



Western Australian Certificate of Education Examination, 2013

Question/Answer Booklet

EARTH AND ENVIRONMENTAL SCIENCE

Stage 3

Please place your student identification label in this box

Student Number: In figures

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In words

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, 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 response	3	2	60	30	30
Total					100

Instructions to candidates

1. The rules for the conduct of Western Australian external examinations are detailed in the *Year 12 Information Handbook 2013*. 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.

1. The human activity that is currently responsible for the greatest loss of the Earth's original forest areas is
 - (a) the extraction of minerals.
 - (b) the growth of towns and cities.
 - (c) the extraction of native timbers.
 - (d) land clearing for farming.

2. The process by which ozone is formed in the stratosphere is best described as the
 - (a) reaction of atmospheric oxygen with hydrofluorocarbons (CFCs).
 - (b) release of ozone by active volcanoes.
 - (c) reaction of oxygen atoms and oxygen molecules in the atmosphere.
 - (d) the release of ozone by decaying vegetation.

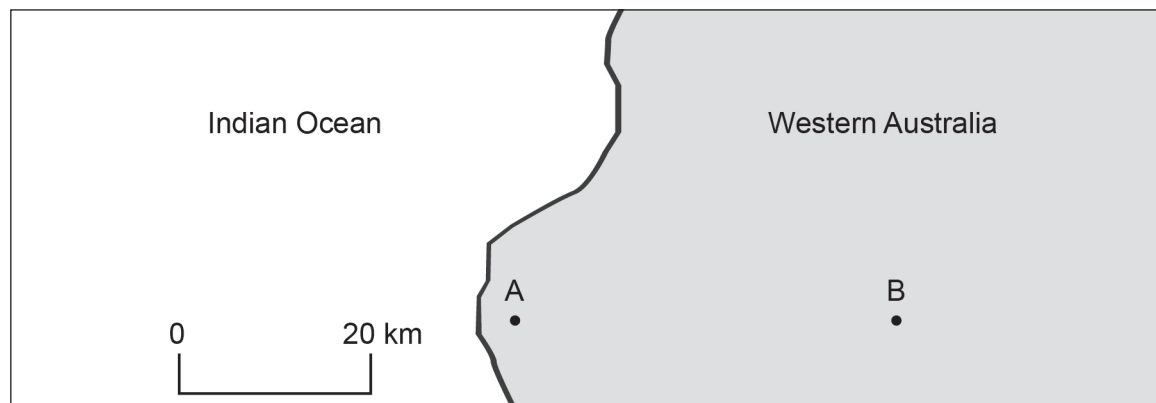
3. Which one of the following would you find on a topographical map?
 - (a) isotherms
 - (b) contour lines
 - (c) a rock type legend
 - (d) rainfall distribution data

4. The global energy budget is best defined as the
 - (a) amount people pay to consume energy for all purposes.
 - (b) energy the Earth loses each winter compared with the energy it gains each summer.
 - (c) transfer of energy around the globe by the movement of winds and ocean currents.
 - (d) total of gains by the Earth of incoming solar energy minus the losses by the Earth of outgoing energy.

5. Which one of the following is **not** a significant greenhouse gas?
 - (a) carbon dioxide
 - (b) water vapour
 - (c) methane
 - (d) nitrogen

See next page

6.



Locations A and B are on the same latitude and at the same height above sea level. Which one of the following statements best describes the relative variation in average summer and winter temperatures between the two places?

- (a) Location A would have hotter temperatures in summer and colder temperatures in winter than Location B.
 - (b) Location A would have lower temperatures in summer and higher temperatures in winter than Location B.
 - (c) Location A would have higher temperatures in summer and higher temperatures in winter than location B.
 - (d) Location A would have lower temperatures in summer and lower temperatures in winter than Location B.
7. The islands of Hawaii are an example of volcanism associated with
- (a) a mid-oceanic rift zone.
 - (b) a mantle hot spot.
 - (c) an intra-continental rift zone.
 - (d) a subduction zone.
8. Which one of the following is a significant source of ozone found in the troposphere?
- (a) car exhaust emissions
 - (b) agriculture
 - (c) volcanic eruptions
 - (d) CFC aerosols
9. Which one of the sequences below has the rocks ordered correctly from lowest to highest in terms of silica content?
- (a) rhyolite, andesite, basalt
 - (b) andesite, basalt, rhyolite
 - (c) basalt, andesite, rhyolite
 - (d) basalt, rhyolite, andesite

