



## Western Australian Certificate of Education Sample Examination, 2016

### Question/Answer Booklet

# EARTH AND ENVIRONMENTAL SCIENCE

Please place your student identification label in this box

Student Number: In figures

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In words

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### Time allowed for this paper

Reading time before commencing work: ten minutes

Working time for paper: three hours

### Materials required/recommended for this paper

#### *To be provided by the supervisor*

This Question/Answer Booklet

Multiple-choice Answer Sheet

Number of additional  
answer booklets used  
(if applicable):

#### *To be provided by the candidate*

Standard items: pens (blue/black preferred), pencils (including coloured), sharpener, correction fluid/tape, eraser, ruler, highlighters

Special items: protractor, drawing compass, mathomat, up to three non-programmable calculators approved for use in the WACE examinations

### Important note to candidates

No other items may be taken into the examination room. It is **your** responsibility to ensure that you do not have any unauthorised notes or other items of a non-personal nature in the examination room. If you have any unauthorised material with you, hand it to the supervisor **before** reading any further.

## Structure of this paper

Section	Number of questions available	Number of questions to be answered	Suggested working time (minutes)	Marks available	Percentage of exam
Section One: Multiple-choice	15	15	20	15	15
Section Two: Short answer	9	9	100	105	55
Section Three: Extended answer	3	2	60	30	30
				<b>Total</b>	100

## Instructions to candidates

1. The rules for the conduct of Western Australian external examinations are detailed in the *Year 12 Information Handbook 2016*. Sitting this examination implies that you agree to abide by these rules.

2. Answer the questions according to the following instructions.

Section One: Answer **all** questions on the separate Multiple-choice Answer Sheet provided. For each question, shade the box to indicate your answer. Use only a blue or black pen to shade the boxes. If you make a mistake, place a cross through that square, then shade your new answer. Do not erase or use correction fluid/tape. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

Sections Two and Three: Write your answers in this Question/Answer Booklet.

3. You must be careful to confine your responses to the specific questions asked and to follow any instructions that are specific to a particular question.
4. Spare pages are included at the end of this booklet. They can be used for planning your responses and/or as additional space if required to continue an answer.
  - Planning: If you use the spare pages for planning, indicate this clearly at the top of the page.
  - Continuing an answer: If you need to use the space to continue an answer, indicate in the original answer space where the answer is continued, i.e. give the page number. Fill in the number of the question that you are continuing to answer at the top of the page.

## Section One: Multiple-choice

15% (15 Marks)

This section has **15** questions. Answer **all** questions on the separate Multiple-choice Answer Sheet provided. For each question, shade the box to indicate your answer. Use only a blue or black pen to shade the boxes. If you make a mistake, place a cross through that square, then shade your new answer. Do not erase or use correction fluid/tape. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

Suggested working time: 20 minutes.

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1. A scientist studying a series of satellite photographs of a large Indonesian island taken between 1990 and 2010 noted a very significant reduction in the amount of rain forest cover. He estimated that, in some parts, up to 60% of the original 1990 cover had been destroyed by 2010.

Which one of the following statements **best** explains the destruction of the rain forest?  
The loss of trees is related to

- (a) a rapidly drying climate because of La Niña.
  - (b) rising levels of salt in the soil.
  - (c) human economic activity.
  - (d) holes developing in the ozone layer.
2. The long-term heating of the Earth's atmosphere over the past 200 years has probably been caused by
- (a) a steady increase in the volume of dust produced by increased volcanic activity.
  - (b) the rapid melting of polar icecaps and glaciers.
  - (c) the heat released by the burning of forests by humans.
  - (d) an increase in the concentration of carbon dioxide (CO<sub>2</sub>), related to the combustion of fossil fuels.
3. Which one of the following is the **best** example of a non-renewable resource?
- (a) crayfish
  - (b) iron ore
  - (c) timber
  - (d) hydroelectric power
4. Nutrients such as nitrogen-based fertilisers that dissolve in water can build up in lakes, swamps and streams, leading to the rapid growth of aquatic plants. This build-up of nutrients is called
- (a) bioaccumulation.
  - (b) nitrification.
  - (c) acidification.
  - (d) eutrophication.

