



Western Australian Certificate of Education Examination, 2010

Question/Answer Booklet

EARTH AND ENVIRONMENTAL SCIENCE

Stage 3

Please place your student identification label in this box

Student Number: In figures

--	--	--	--	--	--	--	--

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

To be provided by the candidate

Standard items: pens, pencils, eraser, correction fluid/tape, ruler, highlighters, approved drawing instruments

Special items: non-programmable calculators satisfying the conditions set by the Curriculum Council

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	15	15	10
Section Two: Short answer	9	9	105	105	60
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 2010*. 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, do not erase or use correction fluid, and shade your new answer. 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(s) that you are continuing to answer at the top of the page.

Section One: Multiple-choice**10% (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, do not erase or use correction fluid, and shade your new answer. 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: 15 minutes.

1. Evidence of the theory of plate tectonics is provided by
 - (a) changes in the rate of rotation of the Earth.
 - (b) the direction of flow of ocean currents in the southern hemisphere.
 - (c) similarities in the fossils found in Australia and Antarctica.
 - (d) the presence of important economic mineral deposits in Western Australia and South Africa.

2. El Niño is a large-scale ocean-atmosphere climate phenomenon in the tropical Pacific Ocean. It is typically characterised by
 - (a) surface waters that are warmer than normal and contain less nutrients.
 - (b) surface waters that are cooler than normal and contain less nutrients.
 - (c) surface waters that are warmer than normal and contain more nutrients.
 - (d) surface waters that are cooler than normal and contain more nutrients.

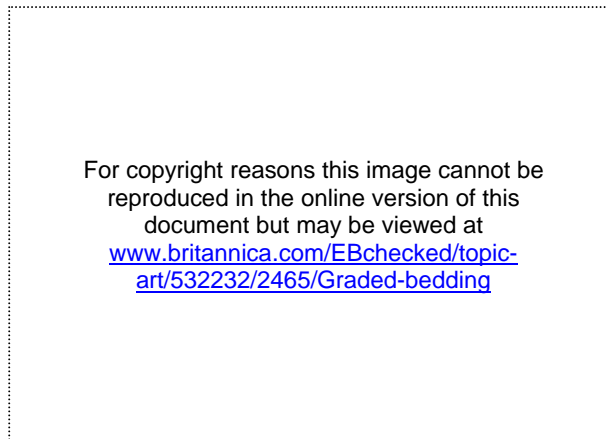
3. Ultraviolet radiation from the sun is absorbed by ozone in the
 - (a) hydrosphere.
 - (b) stratosphere.
 - (c) troposphere.
 - (d) asthenosphere.

4. What was the original depositional environment of Banded Iron Formations (BIFS)?
 - (a) shallow marine trough
 - (b) braided stream
 - (c) limestone reef
 - (d) desert dune

5. In areas where there are no large bodies of water in close proximity, the climate
 - (a) has a small temperature range with high precipitation.
 - (b) has a large temperature range with low precipitation.
 - (c) has a small temperature range with low precipitation.
 - (d) has a large temperature range with high precipitation.