See next page

10. An igneous rock that is fine-grained to glassy, light in colour and has a very low density, is **most** likely to be
- (a) granite.
 - (b) obsidian.
 - (c) rhyolite.
 - (d) pumice.
11. Volcanogenic massive sulfide (VMS) ore deposits are formed by
- (a) regional metamorphism of limestones.
 - (b) deposition of sulfides by wave action.
 - (c) exhalative processes on the ocean floor.
 - (d) oxidation of metal dissolved in the oceans.
12. Which one of the following is the **least** significant source of atmospheric CO₂?
- (a) deforestation
 - (b) fossil fuel use
 - (c) formation of coral reefs
 - (d) volcanic eruption
13. Which one of the following resources is **most** likely to have formed as a result of hydrothermal processes?
- (a) gold
 - (b) chromite
 - (c) diamonds
 - (d) iron ore
14. Which one of the following is **not** associated with El Niño conditions?
- (a) low Southern Oscillation Index
 - (b) weaker than normal trade winds
 - (c) wetter than normal conditions along eastern Australia
 - (d) increased rainfall in the central Pacific Ocean
15. Which one of the following is the **most** likely explanation for the formation of a lamproite or a kimberlite pipe?
- (a) metamorphism of a large diorite intrusion
 - (b) partial melting of the upper mantle
 - (c) hot-spot related melting of the lower crust
 - (d) exhalative volcanism associated with black smokers

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.

Question 16

(10 marks)

Two examples of biogeochemical cycles are the carbon cycle and the nitrogen cycle.

Name and describe **one (1)** major impact that humans can have on each of these cycles, and suggest **one (1)** strategy that could be put in place to reduce the effects of each of these impacts in the future.

(a) Carbon cycle

(5 marks)

Impact:

Strategy:

See next page

(b) Nitrogen cycle

(5 marks)

Impact:

Strategy:

Question 17

(15 marks)

Regional metamorphism is an important type of metamorphism. Two of the textures that help distinguish regional metamorphic rocks from other rock types are schistosity and gneissic banding.

- (a) Describe these two metamorphic textures, giving the names of specific minerals that may be involved in each. (4 marks)

Schistosity:

Gneissic banding:

- (b) Describe **three (3)** other characteristics of regional metamorphism. (3 marks)

- (c) Not all metamorphic rocks show foliated textures such as schistosity or gneissic banding. Name **two (2)** metamorphic rocks that do **not** commonly show a foliated texture, and suggest **two (2)** reasons why some metamorphic rocks lack foliation. (4 marks)

- (d) Metamorphic rocks are produced by the chemical and physical alteration of other rocks (these earlier rocks are often referred to as 'parent rocks'). Complete the following table by suggesting suitable parent or metamorphic rocks. (4 marks)

