BOSTES BOARD OF STUDIES TEACHING & EDUCATIONAL STANDARDS NSW

2014 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 or blue pen
  Black pen is preferred
- 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 17, 21, 25, 29 and 31

Total marks – 100

Section I Pages 2–33

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 21–30
- Allow about 1 hour and 40 minutes for this part

Section II Pages 35–44

25 marks

- 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 of the following best describes the lithosphere?

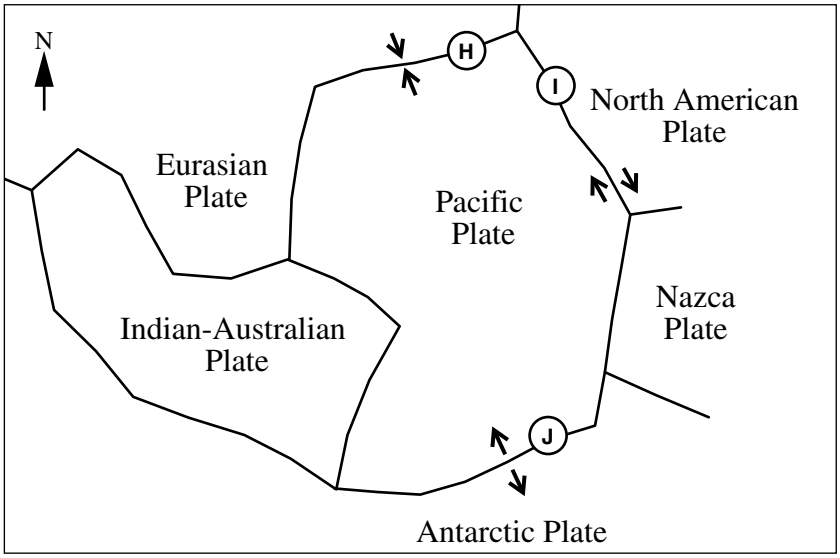
(A) Layers of solid rock which occur within the earth

(B) The upper fluid layer of the mantle which transports the tectonic plates

(C) The combined layer of crust and solid upper mantle which forms the tectonic plates

(D) The thin outermost layer of the earth which consists of both continental and oceanic crust

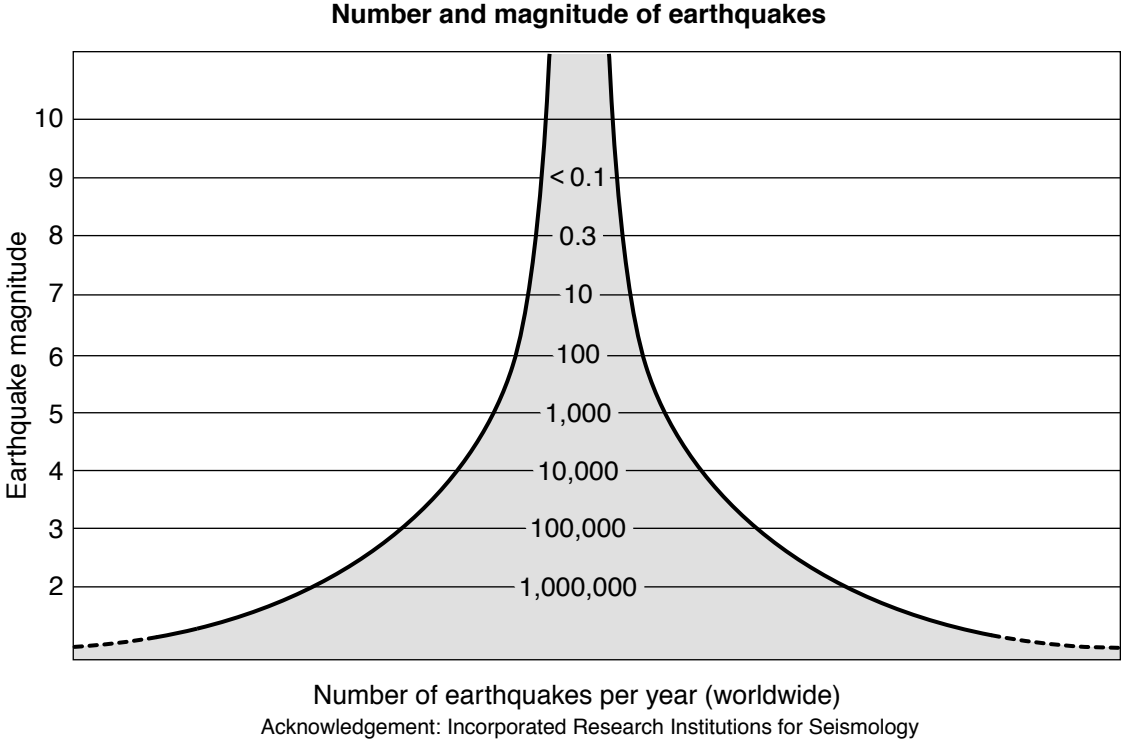
2 The sketch shows the direction of movement at three boundaries of the Pacific Plate.



What are the types of boundaries at **H**, **I** and **J**?

	H	*I*	*J*
(A)	Convergent	Divergent	Conservative
(B)	Conservative	Convergent	Divergent
(C)	Divergent	Conservative	Convergent
(D)	Convergent	Conservative	Divergent

3 The diagram shows the relationship between earthquake magnitude and the number of earthquakes per year.



Newcastle was the location of the epicentre of a 5.6 magnitude earthquake in 1989.

On average, how often does an earthquake with the same magnitude as the Newcastle earthquake occur somewhere in the world?

(A) Every day

(B) Every week

(C) Every year

(D) Every ten years

4 In 2010, a series of volcanic eruptions in Iceland resulted in large ash clouds being ejected as high as 4000 metres. However, the ash did not reach the upper layers of the atmosphere.

Which of the following was the most likely result of this eruption?

(A) Cooler local temperatures for a short time

(B) Warmer local temperatures for a short time

(C) Cooler global temperatures for more than one year

(D) Warmer global temperatures for more than one year

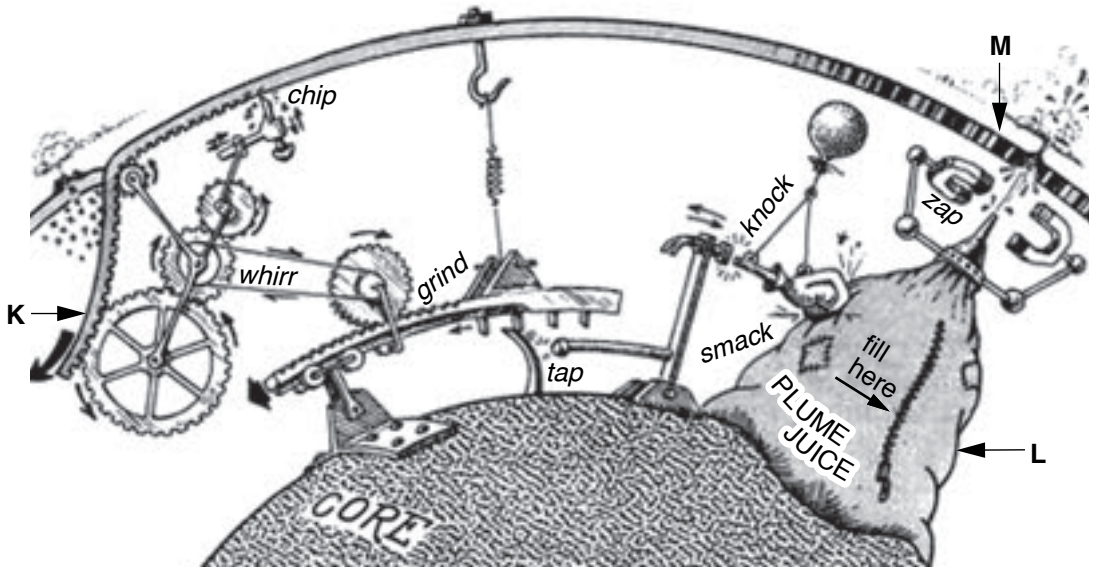
5 The table compares the characteristics of three separate volcanic eruptions.