5. A student collected and examined four metamorphic rock samples. Each sample is described below. Which one of the rocks is **most** likely to be gneiss?
- (a) a white rock showing no foliation that fizzes when acid is added
  - (b) a rock showing alternating bands of light and dark minerals
  - (c) a dark, shiny rock showing strongly-foliated biotite and occasional large garnet crystals
  - (d) a dark, fine-grained rock that splits easily in large sheets
6. Which one of the following statements is correct?
- (a) Nearly 10% of the Earth's water is fresh water.
  - (b) Icecaps and glaciers are the main stores of fresh water.
  - (c) Water circulates in the environment more slowly than silica.
  - (d) Water passes from the atmosphere to the oceans by evaporation.
7. Which one of the following is an example of an interaction between the abiotic and biotic components of an ecosystem related to an active mine site?
- (a) dewatering of groundwater, reducing lake levels in the surrounding ecosystem
  - (b) stockpiling overburden (waste material), following the extraction of a mineral resource
  - (c) introduction of a leaf miner insect, causing tree deaths in the surrounding ecosystem
  - (d) dewatering of groundwater, causing tree deaths in the surrounding ecosystem
8. El Niño is a large-scale ocean-atmosphere climate phenomenon in the tropical eastern Pacific Ocean. It is typically characterised by surface waters that are
- (a) warmer than normal and contain fewer nutrients.
  - (b) cooler than normal and contain fewer nutrients.
  - (c) warmer than normal and contain more nutrients.
  - (d) cooler than normal and contain more nutrients.
9. Three mineral exploration methods that can be used to locate a metallic ore deposit from an aircraft are
- (a) seismic surveys, magnetometer surveys and gravity surveys.
  - (b) geochemical surveys, seismic surveys and magnetometer surveys.
  - (c) photography, seismic surveys and magnetometer surveys.
  - (d) photography, magnetometer surveys and gravity surveys.
10. When considering the development of a mineral resource, native title and social heritage issues must be addressed
- (a) before commencing exploration activities.
  - (b) before commencing mining activities.
  - (c) as components of the Notice of Intent to Mine.
  - (d) at the completion of all activities.

**See next page**

11. The ecological footprint is a measure of the magnitude of
- (a) an ecological community.
  - (b) the demand on resource production, harvesting, transport and processing for consumption.
  - (c) the demand on resources for consumption and waste management following consumption.
  - (d) the demand on resource waste management following consumption.
12. Which one of the following statements regarding the use of renewable sources of energy is correct?
- (a) Renewable energy resources are fully cost-effective, with no constraints on the collection, storage and transfer of the energy produced.
  - (b) The use of renewable energy resources is constrained by the efficiency of currently available technologies to collect, store and transfer the energy produced.
  - (c) Renewable energy resources are currently not being used because of a lack of technologies to collect, store and transfer the energy produced.
  - (d) The use of renewable energy is constrained by a lack of renewable energy resources.
13. Which one of the following **best** describes geothermal energy?
- (a) heat energy released as a result of igneous activity deep inside the Earth
  - (b) heat energy from rocks deep inside the Earth
  - (c) heat energy from rocks on the Earth's surface
  - (d) heat energy released as a result of igneous activity on the Earth's surface
14. Natural ecosystems provide a range of services, including provisioning, regulation and support. Which one of the following is the best example of a regulating service to the environment?
- (a) Carbon sequestration by dense forests has a climatic effect.
  - (b) Fruit-eating animals disperse seeds in their droppings.
  - (c) Wildflowers provide the required nutrients for many native animals.
  - (d) Trees provide shelter from rain or the sun to organisms.
15. Carbon dioxide is the
- (a) most potent (per molecule of gas) of the greenhouse gases.
  - (b) most abundant greenhouse gas.
  - (c) main greenhouse gas produced by human activity in Australia.
  - (d) only greenhouse gas presently increasing in the atmosphere.

**End of Section One**

**See next page**

**Section Two: Short answer**

**55% (105 Marks)**

This section has **nine (9)** questions. Answer **all** questions. Write your answers in the spaces provided.

Spare pages are included at the end of this booklet. They can be used for planning your responses and/or as additional space if required to continue an answer.

- **Planning:** If you use the spare pages for planning, indicate this clearly at the top of the page.
- **Continuing an answer:** If you need to use the space to continue an answer, indicate in the original answer space where the answer is continued, i.e. give the page number. Fill in the number of the question that you are continuing to answer at the top of the page.

Suggested working time: 100 minutes.

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**Question 16**

**(13 marks)**

Metamorphic rocks result from the solid-state alteration of pre-existing rocks by the effects of heat and pressure.

- (a) Describe **two** changes in rock texture that commonly occur during metamorphism.

(2 marks)

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- (b) The type of rock produced and the minerals of which it is composed are related to the type of metamorphism, the composition of the parent rock and the conditions of temperature and pressure involved.

Complete the table below. For each of the parent rocks listed, name a metamorphic rock that may be produced, and suggest a common mineral found in each metamorphic rock.

(6 marks)

Parent rock	Type of metamorphism	Possible metamorphic rock produced from the parent rock	A common mineral found in this type of metamorphic rock
Limestone	regional		
Sandstone	contact		
Shale	regional		

- (c) Metamorphism is responsible for producing many natural resources that are used in modern society. Name a resource formed by metamorphic processes that you have studied. Describe briefly how it was formed and state **one** use for this resource. (5 marks)

Resource: \_\_\_\_\_

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**Question 17**

**(6 marks)**

- (a) Using an example, define the term 'sustainability' as it applies to a natural resource.

**(3 marks)**

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- (b) Licensed kangaroo shooters are allowed to cull a certain number of kangaroos from properties in outback Australia. The number an individual shooter is permitted to shoot varies from year to year, depending on the rate at which the kangaroos reproduce. This rate varies according to the amount of rainfall received, as this in turn influences the quantity of food available and thus the number of young that survive.

