NSW EDUCATION STANDARDS AUTHORITY

2017

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
- NESA 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, 19, 21 and 23

Total marks: 100

Section I – 75 marks (pages 2–24)

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 21–29
- Allow about 1 hour and 40 minutes for this part

Section II – 25 marks (pages 25–33)

- Attempt ONE question from Questions 30–33
- 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 Mountains formed at a mid-ocean ridge are associated with which type of plate boundary?

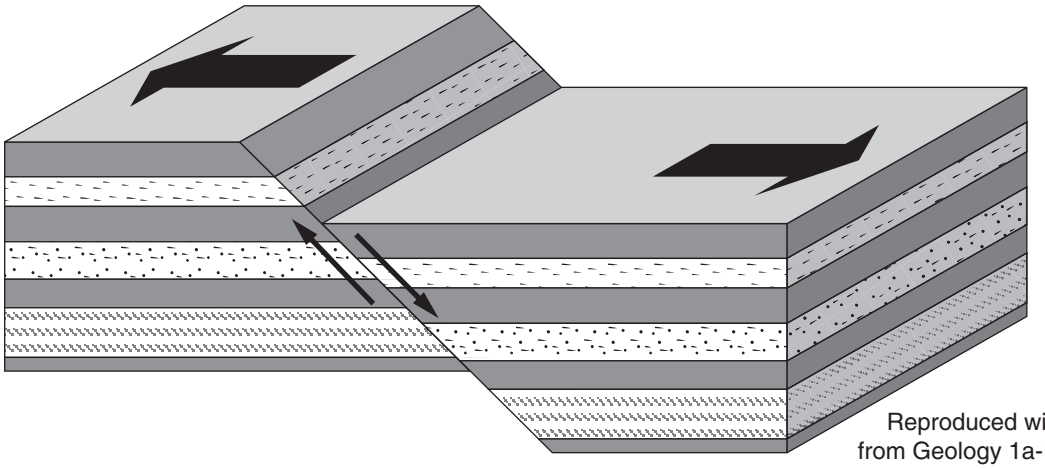
A. Thermal

B. Divergent

C. Convergent

D. Conservative

2 A diagram of a fault is shown.



What type of fault is shown in the diagram?

A. Thrust

B. Normal

C. Reverse

D. Transverse

3 Which gas is needed to make ozone in the upper atmosphere?

A. Oxygen

B. Methane

C. Nitrogen

D. Carbon dioxide

4 Which of the following is best explained by the plate tectonic super-cycle?

A. Cyclical patterns of volcanic eruptions

B. Break-up and formation of supercontinents

C. Cycling of oceanic crust back into Earth's mantle

D. Mass extinctions at the end of geological time periods

5 Which type of plate boundary is most often associated with volcanic eruptions and major destructive earthquakes?

A. Ocean–ocean divergent

B. Ocean–continent convergent

C. Ocean–continent conservative

D. Continent–continent convergent

6 What type of earthquake would have its focus on the Australian continent?

A. Intra-plate earthquake

B. Plate edge earthquake

C. Intra-margin earthquake

D. Plate margin earthquake

7 Which statement correctly relates to the oxygen that was used in the formation of the Australian Banded Iron Formations (BIFs)?

A. The oxygen came from photosynthetic terrestrial plants.

B. The oxygen in the atmosphere alternated from high to low.

C. The oxygen was dissolved in water when Earth was formed.

D. The oxygen came from photosynthetic organisms living in water.

8 Which combination of slope and rock type would be the most appropriate for the location of a waste dump?

	Slope	*Rock type*
A.	Steep	Granite
B.	Steep	Sandstone
C.	Gentle	Limestone
D.	Gentle	Claystone

9 Which of the following should be used to rehabilitate a mine site contaminated with toxic metals?

A. Collect and remove acid rain

B. Treat tailings and wastewater

C. Seed the area with native vegetation

D. Place wooden barriers over old mine shafts

10 Which strategy would be most effective in reversing damage to salt-affected crop land?

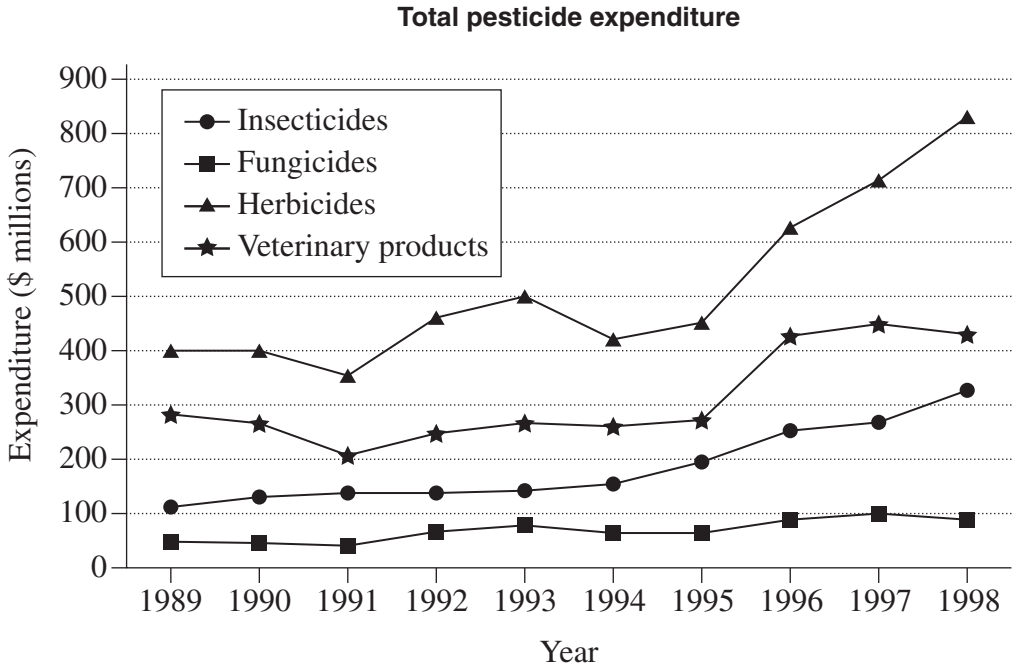
A. Establishing channels to drain excess water away from a site