Volcano	*Main products of an eruption*	*Physical features of the volcanic region*	*Hazards associated with the volcano*
X	Basaltic lava; few or no pyroclastics	Round domes of quickly cooled lava; narrow, steep-sided valleys; hot springs and geysers	Poisonous gases
Y	Extensive, low viscosity lava flows, usually basalt	Volcanoes with gentle slopes and large bases; cinder cones on sides	Fast moving, large shallow lava flows
Z	High viscosity lava, ash, steam; 50% lava and 50% pyroclastics	Volcanoes steep-sided with alternating layers of andesitic lava and ash	Lahars, hot ash flows, high speed pyroclastic flows; poisonous gases; tsunamis

Which row of the table correctly matches each of the volcanoes with its likely tectonic setting?

	Hotspot	*Rift valley*	*Subduction zone*
(A)	X	Y	Z
(B)	Y	X	Z
(C)	Z	X	Y
(D)	Y	Z	X

6 The cartoon illustrates a model to explain the forces driving tectonic plate motion.

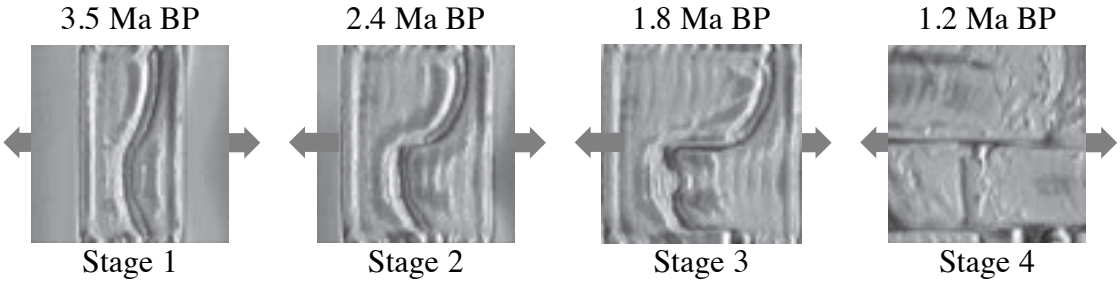


Acknowledgement: "Plume Juice" cartoon, © John C. Holden

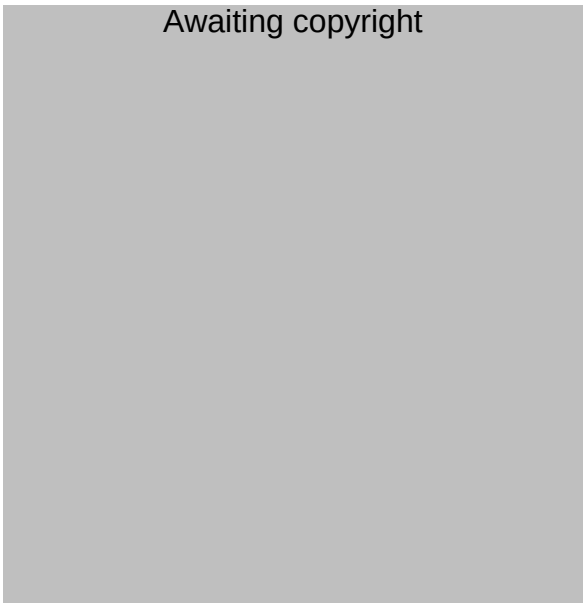
Which aspects of plate motion are represented in the model by the letters **K**, **L** and **M**?

	Ridge push	*Slab pull*	*Mantle magma*
(A)	K	M	L
(B)	M	K	L
(C)	L	K	M
(D)	K	L	M

7 The images show four stages of a model representing the evolution of the Pacific Rise, and a satellite image of the ridge at present.



Acknowledgement: Reproduced with kind permission of Dr Taras Gerya and The American Association for the Advancement of Science (AAAS)



Present day satellite image

Two examples of a geological feature are labelled **X**.

What is the geological feature at **X**?

(A) A normal fault at a divergent plate boundary

(B) A transform fault at a divergent plate boundary

(C) A normal fault at a conservative plate boundary

(D) A transform fault at a conservative plate boundary

8 Based on stable isotope data, when did the first life forms appear on Earth?

(A) 3.8×10^3 years ago

(B) 4.6×10^6 years ago

(C) 3.8×10^9 years ago

(D) 4.6×10^{12} years ago

9 Which equation correctly shows the formation of ozone?

(A) $3O_2 \longrightarrow 2O_3$

(B) $3O_2 \xrightarrow{\text{UV light}} 2O_3$

(C) $2O_3 \xrightarrow{\text{UV light}} 3O_2$

(D) $2O_3 \longrightarrow 3O_2$

10 Which event is an example of a mass extinction?

(A) 10% of species from different groups become extinct across many environments

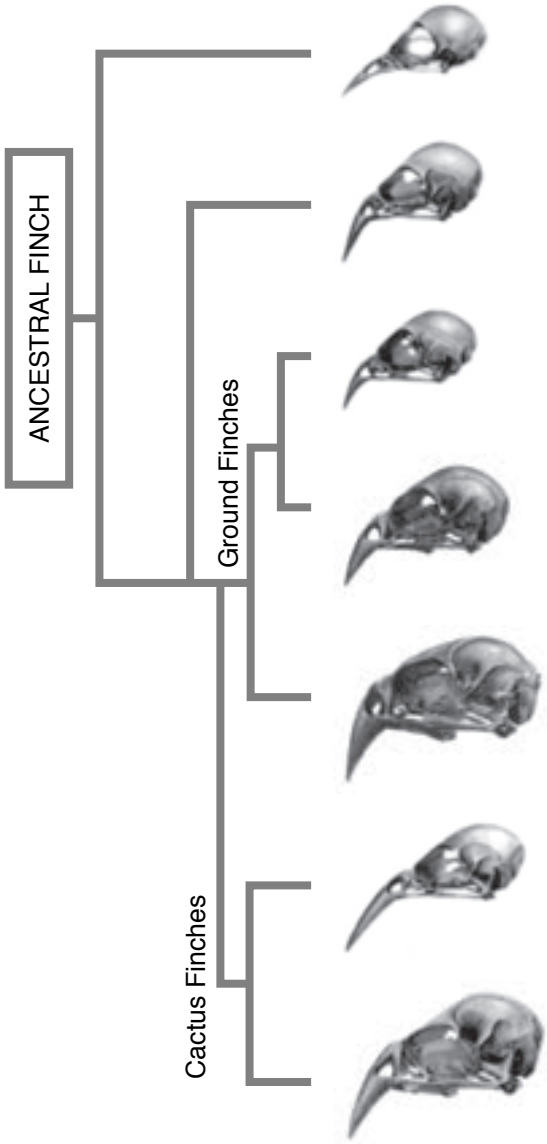
(B) 60% or more species unique to a particular region become extinct at the same time

(C) 10% of species unique to a particular region become extinct over a long period of time

(D) 60% or more species from different groups become extinct across many environments

11 Each of the Galapagos Islands, located off the coast of South America, has a different species of finch.

The diagram shows the variation in beak size and shape for seven of the finch species.



Acknowledgement: K. Petren, B. R. Grant, and P. R. Grant, A phylogeny of Darwin's finches based on microsatellite DNA length variation. Reproduced with kind permission of Dr Kenneth Petren

Which statement correctly explains the variation in beak types?

(A) During the finches' lifetimes, the beaks changed to suit their diets.

(B) The different beaks evolved as finches on some islands interbred with other birds.

(C) Male finches with the largest beaks competed more successfully for mates, resulting in offspring with larger beaks.

(D) Different beak sizes and shapes enabled some finches to access a wider variety of foods, and these beak differences were passed on to offspring.

