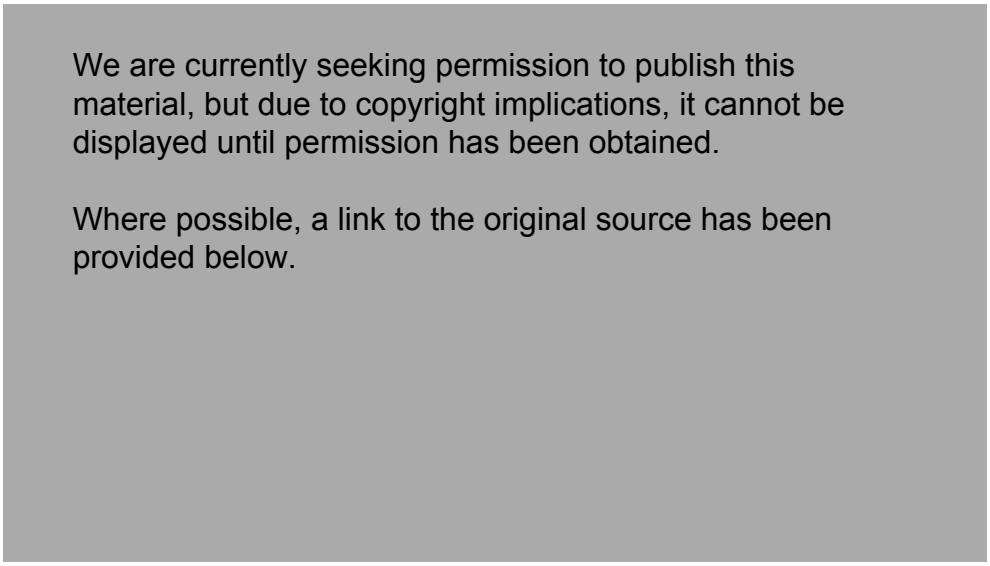


Discuss key issues that should have been included in an Environmental Impact Statement prior to the commencement of this mine.

Question 34 continues on page 36

Question 34 (continued)

(c) The graph shows the price and world production of copper between 1900 and 2010.



(i) Describe TWO trends shown in the graph. **2**

(ii) Predict the feasibility of mining metals such as copper in the long term. Use data from the graph in your answer. **4**

Question 34 continues on page 37

Question 34 (continued)

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

(d) (i) Propose a plan for a first-hand investigation to test for the presence of ore minerals in rocks using either a geophysical method OR geochemical method. **4**

In your plan include:

- the type of data to be collected
- the equipment and materials you would use
- the method of recording your data for your results.

(ii) Outline the role of drilling in determining the size and grade of a metal deposit. **2**

(e) To what extent has Australian society changed its approach to exploration methods for mineral deposits over time? Justify your answer using examples. **6**

End of Question 34

Question 35 — Oceanography (25 marks)

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

(a) Describe TWO ways in which the oceans influence conditions on Earth's surface. **3**

(b) Explain how the attenuation of light in oceans influences the distribution of marine plants. **4**

(c) The graph shows how the solubility of common salts in water changes with increased temperature.

We are currently seeking permission to publish this material, but due to copyright implications, it cannot be displayed until permission has been obtained.

Where possible, a link to the original source has been provided below.

(i) Describe TWO trends shown in the graph. **2**

(ii) Predict how the solubility of common salts may vary both within and between oceans and small enclosed seas. Use data from the graph in your answer. **4**

Question 35 continues on page 39

Question 35 (continued)

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

(d) (i) Propose a plan for a first-hand investigation to demonstrate the effect of surface area to volume ratio of solids on their cooling rate in water. **4**

In your plan include:

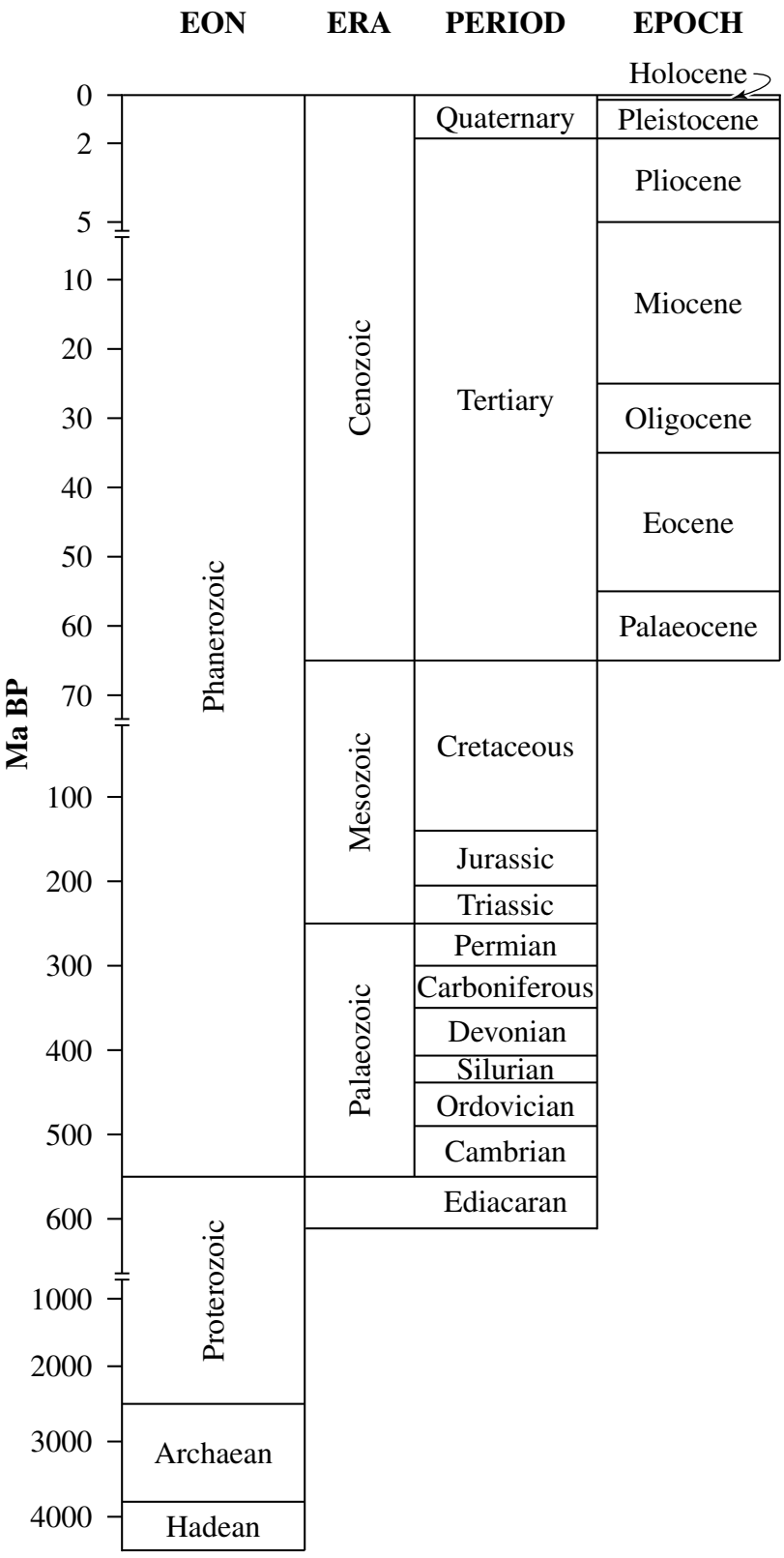
- the type of data to be collected
- the equipment and materials you would use
- the method of recording your data for your results.

(ii) Outline the main characteristics of a deep-sea hydrothermal vent. **2**

(e) To what extent has Australian society changed its attitude towards the use of oceans as a resource over time? Justify your answer using examples. **6**

End of paper

Geological Time Scale



© 2016 Board of Studies, Teaching and Educational Standards NSW