On one property, it was determined that 5000 kangaroos was the sustainable population. At the start of a year, it was estimated that there was a population of 5000 kangaroos. During the following high-rainfall year, 1500 kangaroos were born, and 800 died through natural causes.

- (i) How many kangaroos could the shooters kill and still maintain the population at a sustainable level? **(1 mark)**

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- (ii) Two years later, the property was affected by a severe drought and 2000 kangaroos died and only 100 young survived. Describe how this altered the sustainability and culling quota for the population of kangaroos on the property. (2 marks)

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Question 18

(8 marks)

During the nineteenth and twentieth centuries, thousands of seals were slaughtered for their fur and oil on remote sub-Antarctic islands. In many places they were virtually exterminated. Following restrictions being placed on the number of seals that could be killed, numbers recovered. In the period between 1963 and 1973, the numbers of seals of one species found on a particular small island were recorded as shown in the table below.

Seal numbers, 1963–1973

Year	Number of seals
1963	19
1964	18
1965	18
1966	25
1967	40
1968	99
1969	151
1970	197
1971	202
1972	199
1973	201

(a) Draw a graph (using the grid on page 11) showing the numbers of seals on the island over the eleven-year period. (4 marks)

(b) Explain **two** trends shown in the graph. (4 marks)

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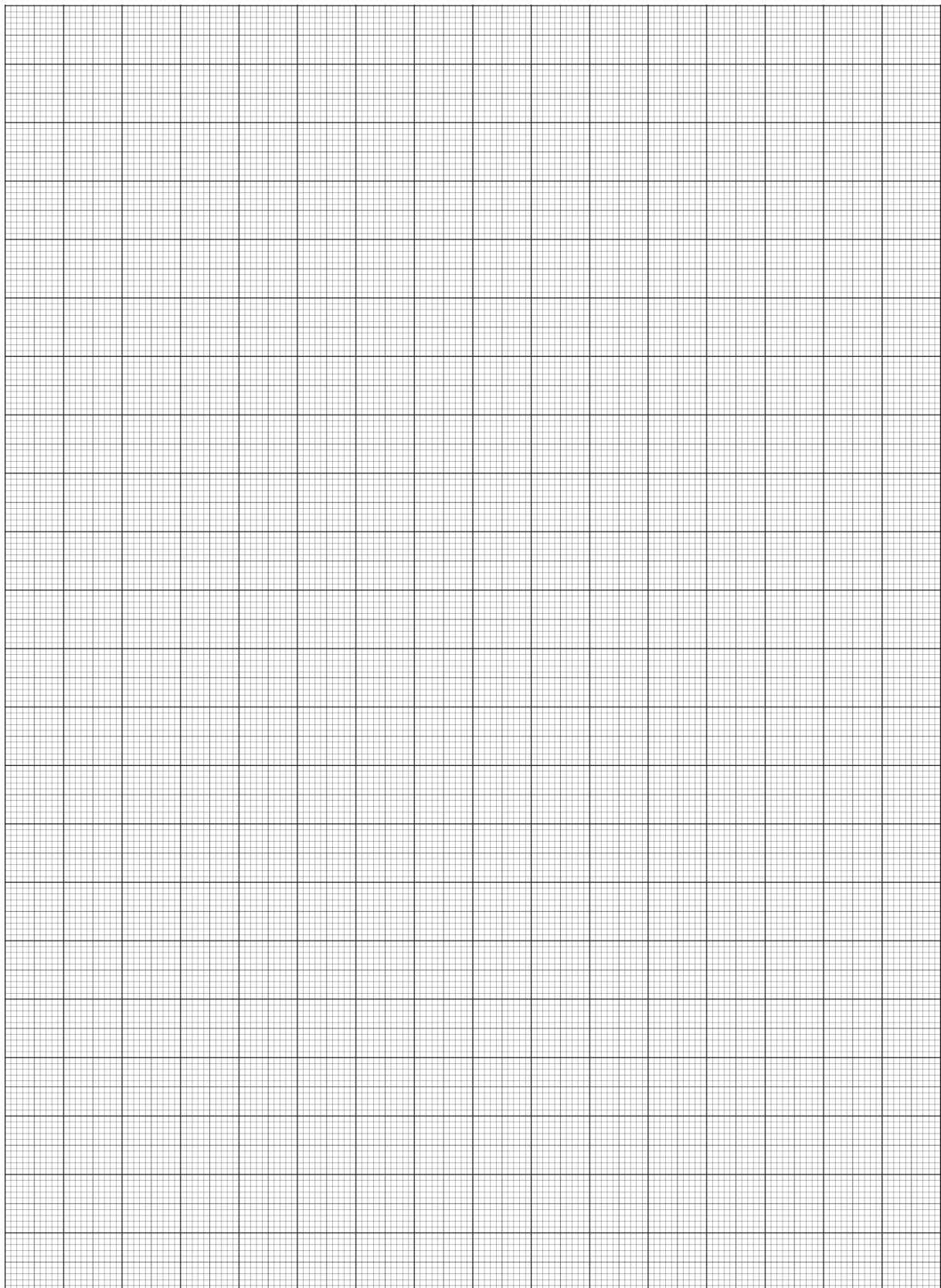
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A spare grid is provided at the back of this booklet. If you need to use it, cross out this attempt.