B. Applying mulch to improve soil conditions and reduce evaporation

C. Pumping water into the groundwater to lower its salt concentration

D. Establishing subsurface banks to direct shallow water away from a site

11 The graph shows total expenditure for pesticides from 1989–1998.



For which pesticide was there the greatest percentage increase in expenditure between 1989 and 1998?

A. Fungicides

B. Herbicides

C. Insecticides

D. Veterinary products

12 The photograph shows a large boulder and broken trees resulting from the Mount St Helens eruption of 1980.

Which volcanic hazard caused this change in the landscape?

A. Ash

B. Lahar

C. Lava flow

D. Poisonous gas

13 Terrestrial plants, amphibians and reptiles all evolved from ancestors that lived in an aquatic environment.

Which adaptation did all three groups need in order to live successfully in a terrestrial environment?

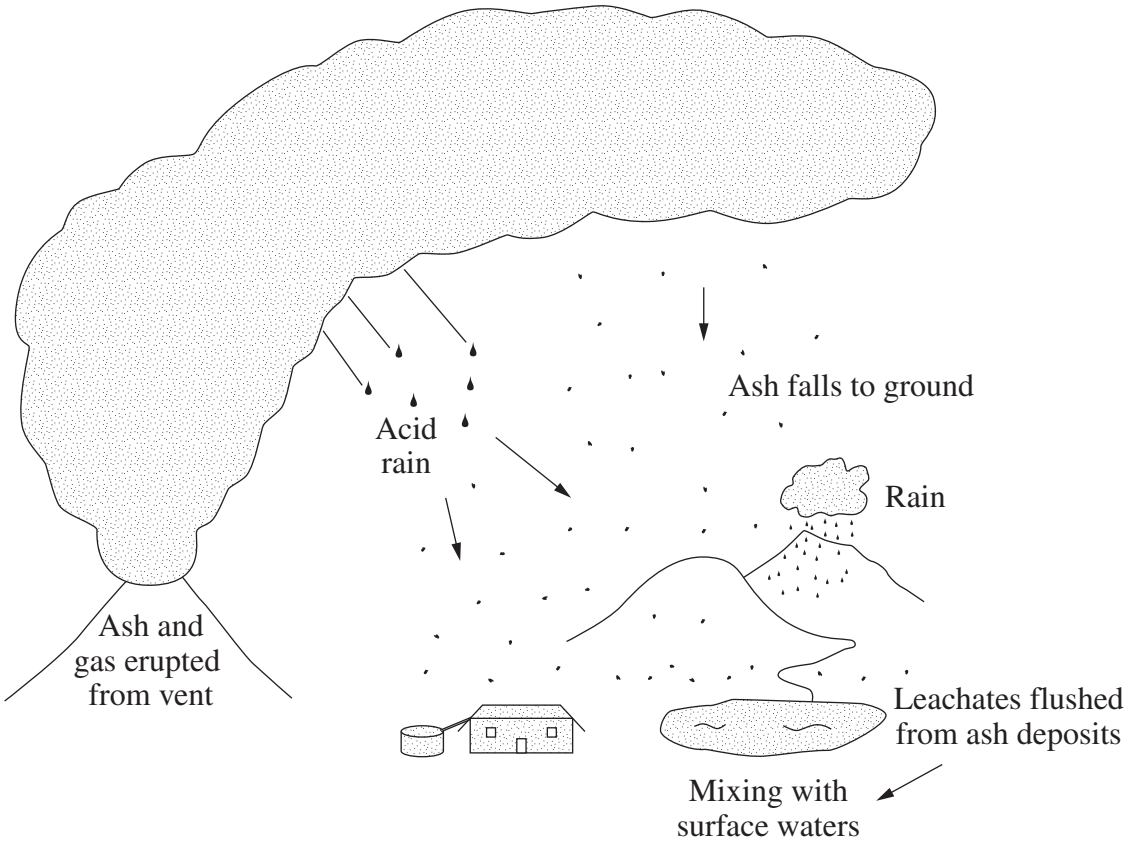
A. A skeletal system for support

B. An egg with a shell to prevent drying out

C. A system of cellular respiration that used oxygen

D. An external covering to reduce the loss of water from tissues

14 The diagram shows products of a volcanic eruption.



Which TWO hazards are formed following this eruption?