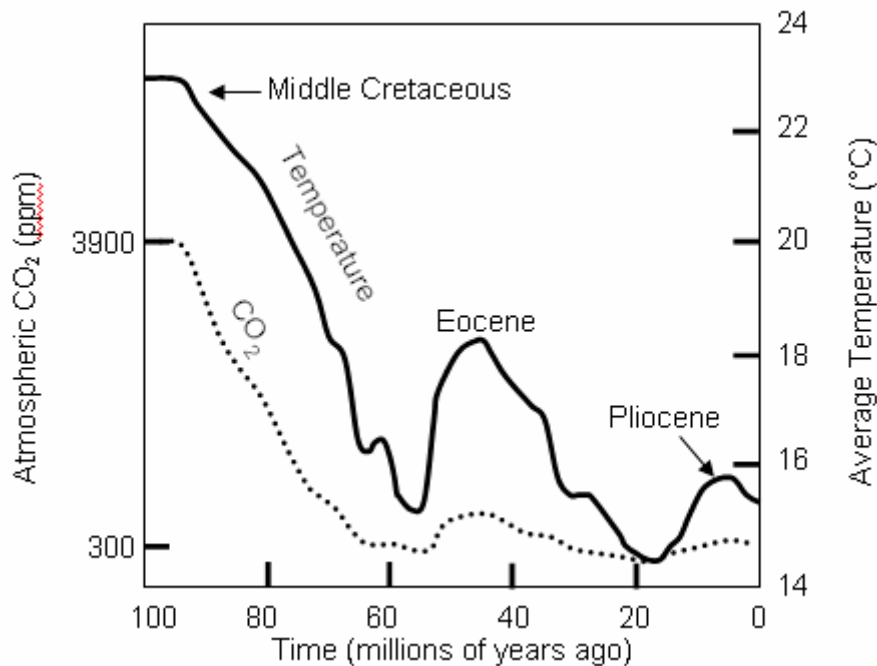
See next page

6. Identify the sedimentary structure in the diagram below.



- (a) mudcrack
 - (b) sole structure
 - (c) graded bedding
 - (d) ripple marks
7. Biomass refers to the
- (a) weight or mass of living material in an ecosystem.
 - (b) variation of life forms within an ecosystem.
 - (c) capacity of an ecosystem to maintain sustainability.
 - (d) rate of energy loss from an ecosystem.
8. In which one of the following environments is a 'black smoker' likely to be found?
- (a) subduction zone at a plate boundary
 - (b) hydrothermal vent at a mid-oceanic ridge
 - (c) the caldera of a volcano
 - (d) a meandering mountain river
9. An Environmental Impact Statement would usually be prepared
- (a) while prospectors were investigating a major mineral deposit.
 - (b) before a mine was developed.
 - (c) while the mine was in production.
 - (d) at the time the mine was sold to a new owner.
10. Plutonic rocks form by
- (a) cooling slowly, deep under the ground.
 - (b) cooling slowly at shallow depths.
 - (c) cooling quickly, deep under the ground.
 - (d) cooling quickly at shallow depths.

11. Which one of the following is **not** a significant greenhouse gas?
- carbon dioxide
 - water vapour
 - methane
 - nitrogen
12. An effective electricity generation system must be able to satisfy the minimum expected demands for power (base load) and be able to supply additional power rapidly at times of high demand (peak load). Which one of the following means of electricity production would be likely to provide the most reliable base load?
- wind
 - solar
 - geothermal
 - wave
13. The graph below shows the variation in CO₂ levels in the atmosphere plotted against the average global temperature over the past 100 million years (note the separate axes for the two curves).



Which one of the following statements is true?

- Throughout the past 100 million years average temperature and atmospheric CO₂ have always risen and fallen together.
- Global CO₂ levels have never been higher than they are today.
- During the last 100 million years the highest average global temperatures were experienced during the Eocene period.
- Average global temperatures today are approximately 8°C lower than in the Middle Cretaceous period.

14. Which one of the following lists contains metamorphic rocks in order from lowest-grade to highest-grade?
- (a) sandstone, slate, gneiss, schist
 - (b) shale, slate, gneiss, schist
 - (c) shale, slate, schist, gneiss
 - (d) slate, phyllite, schist, gneiss
15. Which one of the following is **not** an exploration technique for metallic ores?
- (a) gravity surveys
 - (b) geochemical sampling
 - (c) geomagnetic surveys
 - (d) hydrocarbon fluorescence

End of Section One

See next page

This page has been left blank intentionally

See next page

Section Two: Short answer

60% (105 Marks)

This section has **nine (9)** questions. Answer **all** questions.

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(s) that you are continuing to answer at the top of the page.