**See next page**

Question 19

(12 marks)

Some ore deposits are formed by the redistribution of metals associated with hydrothermal activity, while others are associated with magmatic processes, such as fractional crystallisation, gravitational settling or immiscible liquid separation.

- (a) Choose **one** of the above processes of ore formation and then use a labelled diagram or flow chart, to explain clearly how the minerals are concentrated. Include the source of metals and fluids in the system you illustrate and the physical conditions or properties that are required for the ore deposit to form. (6 marks)

Name of process chosen: \_\_\_\_\_

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- (b) Name a major Western Australian metallic ore deposit. Give its approximate location and state the primary resource contained in the deposit. (3 marks)

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- (c) Name and describe an exploration technique that could be used to search for the mineral resource cited in part (b) above. (3 marks)

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Question 20

(11 marks)

News items about climate change appear in the media almost every day. In a government publication 'State of the Climate 2012', the CSIRO and Bureau of Meteorology reported that average Australian annual temperatures have increased by 0.9 °C since 1910 and predict that these will continue to increase by between 1 °C and 5 °C in the next 50 years.

- (a) Describe and explain the likely effect of this change on Australian species distribution and sea levels. (4 marks)

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- (b) Climate change models provide projections of future climatic conditions. They take into account the natural variability of the world's climate over time, as well as current measured data.

List **two** methods that modellers might use to gather data on previous global climatic conditions. (2 marks)

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- (c) Outline **one** reason why future climate changes may **not** be what climate models predict. (2 marks)

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- (d) Analysis of climatic evidence from the distant past has shown that natural processes have been involved in all climate changes observed in the last 250 million years. Name **one** natural process that has caused a significant global change in climate and explain its effect on climate. (3 marks)

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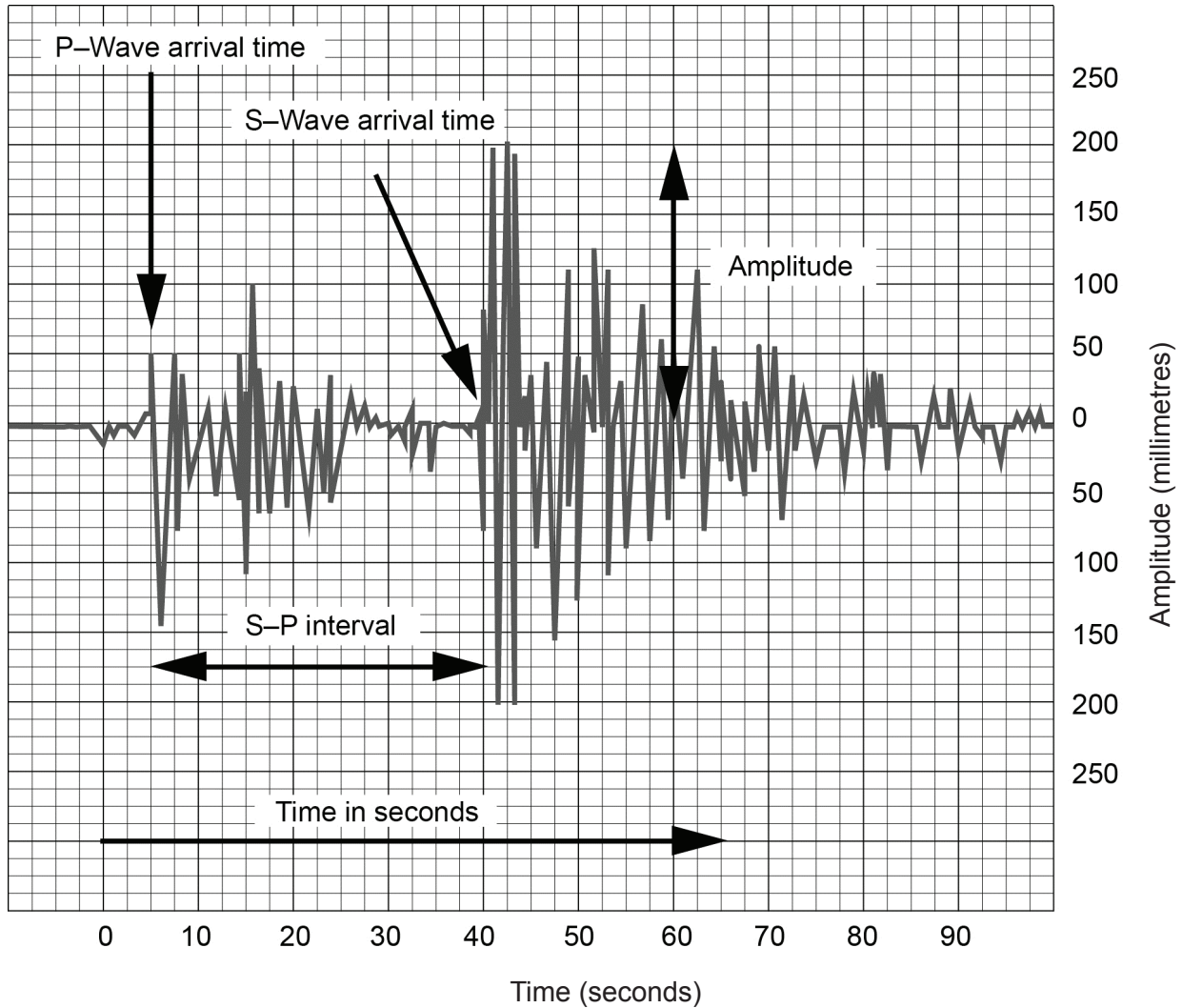
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Question 21