12 The table lists some isotopes and their half-lives.

Isotope	*Half-life* (years)
Carbon-14	5730
Iodine-129	15.7 million
Uranium-235	704 million
Rubidium-87	50 billion

Which isotope could be used to date a rock that was formed in the Cambrian Period?

(A) Carbon-14

(B) Iodine-129

(C) Uranium-235

(D) Rubidium-87

13 The photograph shows a rock from Western Australia made up of alternating red and grey layers.



Acknowledgement: Banded-iron formation rock.
With kind permission of Dr Michael Bau, Jacobs University Bremen

How was this rock formed?

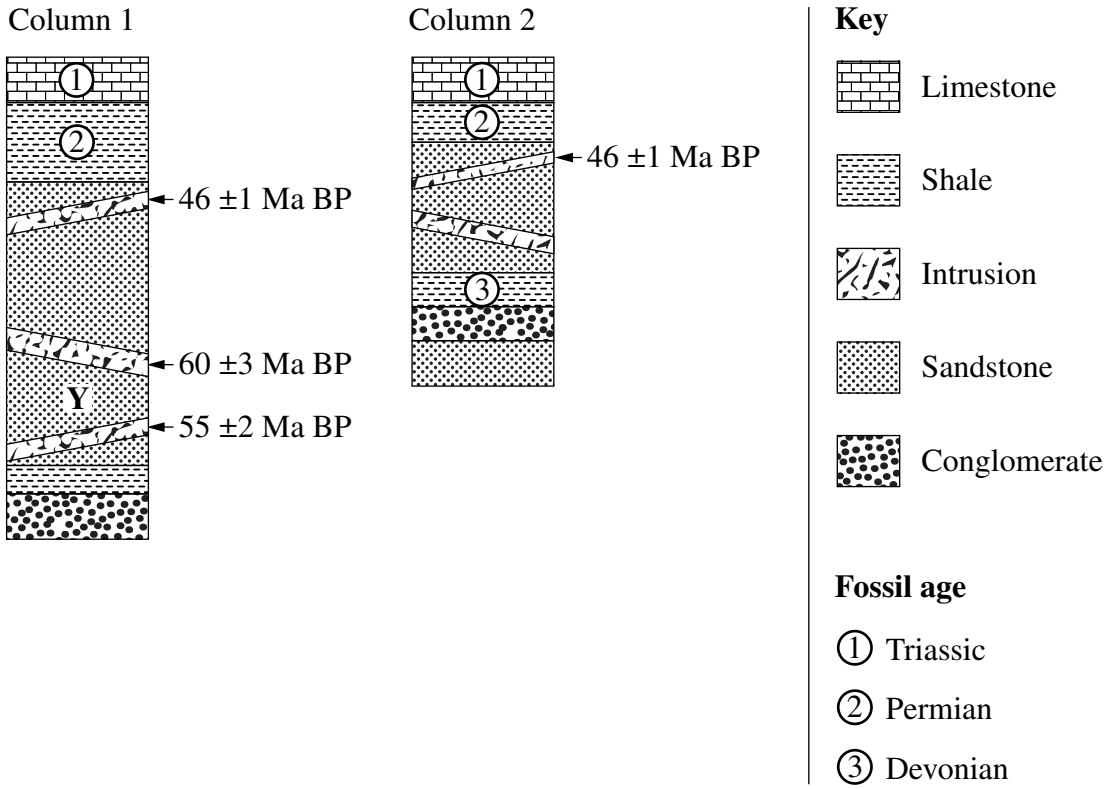
(A) From the growth of cyanobacteria during the Mesozoic Era

(B) From the growth of archaea during the early Proterozoic Eon

(C) From alternating oxygen-rich and oxygen-poor waters in the early Proterozoic Eon

(D) From alternating carbon-dioxide-rich and carbon-dioxide-poor waters in the Mesozoic Era

14 The diagrams shows two stratigraphic columns in which some of the layers have been dated.



What is the most likely age of layer **Y**?

(A) 58 Ma BP

(B) Between 46 ±1 Ma BP and 55 ±2 Ma BP

(C) Older than the Triassic but younger than the Permian

(D) Older than the Permian but younger than the Devonian

15 The image shows a recently seeded paddock with the remains of the previous crop.



Acknowledgment: John Leys, NSW Office Environment and Heritage

What is the reason for using the farming practice shown in the image?

(A) To reduce the rate of soil loss

(B) To replace the use of irrigation

(C) To prevent the formation of lateritic soils

(D) To prevent an increase in pest populations

16 A group of students performed an experiment in which they measured how long it took for 25 mL of water to soak into the ground at two locations. One location had compacted soil and the other location had non-compacted soil.

Which of the following would improve the scientific reliability of their experiment?

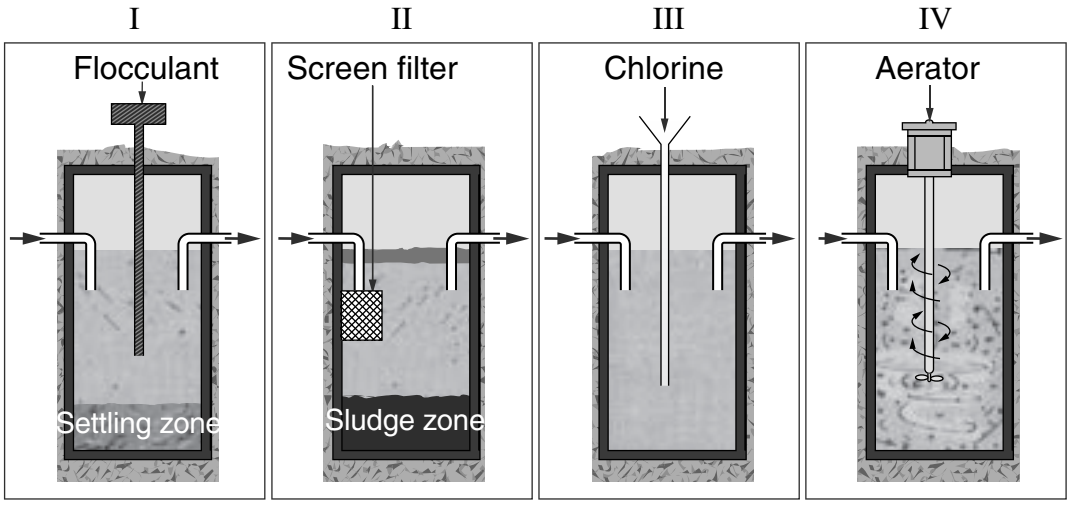
(A) Repeat the experiment several times at each location and obtain an average for each location.

(B) Ensure the air temperature and weather at each location are the same.

(C) Research and read scientific articles and books on the subject.

(D) Increase the volume of water for each test to 50 mL.

17 The diagrams show four stages in the treatment of waste water. The stages are not in the correct order.



What is the correct sequence of stages to treat waste water effectively?

(A) II, I, III, IV

(B) IV, I, II, III

(C) III, II, I, IV

(D) II, IV, I, III

18 Which action would be the most effective in minimising the impact of salinity on a farm?

(A) Applying more fertilisers and herbicides

(B) Introducing flood irrigation for the crops

(C) Grazing fewer cattle than in previous years

(D) Growing more trees on the surrounding hills

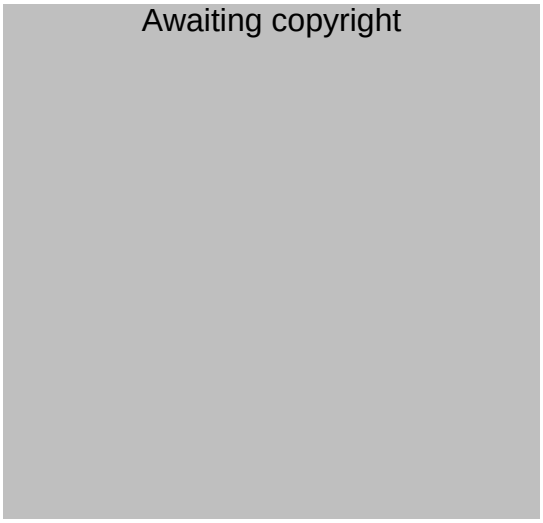
19 The chemical equation shown summarises a reaction that releases greenhouse gases into the atmosphere.