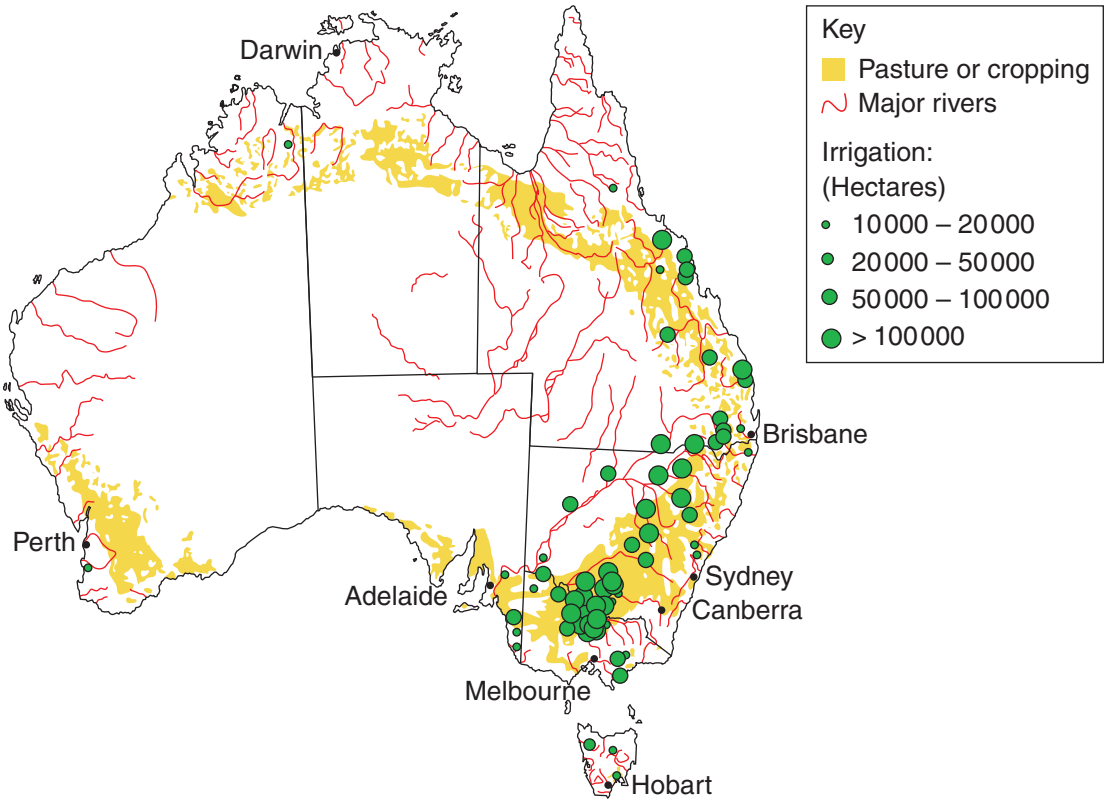
A. Acid rain and after shocks

B. Pyroclastic flows and ash clouds

C. Reduction in global temperatures and lava flows

D. Production of toxic gases and contaminated waters

15 The map shows land use and areas of irrigation in Australia.



According to the map, which region has the greatest risk of salinity?