Parent rock	Metamorphic rock
	marble
basalt	
	quartzite
shale	

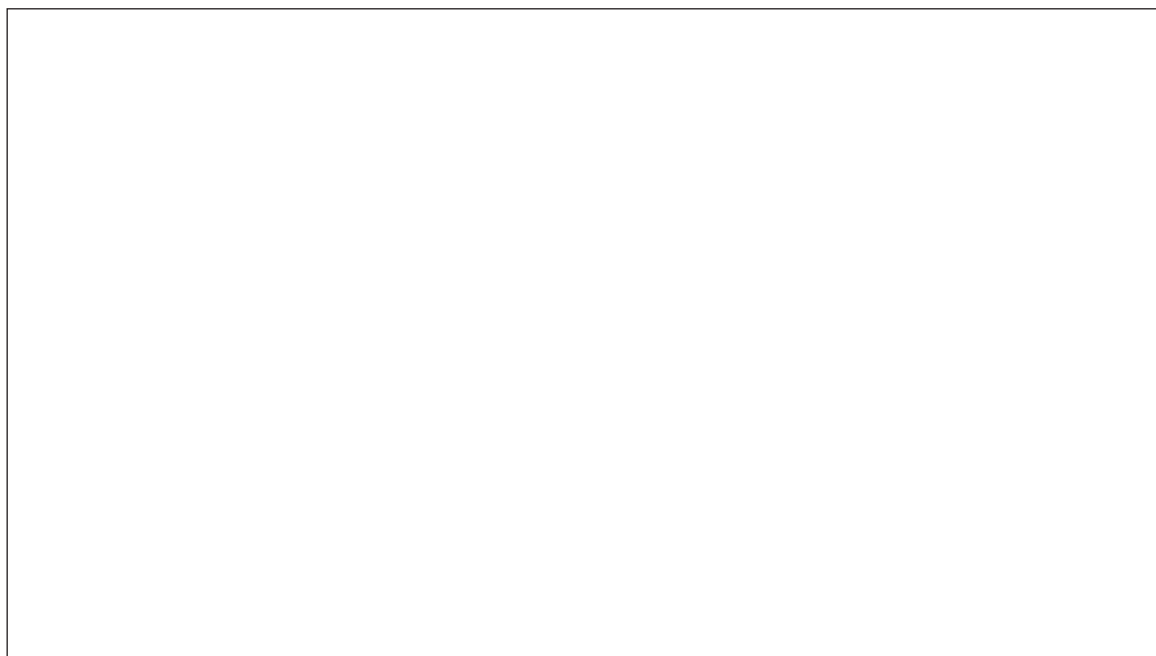
Question 18

(11 marks)

Igneous processes such as fractional crystallisation, gravitational settling and immiscible liquid separation are often associated with the formation of metallic ore deposits.

- (a) With the help of a diagram or flow chart, outline how **one (1)** of these igneous processes could be involved in the production of an ore body. (6 marks)

Name of process chosen: _____