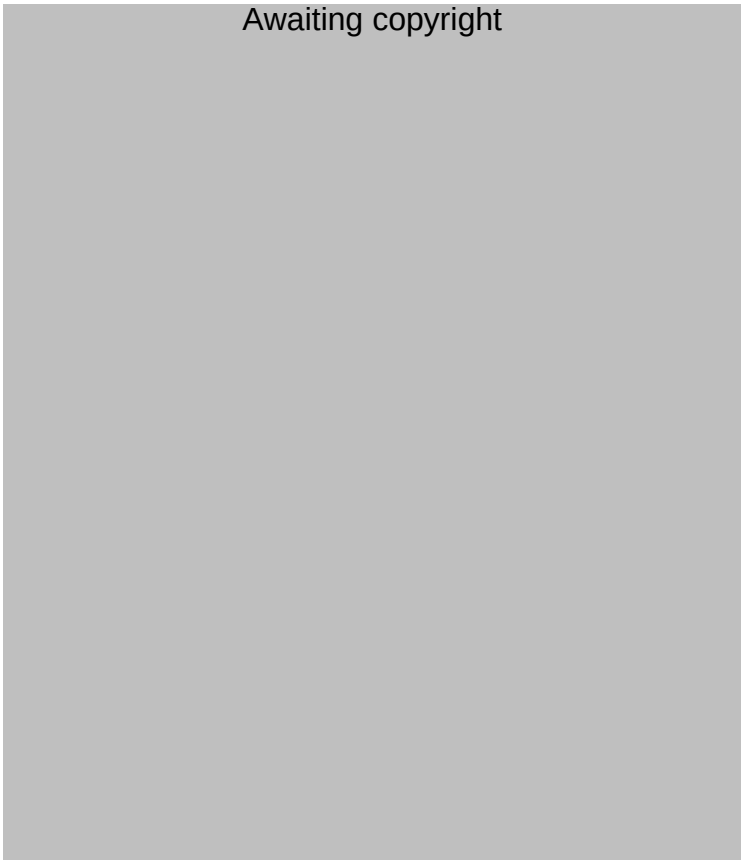
$$\text{coal} + \text{X} \xrightarrow{\text{Y}} \quad + \text{Z}$$

What are the substances X, Y and Z?

	X	Y	Z
(A)	carbon monoxide	carbon dioxide	water
(B)	carbon monoxide	nitrous oxide	oxygen
(C)	oxygen	sulfur dioxide	carbon dioxide
(D)	oxygen	carbon dioxide	water

20 The diagram shows a foodweb for a farm growing corn, and the graph shows the change in peregrine falcon eggshell thickness over time.





In 1945 the insecticide DDT was introduced to combat insect pests. Data such as that shown in the graph prompted scientists to argue for the banning of DDT.

Based on the data given in the graph, what is one argument the scientists could have used for banning DDT?

(A) DDT affects non-target species.

(B) DDT affects the health of humans.

(C) DDT reduces the growth of producers.

(D) DDT reduces the food sources of peregrine falcons.

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Centre Number

Student Number

Section I (continued)

Part B – 55 marks
Attempt Questions 21–30
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 (6 marks)

Please turn over

Question 21 (6 marks)

Australia and Antarctica began drifting apart about 30 million years ago, and are now separated by the Great Southern Ocean.

(a) Outline the tectonic process that has resulted in the present location of the two continents. **2**

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(b) In 2012: **4**

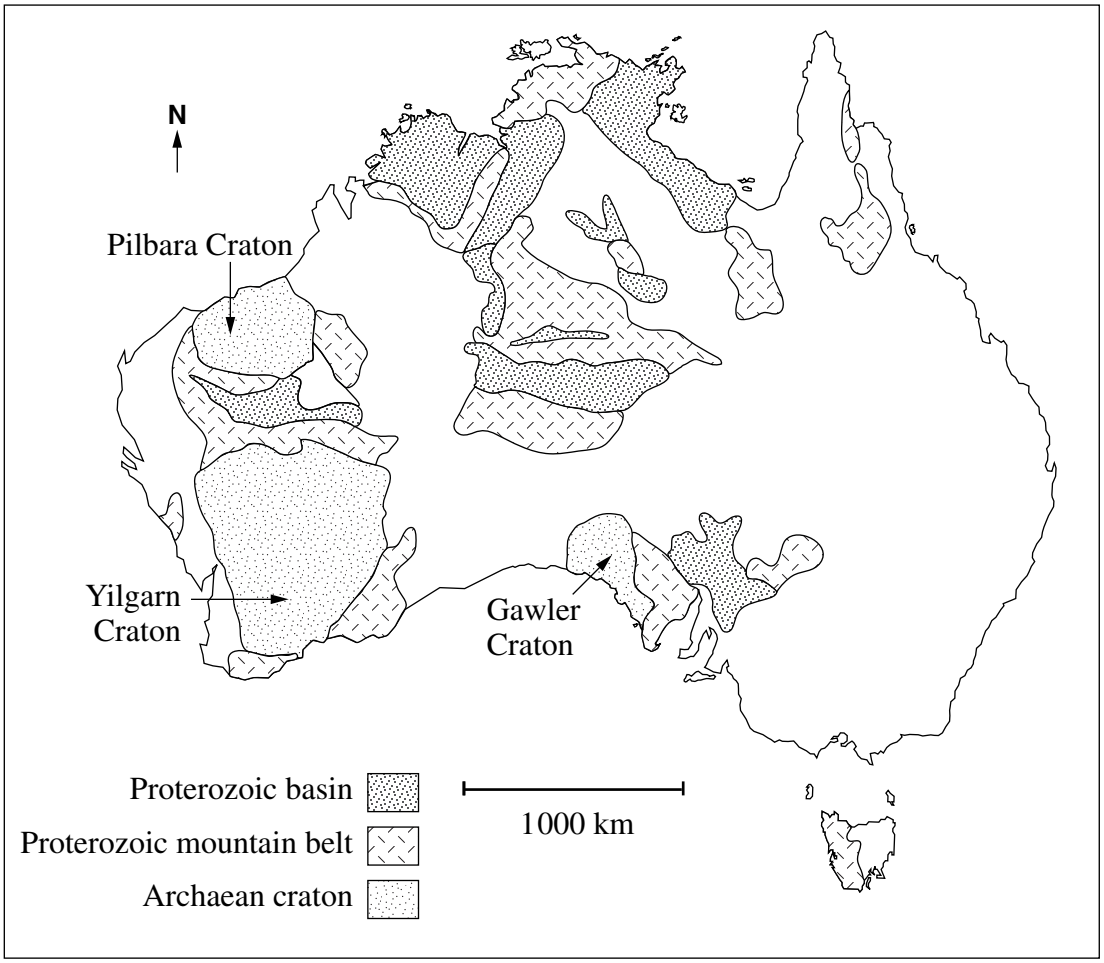
- an earthquake occurred in northern South Australia, far from the edges of the Indian-Australian Plate on which Australia is located.
- an earthquake occurred within the oceanic lithosphere at the edge of the Indian-Australian Plate near Indonesia.

Complete the table to describe the typical characteristics of these earthquakes.

	South Australian earthquake	*Indonesian earthquake*
Probable cause of the earthquake	....	....
Probable magnitude	.....	.....
Probable depth of focus	.....	.....

Question 22 (4 marks)

A simplified geology of Australia is shown in the map. **4**



Using information from the map, e xplain the early geological history of Australia up to the end of the Proterozoic Era.