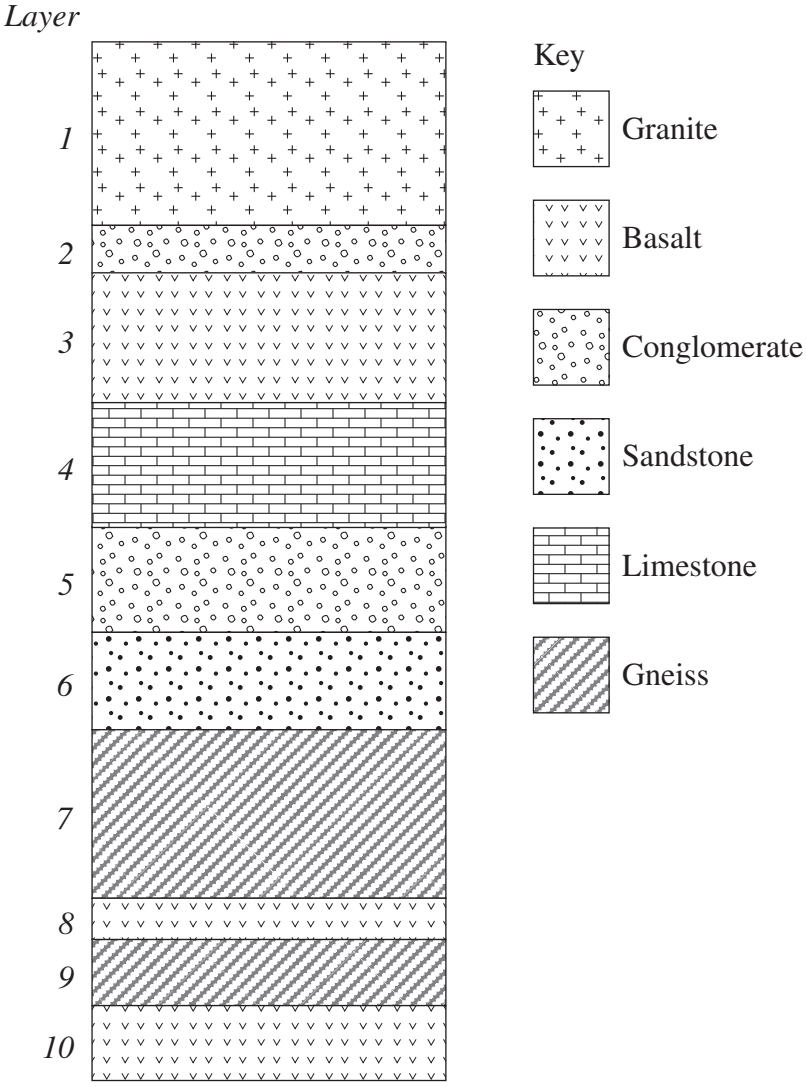
A. Central Australia

B. Northern Australia

C. South-east Australia

D. South-west Australia

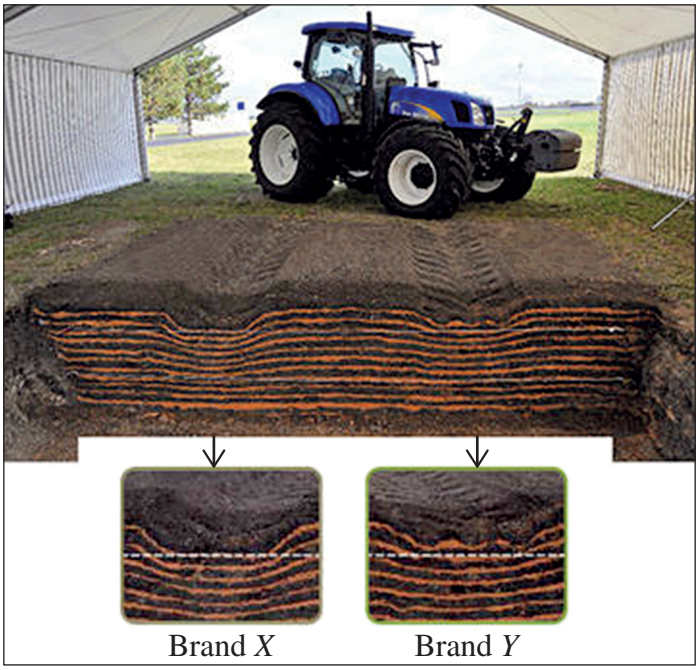
16 The diagram shows a stratigraphic column.



Which row in the table correctly identifies a dating technique for determining the ages of both *Layer 4* and *Layer 9* in this stratigraphic column?

	Layer 4	*Layer 9*
A.	Absolute dating of layers above and below	Relative dating with fossils
B.	Absolute dating of layers above and below	Absolute dating of layers above and below
C.	Relative dating with fossils	Absolute dating of layers above and below
D.	Relative dating with fossils	Relative dating with fossils

17 The diagram shows an experiment to test the effects of two brands of tractor tyres on layers of soil.



Which row of the table correctly identifies the variables and a valid conclusion for this experiment?

	Independent variable	*Dependent variable*	*Conclusion*
A.	Brand of tyre	Amount of compaction	Brand *Y* tyres cause more compaction
B.	Amount of compaction	Brand of tyre	Brand *Y* tyres cause less compaction
C.	Amount of compaction	Brand of tyre	Brand *Y* tyres cause more compaction
D.	Brand of tyre	Amount of compaction	Brand *Y* tyres cause less compaction

18 Which is the most likely group of Australian fauna to have become extinct because of the 'catastrophic' Cretaceous mass extinction?

A. Giant lizards such as *Megalania*

B. Flightless birds such as*Genyornis*

C. Large dinosaurs such as *Australovenator*

D. Herbivorous marsupials such as *Diprotodon*

19 Based on stable isotopic evidence, which of the following can be inferred to have existed approximately 3.8×10^9 years ago?

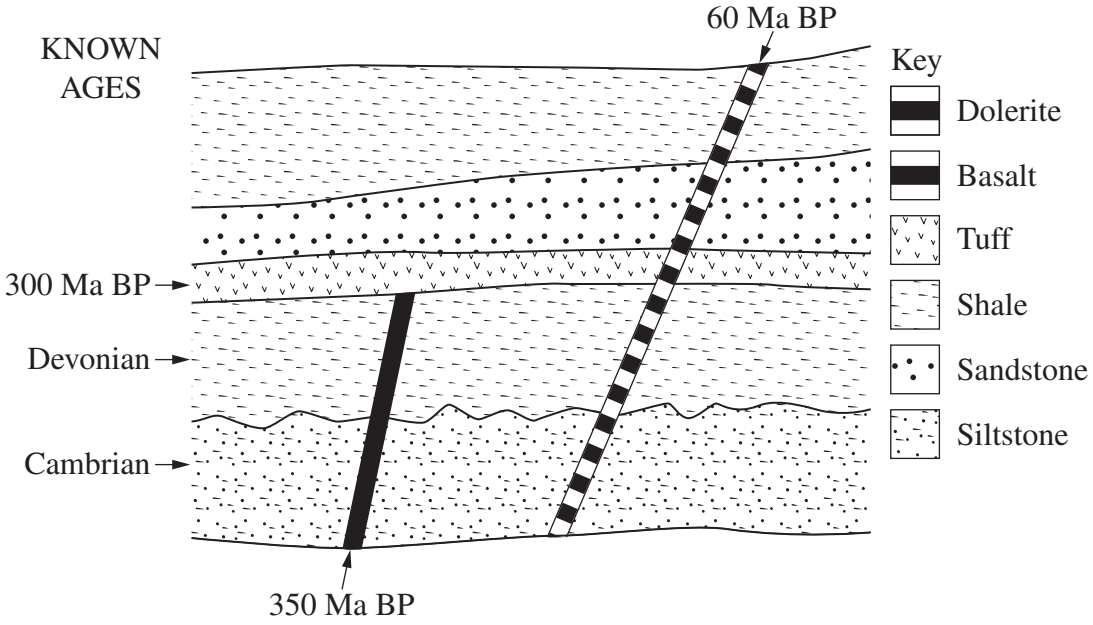
A. Ediacaran fauna

B. Photosynthetic algae

C. Prokaryotic cyanobacteria

D. Bacteria-like cells lacking nuclei

20 A stratigraphic sequence is shown.



What is the best estimate of the age of a fossil found in the sandstone?