- (b) Discuss **one (1)** way in which mining or processing of a metallic ore deposit might result in pollution, with a potentially negative health impact. Describe **one (1)** measure that could be introduced to prevent or reduce this impact. (5 marks)

Question 19

(13 marks)

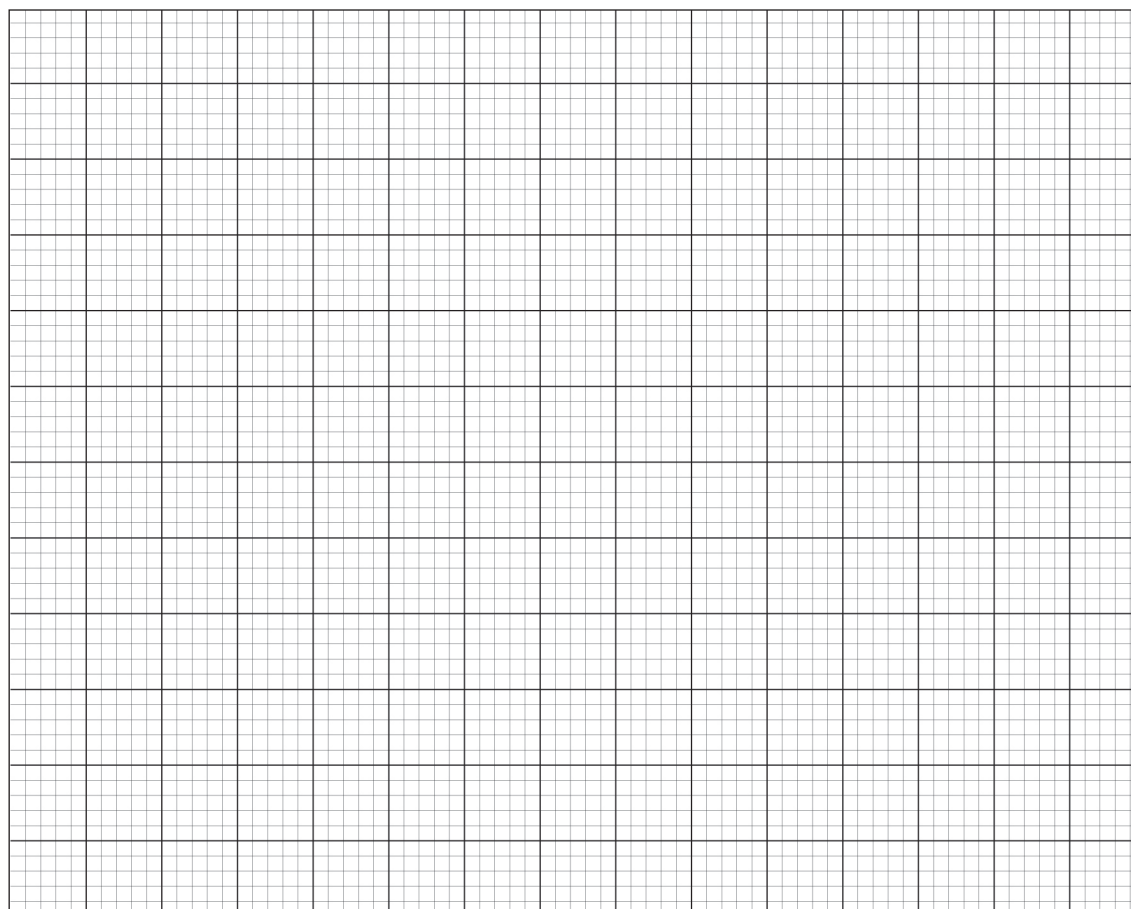
Any change in Australia’s population is likely to have implications for the sustainability of its natural ecosystems and the viability of its resource industries.