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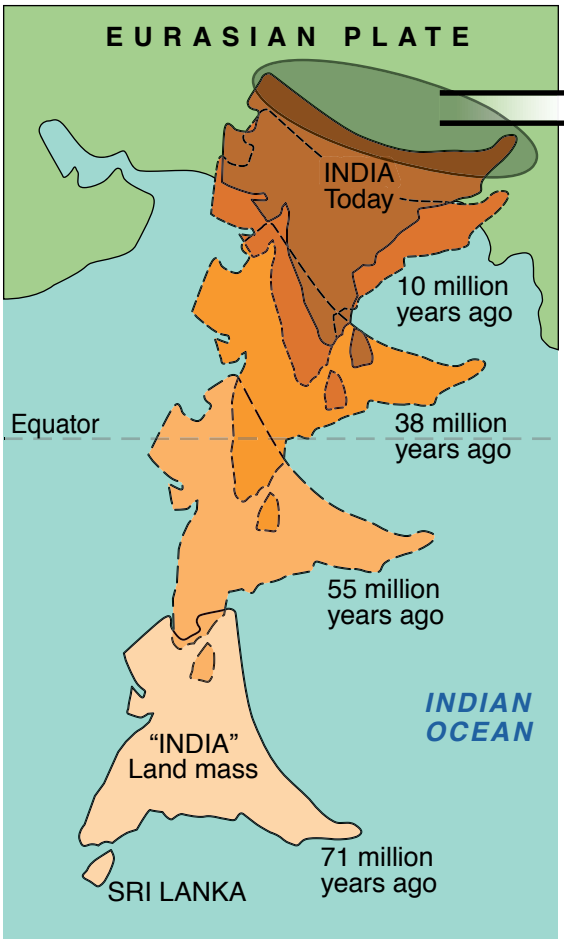
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Question 23 (6 marks)

Please turn over

Question 23 (6 marks)

The diagram shows the Himalaya mountain range forming as India moves towards Eurasia.





Satellite image of the Himalaya mountain range

Acknowledgement: India-Eurasia collision 70-0 Ma - Pierre Dèzes 1999, "Tectonic and metamorphic Evolution of the Central Himalayan Domain in Southeast Zanskar (Kashmir, India)". Mémoires de Géologie (Lausanne) No. 32, ISSN 1015-3578 http://comp1.geol.unibas.ch/zanskar/.

(a) Name TWO rocks likely to be found in the Himalaya mountain range. **1**

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(b) Describe TWO geological structures likely to be found in the Himalaya mountain range. **2**

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Question 23 continues on page 23

Question 23 (continued)

(c) Explain the tectonic processes that are forming the Himalaya mountain range. **3**

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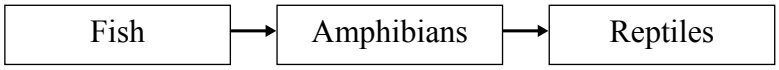
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Question 24 (6 marks)

The sequence shows the evolutionary path for vertebrate animals from an aquatic environment to a terrestrial environment. **6**



Explain the evolutionary changes that would have been necessary for progression from an aquatic environment to a terrestrial environment.

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Question 25 (6 marks)

(a) Draw a flow chart to show the THREE major steps in the formation of a fossil. **3**

(b) Why are some fossil types less likely to be fossilised than others? Give examples in your answer. **3**

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Question 26 (5 marks)

Discuss how knowledge of major changes in life forms on Earth has helped geologists develop the Geological Time Scale. In your answer, link examples from the fossil record to the divisions of the time scale. **5**

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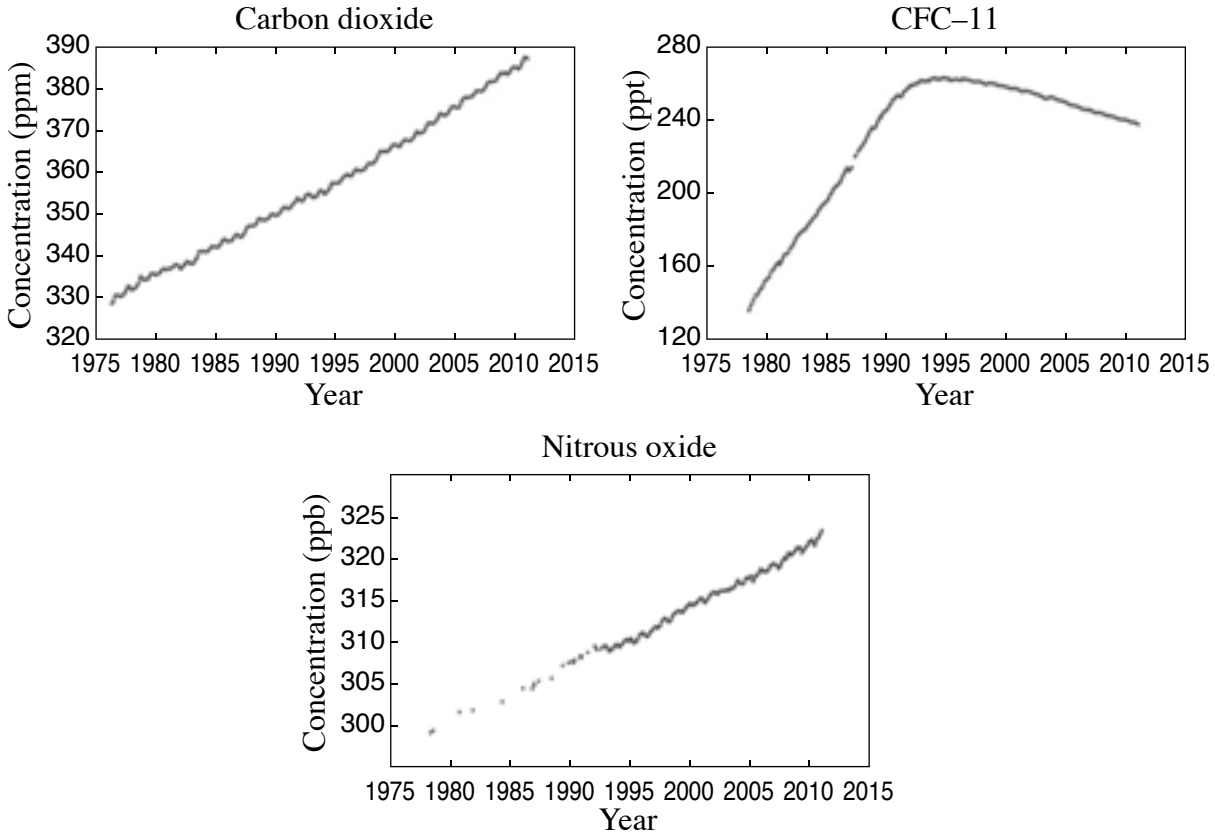
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Question 27 (5 marks)

The graphs show the trends in major atmospheric pollutants at Cape Grim, Tasmania up to 2012. **5**



Acknowledgement: © CSIRO Oceans and Atmosphere Flagship

Using information from the graphs, evaluate TWO named international strategies in combating the impacts of pollutants on the atmosphere.

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Question 28 (6 marks)

Use this statement to answer parts (a)–(b).

The rate at which farmland resources in New South Wales are degrading has generally decreased as a result of improved land and water management.