(14 marks)

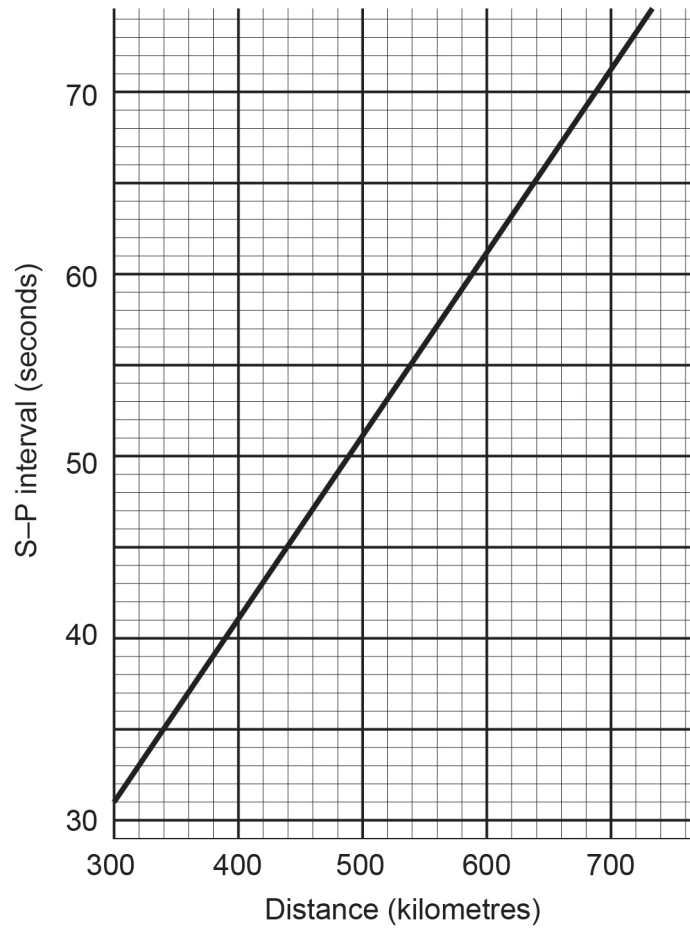
Earthquake epicentres can be located on the Earth's surface by analysing seismograph profiles and making calculations based on the physical properties of S and P waves.



- (a) (i) Determine the S–P interval for the profile above. (2 marks)

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- (ii) Determine the distance between the location where the seismograph profile was recorded and the earthquake's epicentre. Use the graph above which shows the relationship between the S-P interval and the distance of the seismograph from the epicentre. (2 marks)
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**See next page**



(b) Describe **two** strategies that could be used to reduce the impact of bushfires. (4 marks)

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(c) Using an Australian example, describe **two** ways in which bushfires can have a beneficial effect on the components of a natural ecosystem. (4 marks)

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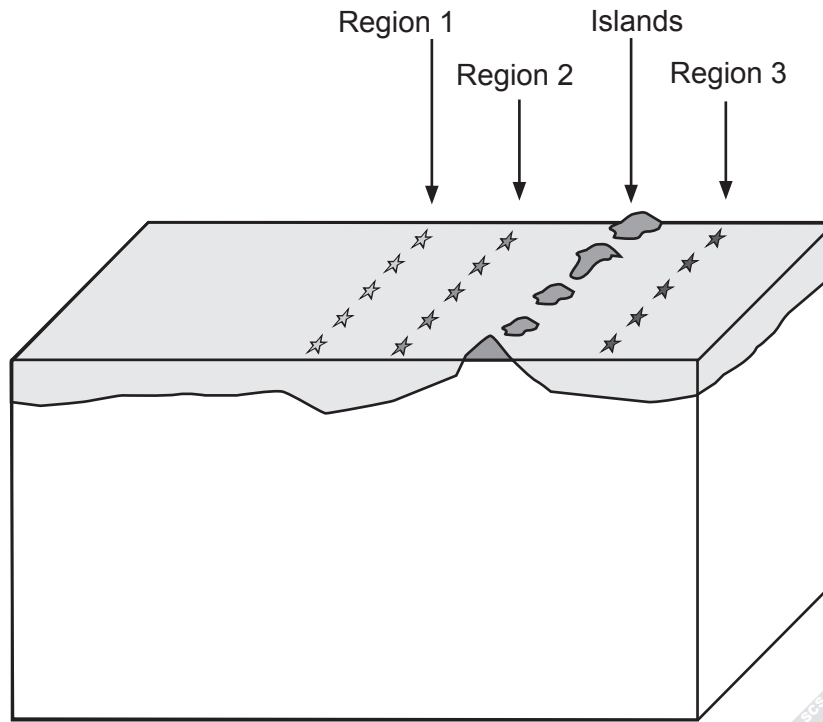
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Question 23