A. Permian

B. Carboniferous

C. Older than 300 Ma BP

D. Younger than 60 Ma BP

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Centre Number

Earth and Environmental Science

Student Number

Section I (continued)

Part B – 55 marks
Attempt Questions 21–29
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 (9 marks)

Answer parts (a)–(c) in relation to ONE specific natural disaster associated with tectonic activity.

Name of specific natural disaster .....

(a) Outline TWO features of the named natural disaster associated with tectonic activity. **2**

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(b) Explain the tectonic movement or process that resulted in this disaster. **3**

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Question 21 continues on page 14

Question 21 (continued)

(c) Justify TWO possible ways of minimising the effects of this type of natural disaster in the future. **4**

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Question 22 (4 marks)

Explain how the planting of native vegetation could address TWO land management issues associated with agricultural land. **4**

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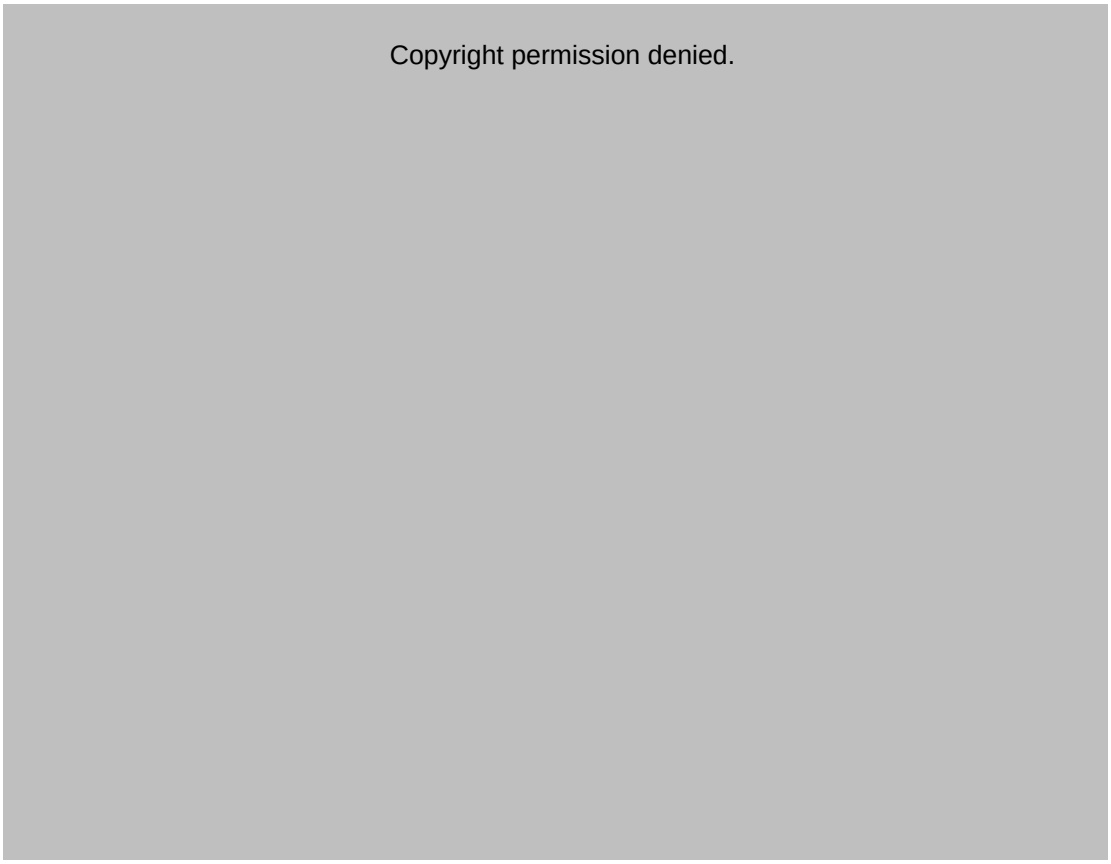
Question 23 (6 marks)

Please turn over

Question 23 (6 marks)

The diagram provides the date, the volume of ejecta and the Volcanic Explosivity Index (VEI) of a range of volcanic eruptions.



(a) Identify TWO trends in this diagram. **2**

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Question 23 continues on page 17

Question 23 (continued)

(b) Describe ONE strength of the diagram as a model of volcanic activity. **2**

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(c) Describe ONE weakness of the diagram as a model of volcanic activity. **2**

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End of Question 23

Question 24 (6 marks)

> In November 2016, the Federal Government announced plans to change water allocations along the Murray-Darling River System. The proposal will cut the amount of water set aside for environmental flows and increase the amount of water released to farmers for irrigation and watering stock. Murray-Darling Basin Authority Chief Executive, Phillip Glyde, said the changes, struck a 'sensible balance between social, economic and environmental interests'.

To what extent do changes to water allocations, such as those proposed for the Murray-Darling River System, affect the sustainability of Australian river systems? **6**

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Question 25 (7 marks)

(a) An investigation to simulate a process used in the treatment of liquid waste is to be carried out in a school laboratory. Draw a diagram to show such a simulation. Use labels to both identify the apparatus and describe the process. **4**

(b) Assess ONE method currently used for the disposal OR recycling of solid waste. **3**

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Question 26 (6 marks)

In Earth and Environmental Science, you have undertaken both first-hand and secondary source investigations.