(a) Describe ONE land management practice that would support the above conclusion. **3**

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(b) Describe ONE water management practice that would support the above conclusion. **3**

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Question 29 (4 marks)

Explain the reasons for the differences between soils typically found in Western Australia and those found along the east coast of Australia. **4**

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Section I – Part B (continued)

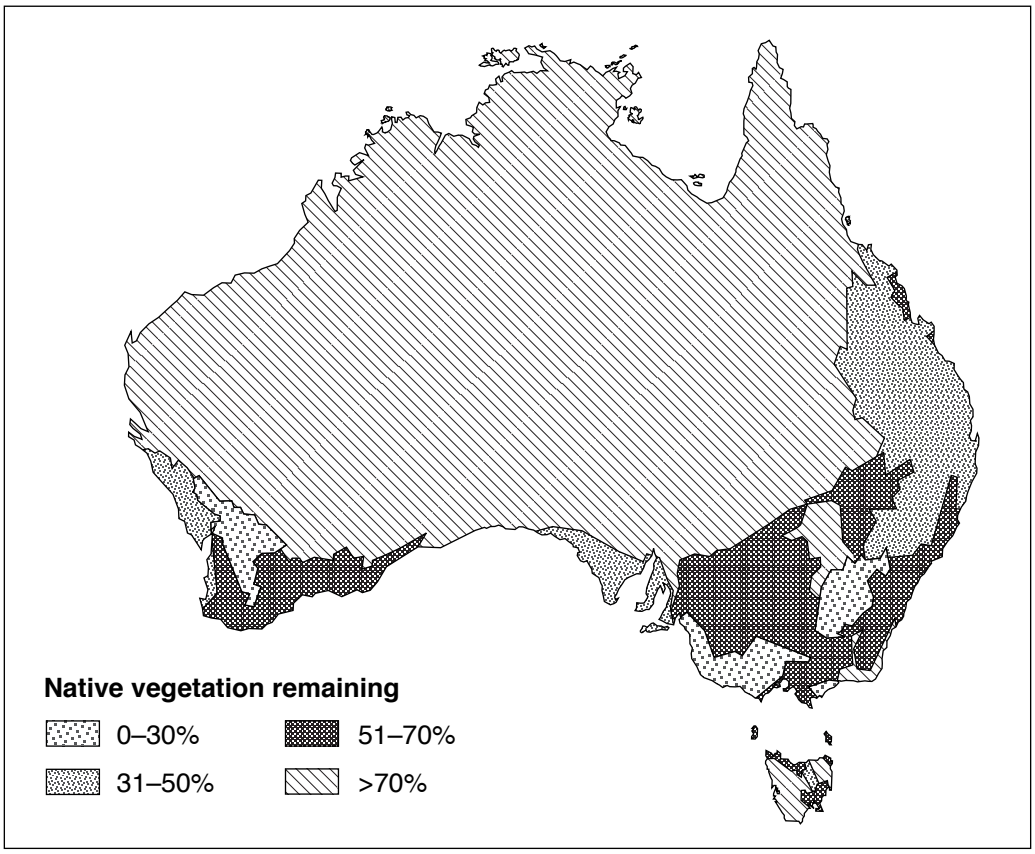
Question 30 (7 marks)

Please turn over

Question 30 (7 marks)

The map summarises the loss of vegetation since 1750, and the table summarises the conservation status of native Australian species. **7**

Percentage of estimated pre-1750 native vegetation remaining



Acknowledgement: © Commonwealth of Australia, 2014

Conservation status of native Australian species

	Number of species			
	Extinct	**Critically endangered**	**Endangered**	**Vulnerable**
From fossil record	Megafauna 46			
Flora since 1750	40	130	526	593
Fauna since 1750	55	31	125	182

Question 30 continues on page 33

Question 30 (continued)

To what extent does Australia have to change environmental management practices, which have been used since human habitation, to reduce our contribution to a possible sixth mass extinction event? Use data from the map and table to support your arguments.

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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)–(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 31	Introduced Species and the Australian Environment	36–37
Question 32	Organic Geology – A Non-renewable Resource	38–40
Question 33	Mining and the Australian Environment	41–42
Question 34	Oceanography	43–44

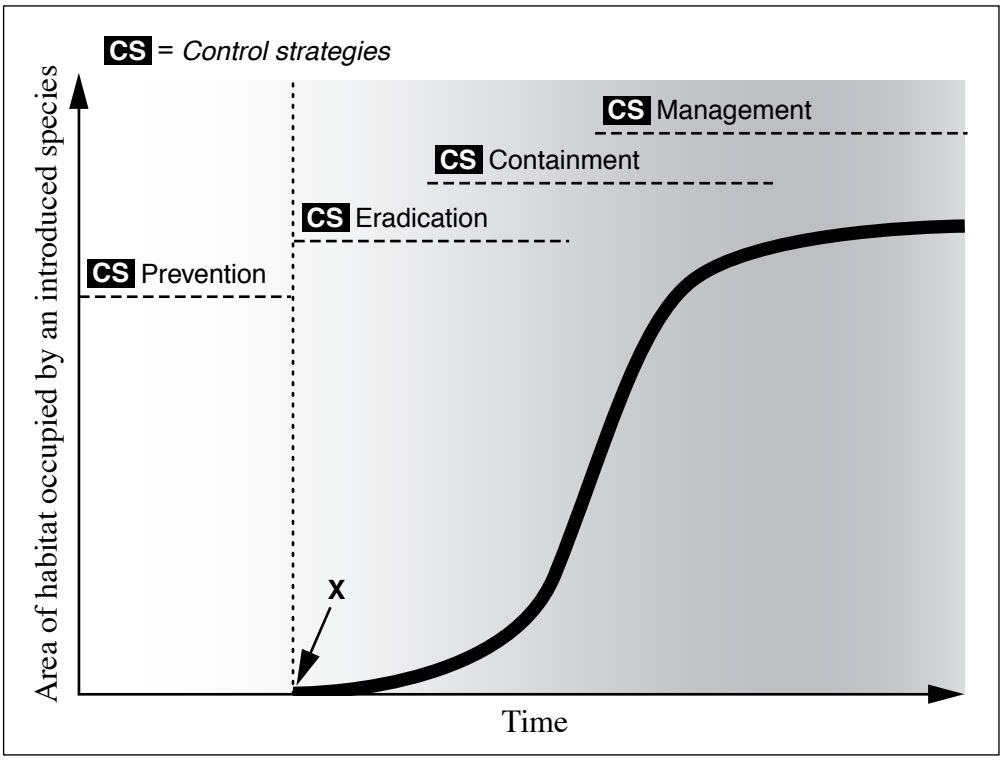
Question 31 — Introduced Species and the Australian Environment (25 marks)

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

(a) Describe TWO quarantine methods used in Australia. **3**

(b) Explain how the features of a biological control method made it successful in eradicating a named pest. **4**

(c) The graph shows the change in the habitat area occupied by an introduced species and the change in control strategies over time.



Acknowledgement: © NSW Department of Agriculture & Food Western Australia

(i) How does the shape of the curve represent the changes in the area occupied by an introduced species over time? **2**

(ii) For one introduced species, provide the reasons for the change in control strategies after point **X** on the graph. Use examples of these strategies in your answer. **4**

Question 31 continues on page 37

Question 31 (continued)

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

(d) (i) Based on research using secondary sources, write a conclusion that summarises the criteria that can be used to identify a species as 'introduced'. **2**

(ii) Write a scientific method, in point form, that could be used to investigate the impact of an introduced species on a named local environment. **4**

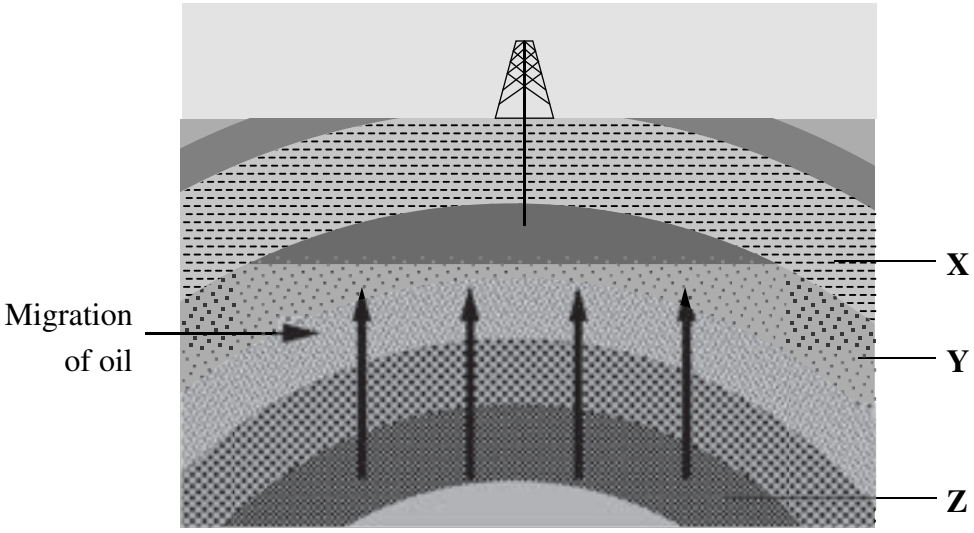
(e) Explain, using examples, how past practices to control introduced species are changing in order to achieve sustainability of Australian ecosystems. **6**

End of Question 31

Question 32 — Organic Geology – A Non-renewable Resource (25 marks)

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

(a) Name this type of trap and outline the functions of the layers **X**, **Y** and **Z**. **3**



(b) *Coal and petroleum are mixtures, and this determines the way they are refined.* **4**

Describe how both coal and petroleum are refined to produce marketable and usable products.