(12 marks)

The diagram below shows a chain of volcanic islands and the locations of some recent earthquakes in the area. The depth of the earthquakes increases towards the right, beginning with Region 1, which is shallowest, and progressing to Region 2 (deeper) and Region 3 (deepest).



- (a) On the front of the above diagram, draw in the **most** likely arrangement of the tectonic plates in this setting, showing the directions of relative movement with arrows. (4 marks)
- (b) The islands are home to a number of active volcanoes. What type of volcano would you expect to form at this tectonic location? (1 mark)

- (c) On the basis of your knowledge of this type of volcanic eruption, assess the relative risk to local populations from the volcanoes formed on these islands. You should justify your assessment with reference to the characteristics of the magma. (4 marks)

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- (d) Describe **three** measures that could be taken to reduce the likely impact of these volcanoes on local human populations. (3 marks)

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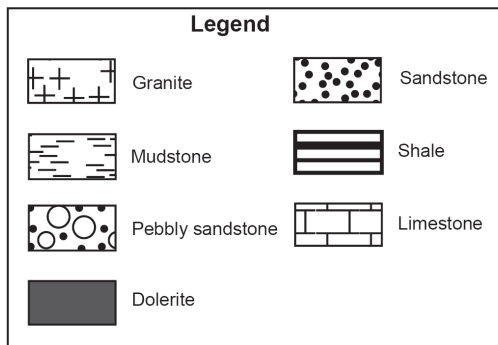
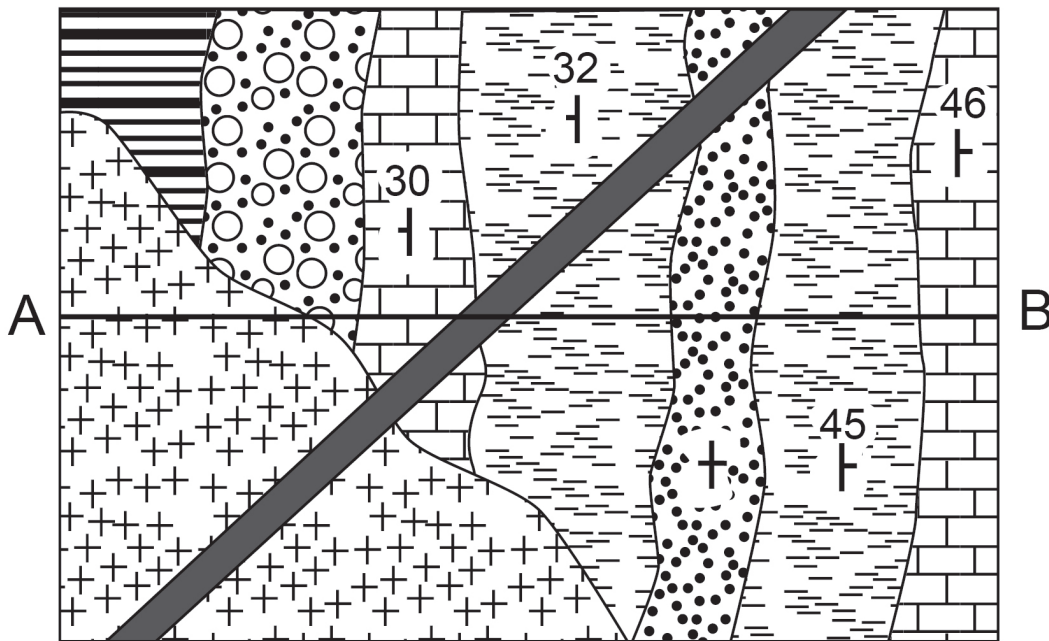
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Question 24

(15 marks)

The geological map below was produced by a student during a field trip.



- (a) On the axes provided draw a geological cross-section from 'A' to 'B' to a depth of 400 m. Note: to assist you in transcribing strata locations, you may remove page 37 of the booklet by tearing along the perforations. (6 marks)





- (b) Use the information shown on the map and your cross-section drawn in part (a) to complete the following:

(4 marks)

name the oldest rock unit shown on the cross-section

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name the youngest rock unit shown

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name the type of fold formed by the sedimentary layers

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name the intrusive feature formed by the dolerite.