(a) Explain why a secondary source must be reviewed for its reliability. **3**

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(b) Name a first-hand investigation and explain why it is better undertaken by a team. **3**

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Question 27 (8 marks)

(a) How can fossils be used as evidence for evolution? **2**

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(b) Describe ONE advantage a terrestrial environment offered for the first land plants that evolved from ancestors that lived in an aquatic environment. **2**

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Question 27 continues on page 22

(c) The diagram shows one possible evolutionary tree for a range of Australian songbirds. **4**

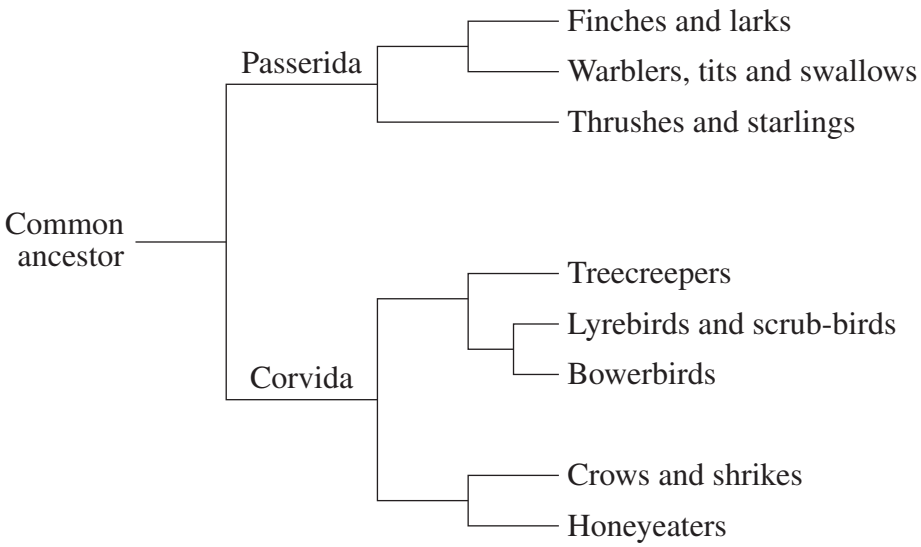

Figure from Charles G Sibley and John E Ahlquist (1985). The total Phylogency and Classification of the Australo-Papuan Passerine Birds, Emu – Austral Ornithology, 85:1, 1–14

Explain the process of evolution by which this range of Australian songbirds could have developed from a common ancestor.

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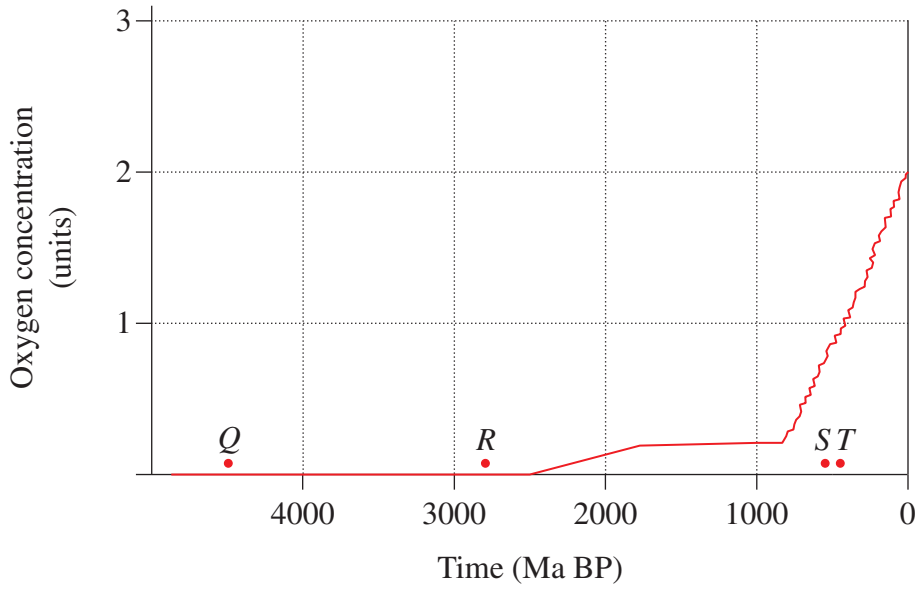
End of Question 27

Question 28 (4 marks)

The graph shows the oxygen concentration in Earth's atmosphere over time. **4**



Complete the table using information from the graph and your own knowledge of the history of life on Earth.

Point on graph	*Age* (Ma BP)	*Typical life form*	*Major event*
Q			Formation of Earth
R	2800	Stromatolites	
S			Cambrian explosion
T	450		First life on land

Question 29 (5 marks)

Compare TWO hypotheses that have been used to explain the mass extinction either at the end of the Permian Period OR at the end of the Cretaceous Period. **5**

Name of Period .....

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Earth and Environmental Science

Section II

25 marks
Attempt ONE question from Questions 30–33
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.

Question 30 — Introduced Species and the Australian Environment (25 marks)

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

(a) Name an introduced animal and describe the characteristics that led to it becoming a pest. **3**

(b) Name an introduced plant and explain the advantages of using a successful biological method to control it. **4**

(c) A section of an incoming passenger card for Australia is shown.