Suggested working time: 105 minutes.

Question 16

(12 marks)

- (a) Outline what is meant by the following, giving an example of each.

Ecological sustainability

(2 marks)

A resource site

(2 marks)

An ecosystem

(2 marks)

- (b) Describe the 'precautionary principle' as it relates to negative environmental impacts and give an example of where it might apply in Western Australia. (4 marks)

- (c) At the start of each fishing season, a heavily-fished freshwater lake contains, on average, a stock of 1000 trout. Each year, 400 trout are put into the lake from a nearby fish hatchery. Normal reproduction adds a further 200 to the stock. Typically predators and natural causes remove 100 trout each fishing season.

Use a calculation to explain the ecological sustainability of this site. (2 marks)

Question 17

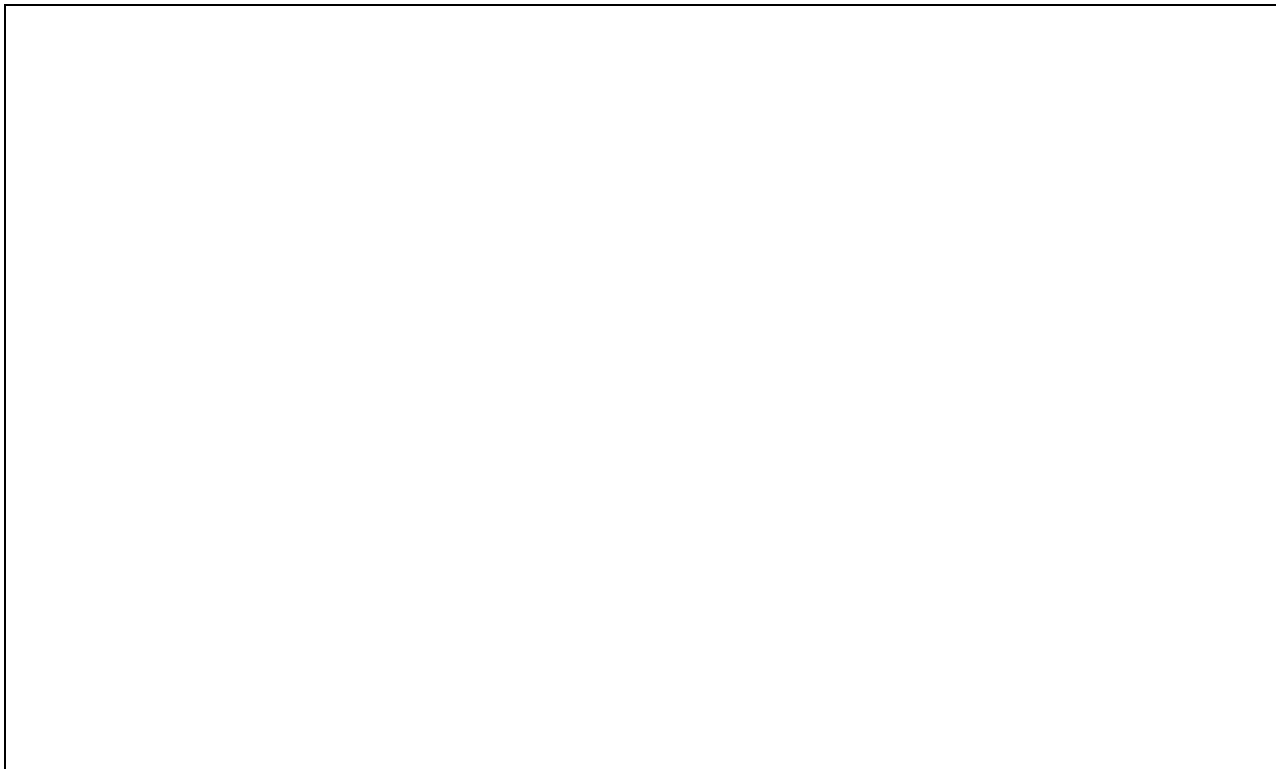
(14 marks)