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- (c) Use the information shown on the map, your cross-section and your knowledge of natural processes to answer the following:

- (i) Name and explain the principle by which you determined the youngest rock type in part (b). (2 marks)

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- (ii) Name the type of forces that produced the fold shown in the cross-section and suggest a tectonic environment in which the folding may have occurred. (2 marks)

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- (iii) The student noticed that surrounding the granite intrusion was a thin zone within the country rock in which the sediments had been altered. Suggest a name for this thin zone. (1 mark)

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**End of Section Two**

**See next page**

## Section Three: Extended response

30% (30 Marks)

This section contains **three (3)** questions. You must answer **two (2)** questions: the compulsory question (Question 25) and **one (1)** of the other questions (Question 26 or Question 27). Write your answers in the lined pages provided following Question 27.

If you use a page for planning, indicate this clearly at the top of the page.

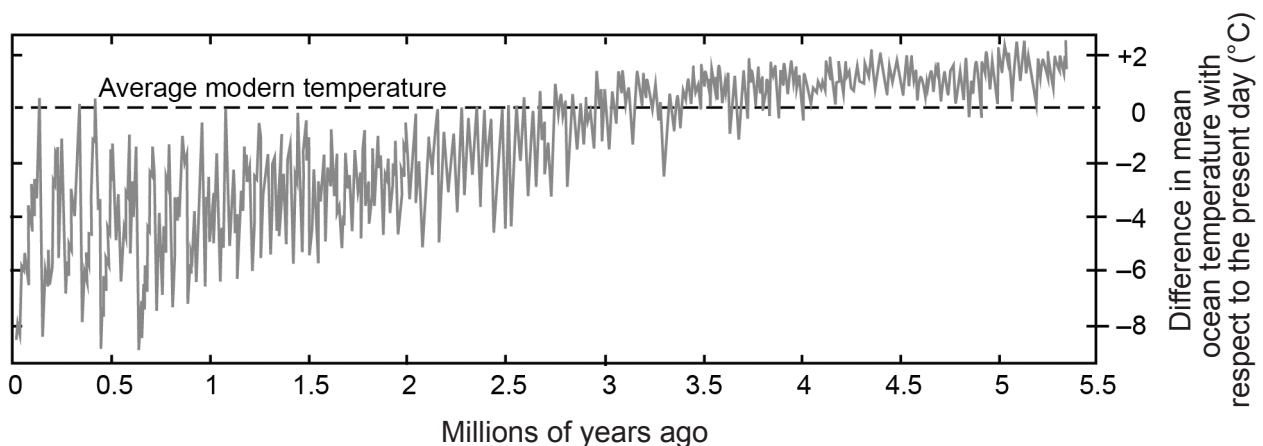
Suggested working time: 60 minutes.

## Question 25 (compulsory)

(15 marks)

The isotopic composition of some compounds in marine organisms has been shown to vary with the temperature of the water in which they live. This relationship is conserved in stable body parts (shell, bones, and teeth) after death, providing a means by which we can monitor temperature change in the oceans over the course of geological time. Such records provide an insight into global climate change on timescales much longer than the 200 000 years that modern humans have inhabited this planet.

The graph below is a summary of such a record, which was compiled from micro-fossils contained in a core sample of marine sediment extending back over 5 million years from the present.



With reference to the graph shown above, discuss how the Earth's climate has changed over geological time. In your answer you need to:

- describe the variation in ocean temperature revealed in this record over the past 5 million years and explain the implications of this variation for the Earth's climate, glacial ice and sea level over the same period. (8 marks)
- outline how changes in climate, glacial ice and sea level may have affected early human societies and discuss **two** implications of global climate change for future human societies. (7 marks)

See next page

Answer Question 26 or Question 27.

**Question 26**

**(15 marks)**

Some estimates suggest that by the year 2100, oil, gas, coal and nuclear power will provide less than 15% of the energy used by the population of this planet as the use of renewable energy resources increases.

- (a) Using **two** examples, explain what is meant by the term 'renewable energy resources'.  
(4 marks)
- (b) For each of the above examples describe how the energy is released or utilised and outline the advantages and disadvantages involved in the development and/or continued operation of each energy source.  
(6 marks)
- (c) Identify **one** site in Western Australia where a renewable energy resource has been developed, and explain both the reason that this location was chosen as well as the specific environmental impacts involved with its development and/or continued operation.  
(5 marks)

or

**Question 27**

**(15 marks)**

Water is essential to human and other life on our planet. However, current water usage practices are **not** sustainable and Australia is facing unprecedented water management challenges.