Incoming passenger card • Australia	PLEASE X AND ANSWER EVERY QUESTION – IF UNSURE, Yes X	
PLEASE COMPLETE IN ENGLISH WITH A BLUE OR BLACK PEN	Are you bringing into Australia:	
Family name/surname _____	1. Meat, poultry, fish, seafood, eggs, dairy, fruit, vegetables?	Yes_ No_
Given names_____	2. Grains, seed, bulbs, straw, nuts, plants, parts of plants, traditional medicines or herbs, wooden articles?	Yes_ No_
Passport number_____	3. Animals, parts of animals, animal products including equipment, pet food, eggs, biologicals, specimens, birds, fish, insects, shells, bee products?	Yes_ No_
Flight number or name of ship _____	4. Soil, items with soil attached or used in freshwater areas eg sports/ recreational equipment, shoes?	Yes_ No_
	5. Have you been in contact with farms, farm animals, wilderness areas or freshwater streams/lakes etc in the past 30 days?	Yes_ No_

DECLARATION	**YOUR SIGNATURE**	Day	Month	Year
The information I have given is true, correct and complete. I understand failure to answer any questions may have serious consequences.	_____	_ _	_ _	_ _ _ _

(i) Describe why incoming passengers are required to complete questions 1–5 on the card before entering Australia. **2**

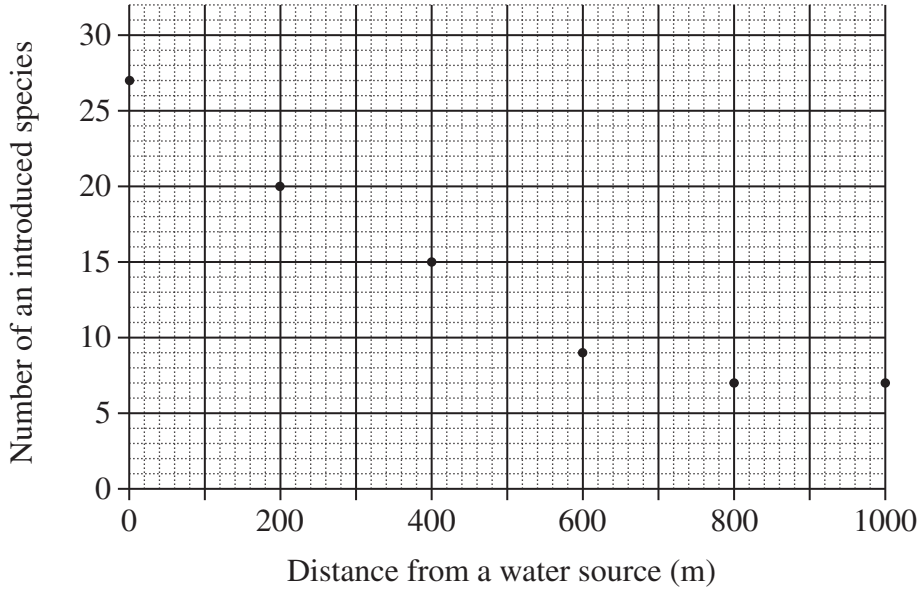
(ii) Explain how a breach of quarantine regulations could affect the biotic and abiotic features of Australia. Use examples to support your answer. **4**

Question 30 continues on page 27

Question 30 (continued)

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

(d) The graph shows the relationship between the number of individuals of an introduced species and the distance from a water source.



(i) Identify the independent variable shown in the graph. **1**

(ii) Identify the overall trend shown in the graph. **1**

(iii) Construct a table to display the data shown in the graph. **4**

(e) Evaluate strategies which can be used to rehabilitate an ecosystem that has been affected by an introduced species. Use examples to support your answer. **6**

End of Question 30

Question 31 — Organic Geology – a Non-renewable Resource (25 marks)

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

(a) Describe the properties of gaseous fossil fuels in terms of their energy yield. **3**

(b) Compare the formation of coal with the formation of oil. **4**

(c) The diagram below shows one type of technology used by geologists to search for petroleum.

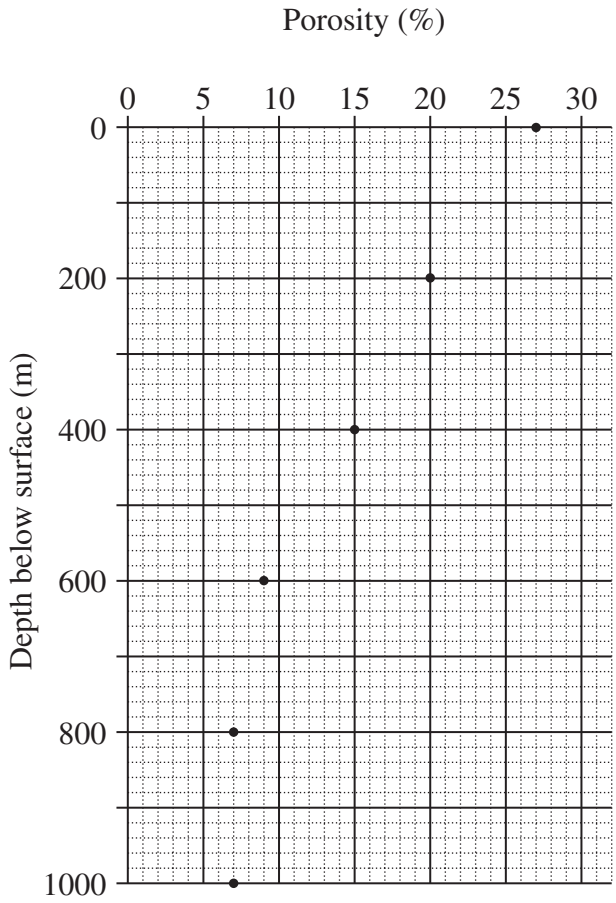
(i) Describe the technology illustrated in the diagram. **2**

(ii) Explain how an exploration method other than that used in part (c) (i) can show the presence of a coal seam. **4**

Question 31 continues on page 29

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

(d) The graph shows the relationship between porosity and depth in a petroleum drill hole.