The table below shows Australia’s population between 1905 and 2005.

Year	Population (millions)
1905	4.0
1925	5.9
1935	6.7
1945	7.4
1955	9.2
1965	11.4
1985	15.8
1995	18.1
2005	20.3

(a) Draw a line graph of the above data.

(5 marks)



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

See next page

(b) Describe **two (2)** trends shown in the population data. (2 marks)

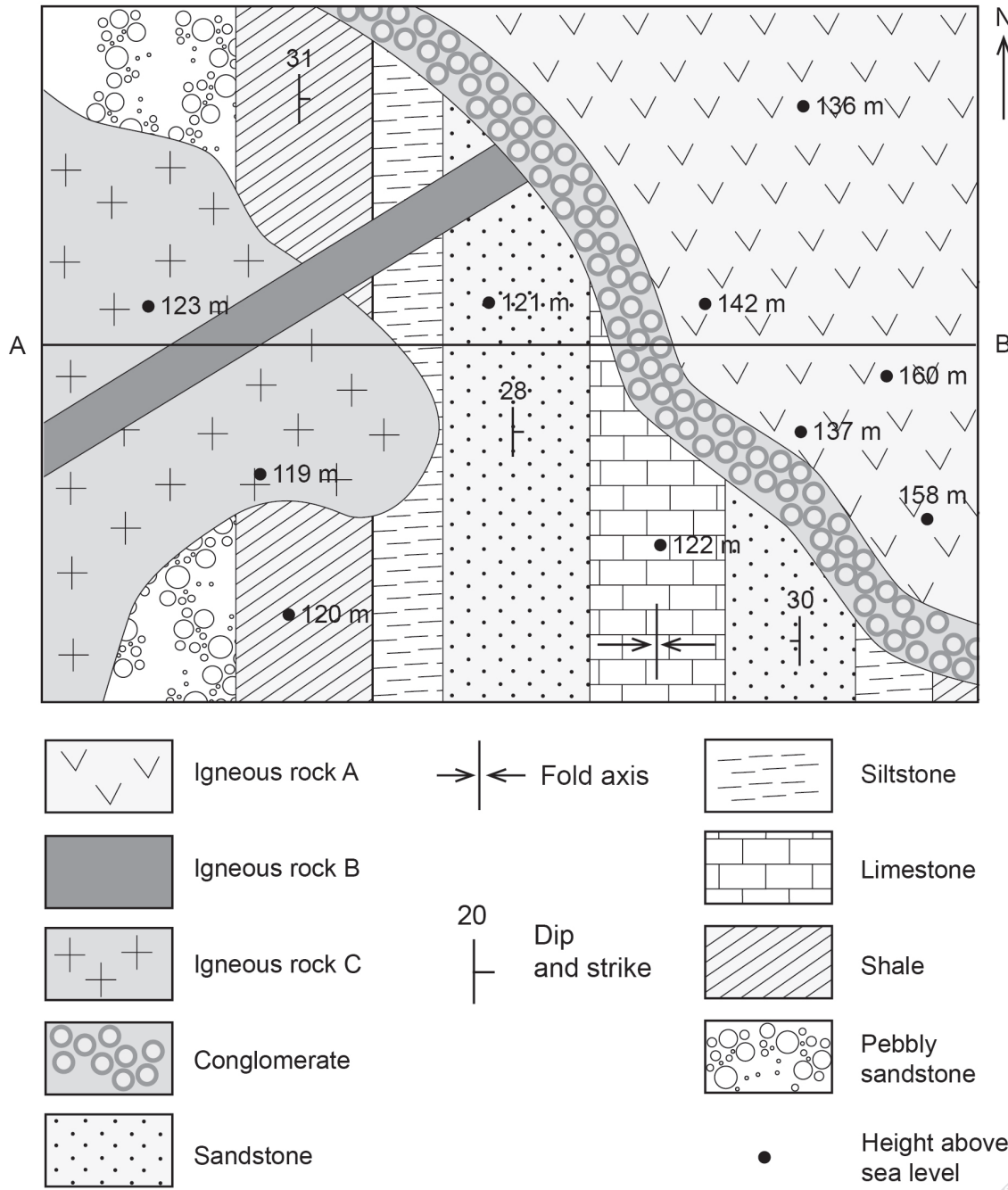
(c) Using an example, suggest an effect the change in Australia's population may have on:

(i) the sustainability of a natural ecosystem in Australia. (3 marks)

(ii) the long-term viability of an Australian resource industry. (3 marks)

Question 20

(17 marks)



After a field trip, a student produced the above geological map. She was uncertain as to what names she should give the three igneous rocks so she took samples and recorded the following notes:

Igneous rock A appears to be a flat layer of fine-grained dark igneous rock that looks similar to rock B but is finer grained.

Igneous Rock B is a small vertical intrusion of medium-grained rock, with about 60% dark minerals and no quartz.

Igneous rock C is part of a large igneous intrusion. It is a coarse-grained rock that contains about 30% quartz, lots of very weathered feldspar and about 10% dark minerals.

See next page

- (a) Suggest names for each of these three igneous rocks. (3 marks)

Igneous rock A:

Igneous rock B:

Igneous rock C:

- (b) On the axes below, draw a geological cross-section from 'A' to 'B' down to sea level. (6 marks)



Note: to assist you to transcribe strata locations, you may remove page 33 of the booklet by tearing along the perforations.

Question 20 (continued)

Use the information provided on page 14 and your cross-section to answer the following.

- (c) (i) Name the igneous structure produced by each of the three rocks. (3 marks)

Structure produced by igneous rock A:

Structure produced by igneous rock B:

Structure produced by igneous rock C:

- (ii) Name the structure outlined by the north-south striking sedimentary layers. (2 marks)

- (iii) Name the stratigraphic feature between the conglomerate and the sediment layers beneath it. (2 marks)

- (iv) Identify the oldest rock unit. (1 mark)

Question 21

(11 marks)

Strategies for the protection of the natural environment have been adopted by individuals, community groups, business and governments as a response to the impact of increased population and economic activity.