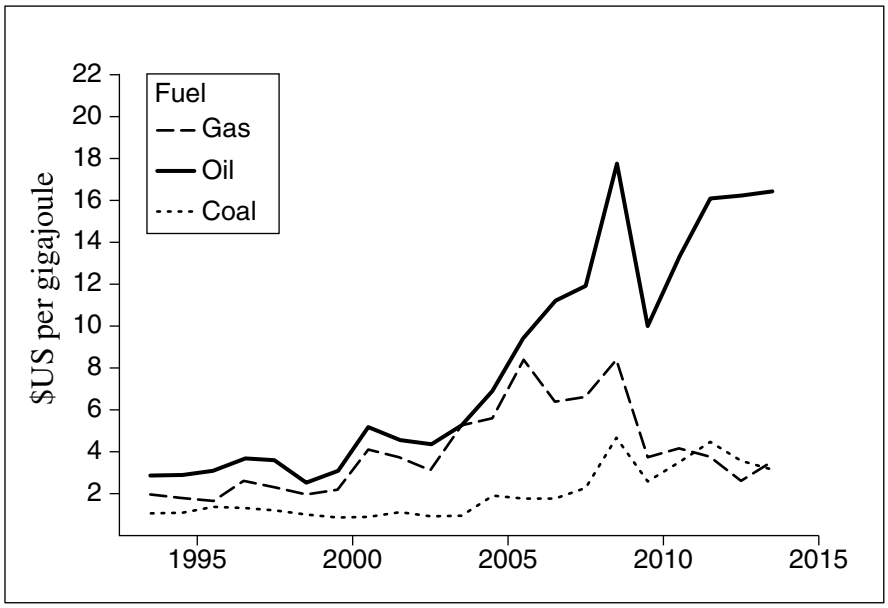
Question 32 continues on page 39

Question 32 (continued)

(c) The table and the graph give data about three fossil fuels.

	Energy content (kJ/g)	*CO_2 released* (mol/10^3 kJ)	*Known global reserves 2011* (billion tonnes)
Gas	51.6	1.2	330
Oil	43.6	1.6	170
Coal	39.3	2.0	900

Market price of coal, gas and oil since 1995



Acknowledgement: Adapted from The Conversation: A "frack" in the bridge from coal to gas. Reproduced with kind permission of Mike Sandiford

2

(i) Compare these three fuels in terms of their energy content and market price.

4

(ii) Using the data given in the table and the graph, predict the future global use of these fossil fuels.

Question 32 continues on page 40

Question 32 (continued)

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

(d) (i) Based on research using secondary sources, write a conclusion about the effects of the combustion of fossil fuels. **2**

(ii) Write a scientific method, in point form, that could be used to distinguish between the products of complete and incomplete combustion of a named fossil fuel. **4**

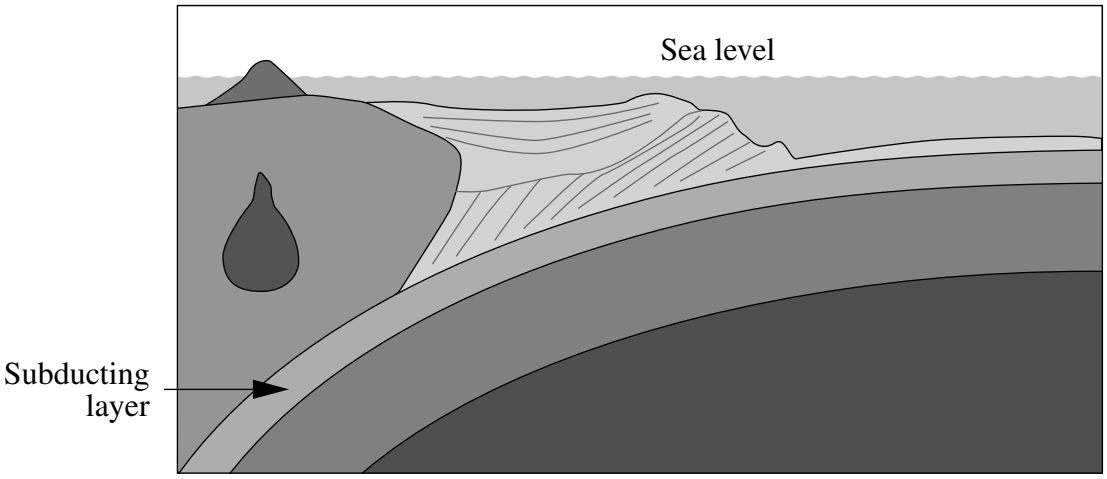
(e) Explain, using examples, how society's dependence on fossil fuels is changing to ensure alternative energy sources will be utilised in the future. **6**

End of Question 32

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

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

(a) Name one metal deposit that could be found in the geological setting shown and outline THREE features of the deposit. **3**

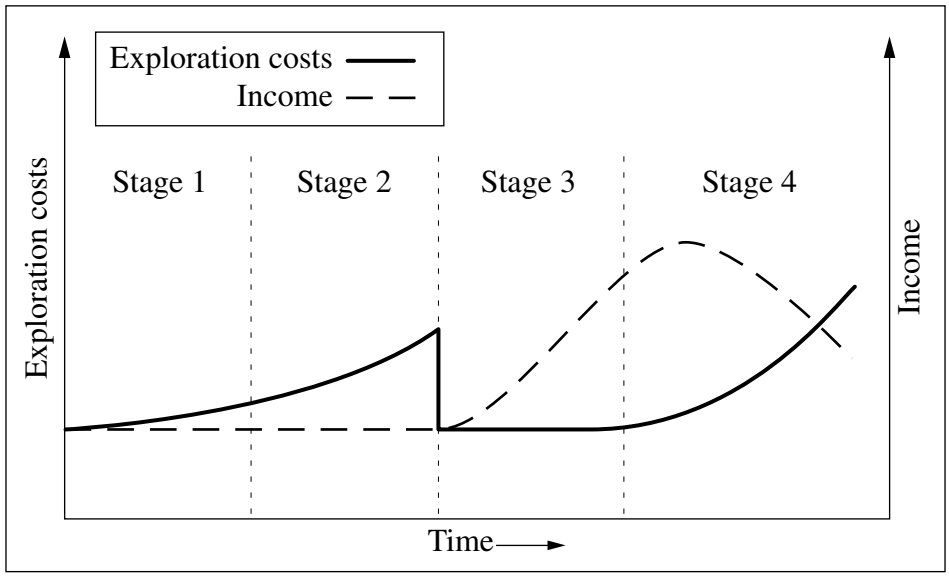


(b) Explain how geological factors and cost factors determine the economic value of a deposit. **4**

Question 33 continues on page 42

Question 33 (continued)

(c) The graph shows the changes in exploration costs and income for a resource.