(i) Identify the independent variable shown in the graph. **1**

(ii) Identify the overall trend shown in the graph. **1**

(iii) Construct a table to display the data shown in the graph. **4**

(e) Evaluate the environmental impact of modern society's continued dependence on fossil fuels. Use examples to support your answer. **6**

End of Question 31

Question 32 — Mining and the Australian Environment (25 marks)

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

(a) Describe ONE model that explains how an ore body forms in a sedimentary environment. **3**

(b) Explain how an Environmental Impact Statement can be used to reduce the impact of mining on the environment. **4**

(c) The image shows an abandoned metalliferous mine.

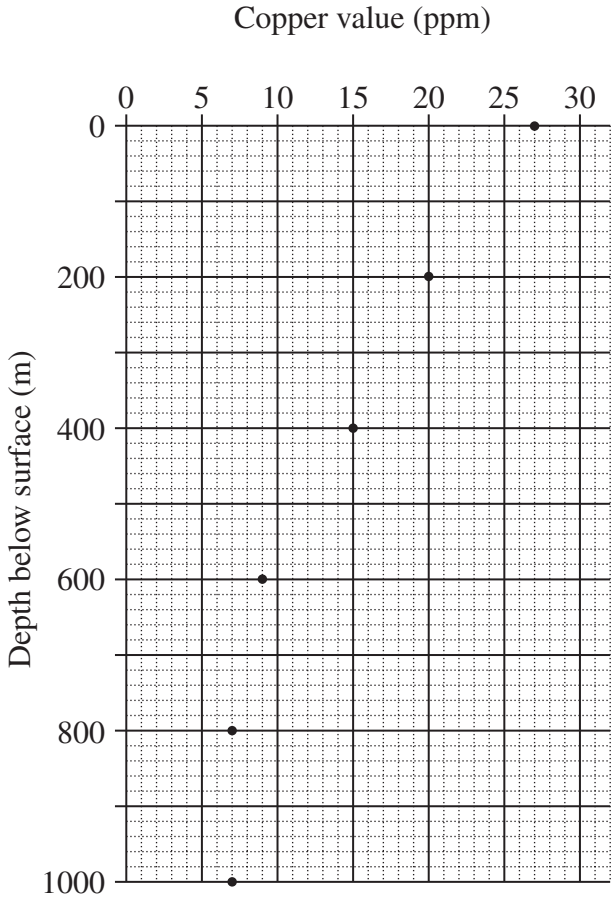
(i) Describe ONE method that may have been used in the exploration of a deposit such as the one shown in the image. **2**

(ii) Explain how the economic value of a deposit, such as the one shown, would have been assessed. **4**

Question 32 continues on page 31

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

(d) The graph shows the relationship between copper value and depth in a drill hole.



(i) Identify the independent variable shown in the graph. **1**

(ii) Identify the overall trend shown in the graph. **1**

(iii) Construct a table to display the data shown in the graph. **4**

(e) Evaluate the effects of technology and government policies on the modern mining industry. Use examples to support your answer. **6**

End of Question 32

Question 33 — Oceanography (25 marks)

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

(a) Describe ONE type of mass motion of ocean waters. **3**

(b) Explain how hydrothermal waters (brines) leach or scavenge elements from rocks. **4**

(c) Oceanographers use technology to explore the world's oceans.

(i) Describe ONE technology that could be used by the ship to gather information about the ocean. **2**

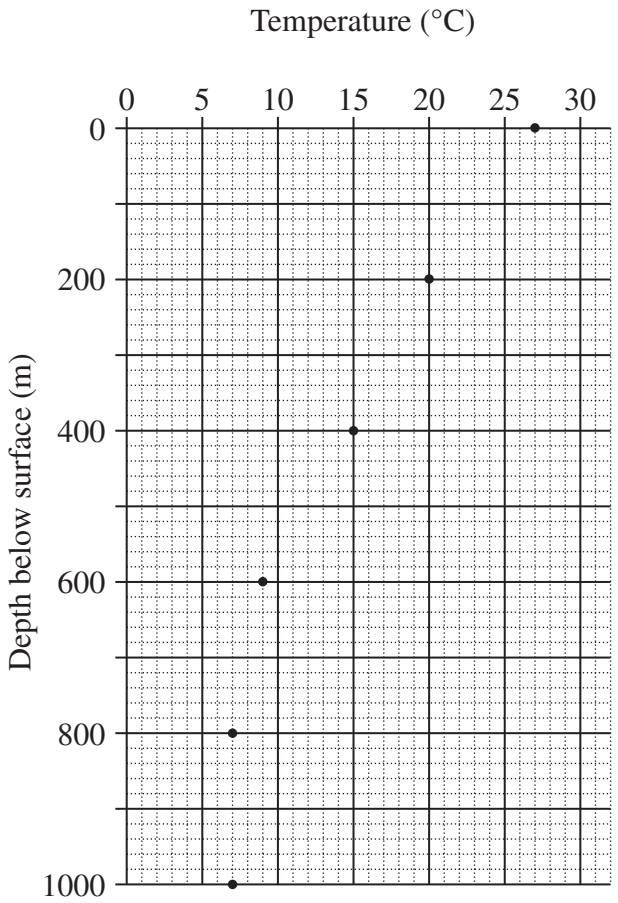
(ii) Explain how a technology, other than that used in part (c) (i), provides information about the ocean. **4**

Question 33 continues on page 33

Question 33 (continued)

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

(d) The graph shows the relationship between temperature and depth in an ocean.



(i) Identify the independent variable shown in the graph. **1**

(ii) Identify the overall trend shown in the graph. **1**

(iii) Construct a table to display the data shown in the graph. **4**

(e) Evaluate the effectiveness of laws which relate to the management of the world's oceans. Use examples to support your answer. **6**

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Geological Time Scale