- (a) Name **one (1)** renewable Western Australian natural resource currently in use and describe a strategy involving careful management that would ensure the resource will be available for future generations. (4 marks)

- (b) Name **one (1)** Western Australian metallic mining operation that you have studied. Outline any potential damage to the surrounding ecosystem associated with the mining of the ore at this site. (4 marks)

Question 21 (continued)

- (c) For the operation that you discussed in (b), describe **one (1)** strategy that is or could be used to reduce the potential damage to the surrounding ecosystem. (3 marks)

Question 22

(8 marks)

Earth scientists have discovered evidence to indicate that the major mass extinction event that happened about 65 million years ago was caused by the impact of a meteorite with the planet. This impact would have caused major changes to Earth's climate in both short and long term.

- (a) Define the term 'mass extinction'. (2 marks)

- (b) Describe the evidence that establishes the following aspects of an extinction event. (2 marks)

Occurrence: _____

Timing: _____

- (c) Describe how the impact of a meteorite approximately 10 kilometres in diameter might produce abrupt and catastrophic climate changes that could lead to a mass extinction event. (4 marks)

Question 23

(6 marks)

In Australia and elsewhere in the world, studies have shown recent changes in ecosystem biodiversity. Major causes of such changes include climate change, land clearing and the introduction of exotic species.

Describe **two (2)** examples of changes to biodiversity caused by human activities. Your answer should describe the activities that caused each change, the nature of the change and its effects. One change should be on a local scale and the other on a global scale.

Local change: _____

Global change: _____

Question 24

(14 marks)

Banded iron formations are distinctive units of sedimentary rock that consist of repeated, thin layers of iron oxides, alternating with bands of iron-poor shales and cherts.

- (a) Explain the physical and chemical processes involved in the creation of banded iron formations. (5 marks)

Conditions leading to the formation of banded iron formations were common throughout much of the Earth's history, but such rocks have not formed in significant quantities since the Precambrian era.

- (b) Explain why extensive banded iron formation sequences have not formed since the Precambrian. (3 marks)

Question 24 (continued)

When subjected to secondary alteration processes to remove carbonate and silica, banded iron formations provide important commercial sources of iron ore.

- (c) (i) Name a region of Australia in which significant iron ore deposits are found. (1 mark)

- (ii) Describe an exploration strategy that could be used to identify iron ore resources. Specify **two (2)** techniques you would use, the order in which they would be applied, and the way in which they would identify the presence, distribution and/or quality of the resource. (5 marks)

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**(15 marks)**

In the 1950s, scientists investigating the death of large numbers of freshwater fish in Scandinavia discovered that the cause was high levels of acidity in rainwater that increased the acidity of the rivers and lakes. They described this phenomenon as 'acid rain'.

- (a) Name **two (2)** chemicals that are responsible for the production of acid rain. (2 marks)

- (b) Describe **two (2)** human activities that produce high concentrations of the chemicals responsible for the formation of acid rain. (4 marks)

- (c) Discuss **two (2)** strategies that have been or could be used to reduce the levels of these chemicals in the atmosphere. (6 marks)

- (d) Discuss **three (3)** other impacts of acid rain on the environment or society. (3 marks)

See next page

Answer Question 26 or Question 27.

Question 26

(15 marks)

Local and global winds, together with ocean currents play a major role in distribution of the energy the Earth receives from the Sun.

- (a) With the help of a diagram, describe how local winds (such as sea breezes) are produced. (6 marks)

- (b) Name **one (1)** major ocean current you have studied and explain the processes that drive the flow of this current. Include a sketch map showing the location of the current and its normal direction of flow to assist your explanation. (6 marks)

- (c) The ocean current that you identified in (b) affects the region around it. Describe **three (3)** aspects of climate that are modified in the affected region. (3 marks)

or

Question 27

(15 marks)

Massive increases in industrial activity and the consumption of manufactured and processed products have led to a rapid accumulation of waste. This waste causes pollution of the natural environment that can have a detrimental effect on plants and animals.