(i) What is the relationship between exploration costs and income for the resource shown? **2**

(ii) Explain the exploration methods that would be used in each of stage 1, stage 2 and stage 4. **4**

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

(d) (i) Based on research using secondary sources, write a conclusion about ONE method that is used to refine an ore from a mineral deposit. **2**

(ii) Write a scientific method, in point form, that could be used to distinguish between waste rock and an ore from a named mineral deposit. **4**

(e) Explain, using examples, how past practices in the mining industry are changing in order to minimise environmental damage in the future. **6**

End of Question 33

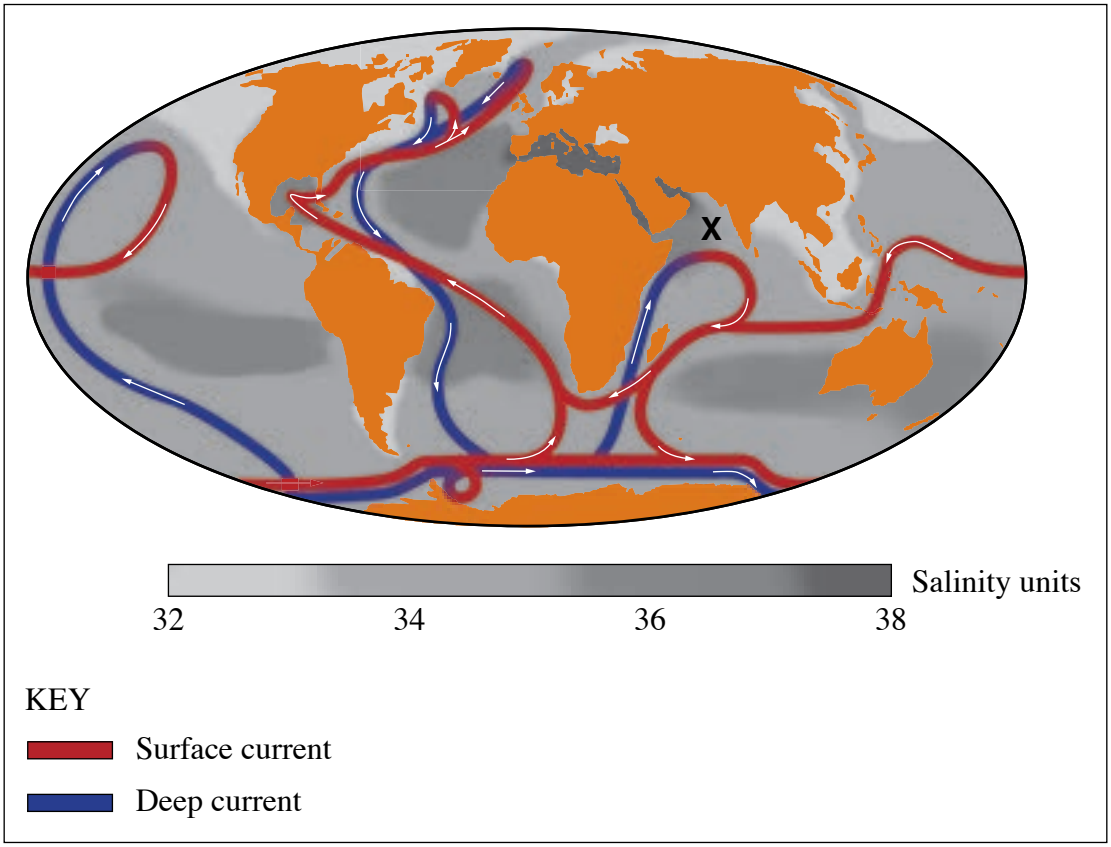
Question 34 — Oceanography (25 marks)

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

(a) Describe TWO methods used to date ocean floors. **3**

(b) Explain how differences in the physical properties of ocean water determine the nature of food chains in surface waters and those in deep water. **4**

(c) The map shows global ocean currents and salinity levels in the oceans.



Acknowledgement: © NASA

(i) Give TWO reasons for the changes in the ocean current at X. **2**

(ii) Using information provided in the diagram, explain the circulation of the global ocean currents. **4**

Question 34 continues on page 44

Question 34 (continued)

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

(d) (i) Based on research using secondary sources, write a conclusion about the differences in the concentration of salts in ocean waters of different temperatures. **2**

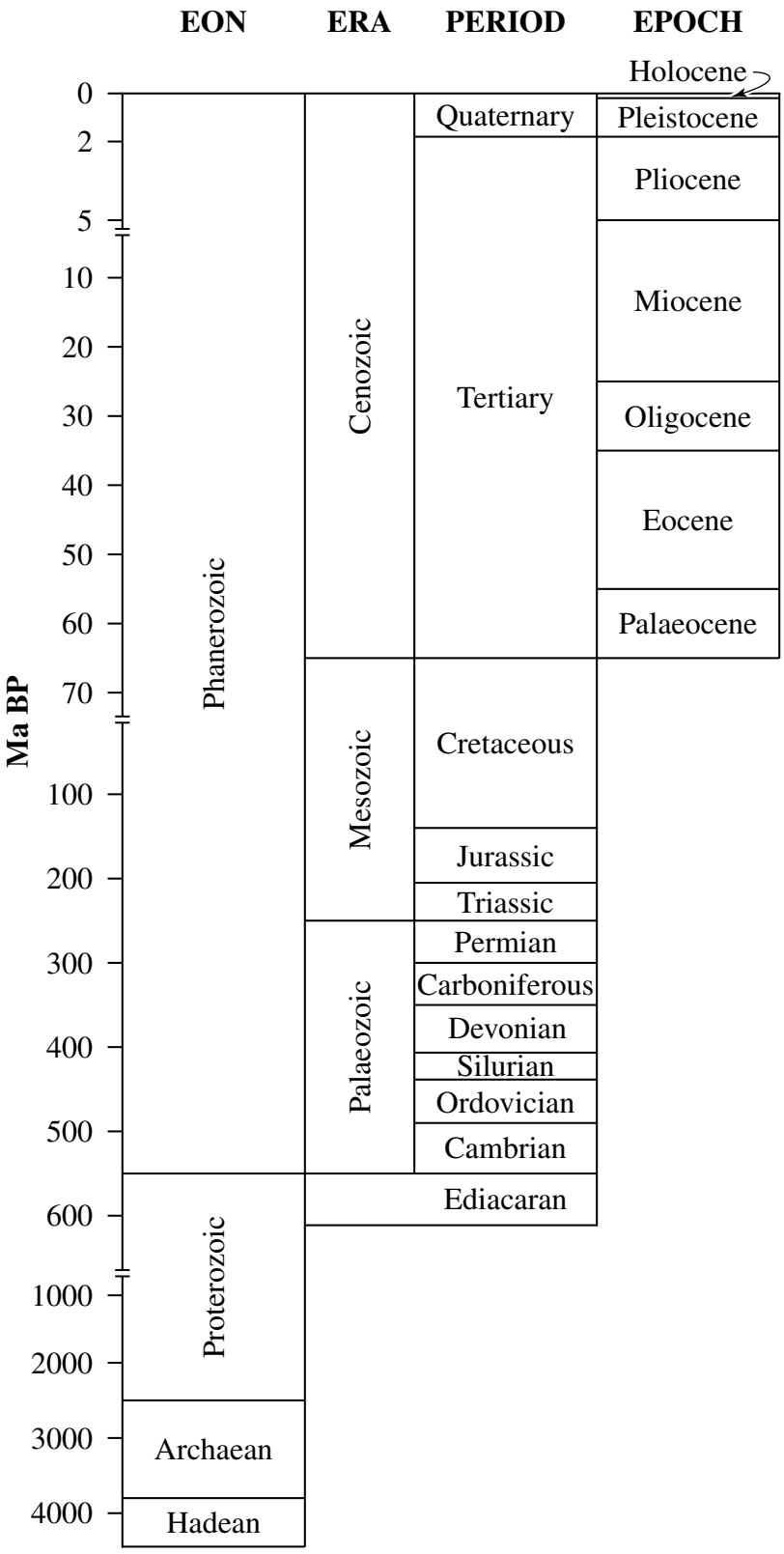
(ii) Write a scientific method, in point form, that could be used to compare the solubility of a named salt in water at different temperatures. **4**

(e) Explain, using examples, how past management practices are changing to ensure the sustainability of our ocean resources. **6**

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Geological Time Scale



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