Discuss the environmental consequences that would follow the unsustainable use of water, by addressing the following points:

- (a) Identify **two** sources of fresh water available for human use and **one** source of fresh water which is not readily available for human use with current technologies. (3 marks)
- (b) Both human activity and natural factors can contribute to a decrease in the availability of fresh water. Describe **two** human activities that can pollute fresh water sources as well as **two** other factors that might contribute to a severe fresh water shortage. For each activity and factor described, explain both the environmental effects as well as effects on humans directly. (8 marks)
- (c) Explain **two** ways to improve the sustainability of Western Australia's sources of fresh water. (4 marks)

**End of questions**





















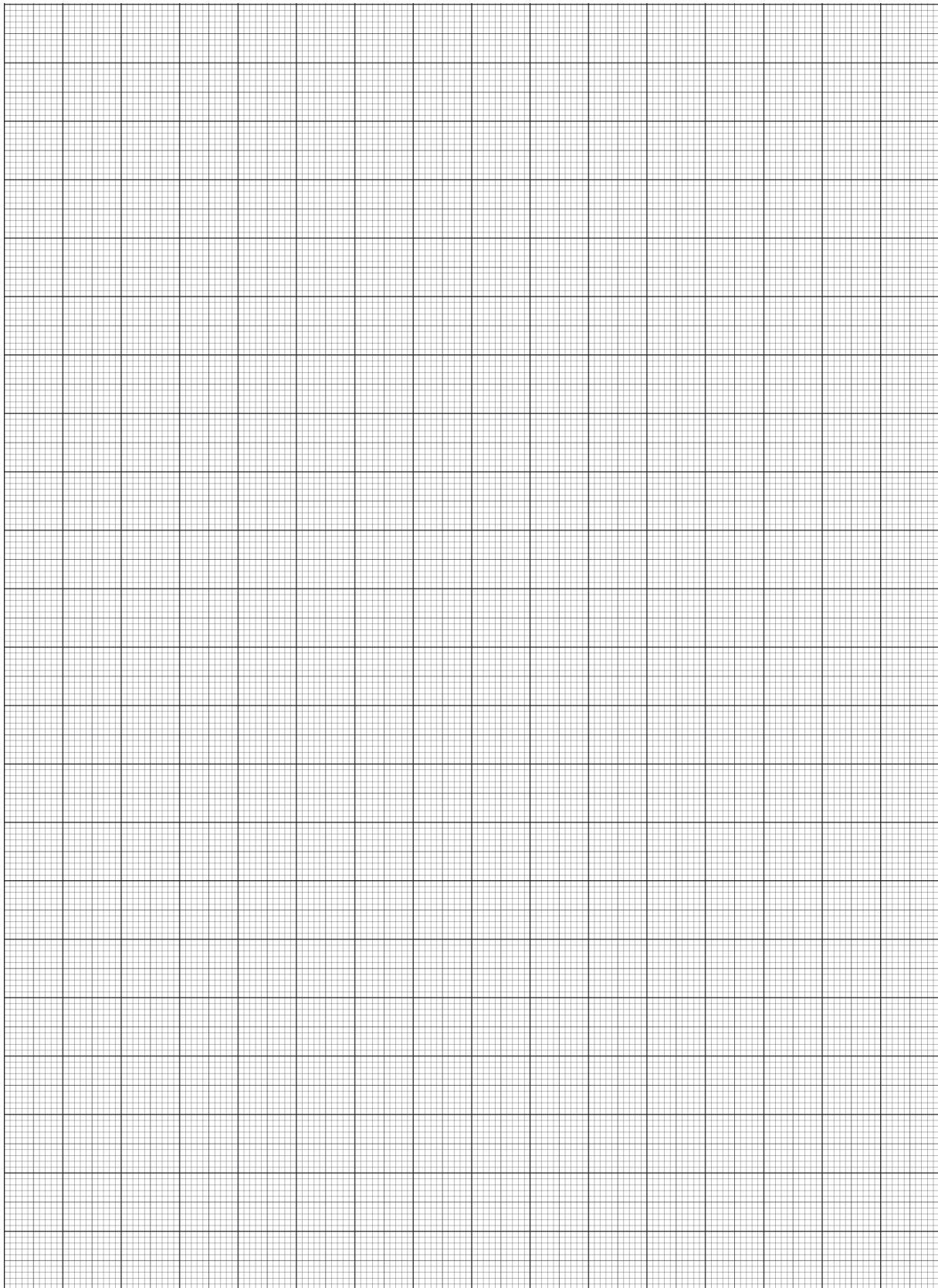
You may tear along the perforations to use this page (to transcribe strata locations for Question 24).

**This page is to be used for transcribing strata locations only**

You may tear along the perforations to use this page (to transcribe strata locations for Question 24).

**This page is to be used for transcribing strata locations only**

Question 18 spare grid.



## ACKNOWLEDGEMENTS

### Section Three

#### Question 25

Image adapted from: Lisiecki, L. & Raymor, M. (2005). *A Pliocene-Pleistocene stack of 57 globally distributed benthic  $\delta^{18}O$  records*. Retrieved March, 2011, from <http://lorraine-lisiecki.com/LisieckiRaymo2005>

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