- (a) Discuss **one (1)** possible impact on marine plants and animals of the release of plastic products into waterways and oceans. (3 marks)

- (b) Discuss **two (2)** possible impacts on the natural environment of the accidental release of large volumes of crude oil into seas and oceans during undersea drilling operations. (4 marks)

- (c) Name **one (1)** of the major gases released by the decomposition of food scraps and other organic materials in large urban waste sites. Describe **one (1)** impact of the release of the gas you have named on the natural environment. (4 marks)

- (d) For **one (1)** of the impacts you described in (a), (b) or (c), discuss in detail a possible plan to reduce or eliminate the effects of this impact. (4 marks)

End of questions

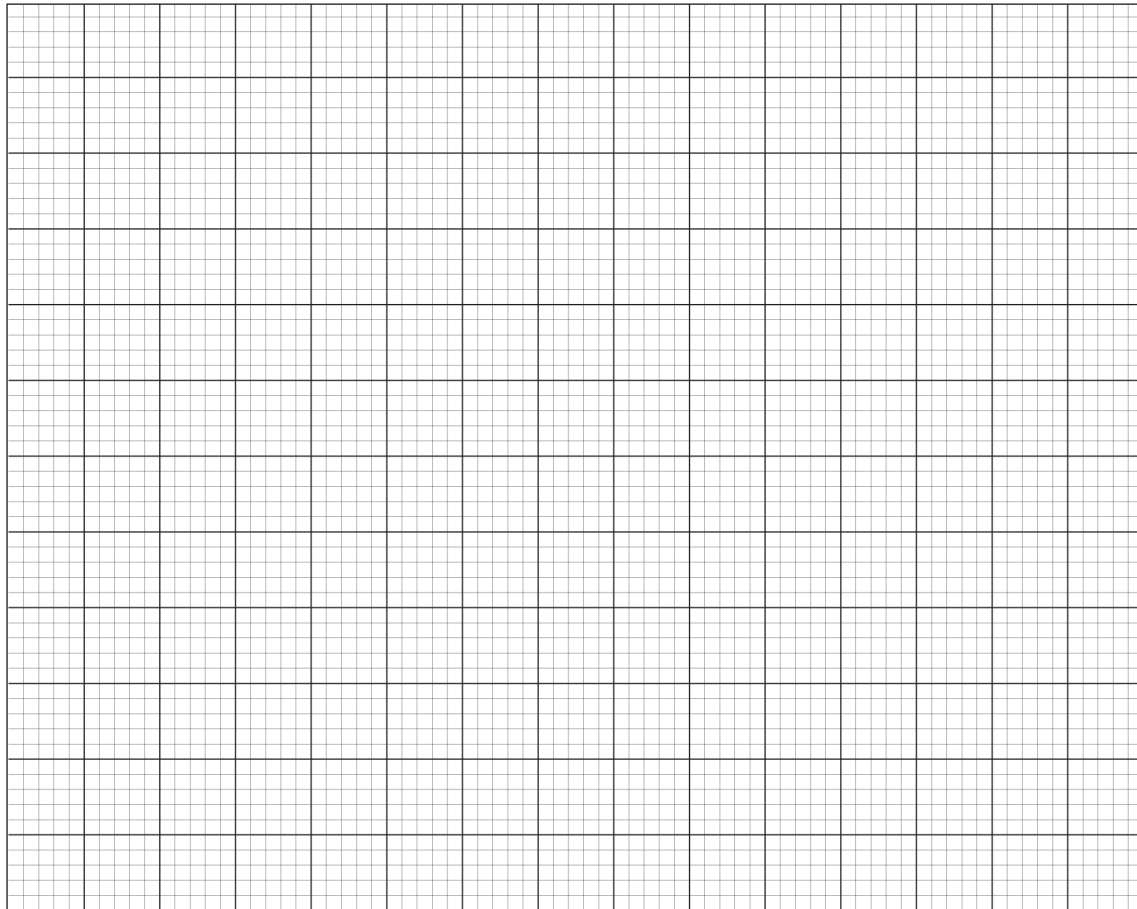
You may tear along the perforations to use this page (to transcribe strata locations for Question 20).

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Question 19 spare grid.



ACKNOWLEDGEMENTS

Section Two

Question 19

Data source: Australian Bureau of Statistics. (2013). *Australia's population between 1905 and 2005* [table]. Retrieved March, 2013, from www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/3105.0.65.0012006

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*Published by the School Curriculum and Standards Authority of Western Australia
27 Walters Drive
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