- (a) Complete the table below by naming **one** rock type and **one** common mineral found in each of the groups of igneous rocks listed in the table. (8 marks)

Group	Example of a rock type	Example of a common mineral
Felsic (acidic)		
Mafic (basic)		
Intermediate		
Ultramafic		

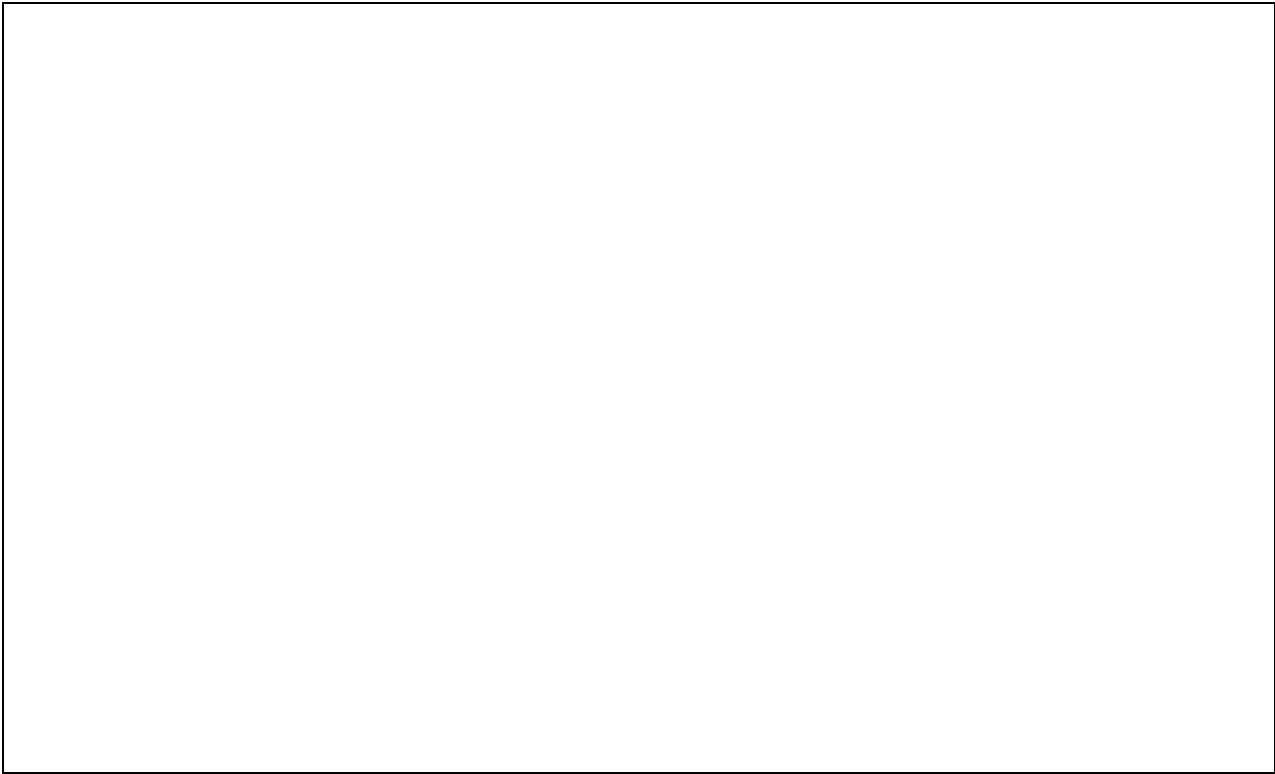
- (b) Draw a labelled diagram of each of the following plutonic igneous intrusions, showing clearly their relationships with the surrounding country rock.

- (i) dyke (3 marks)



(ii) batholith

(3 marks)

A large empty rectangular box with a thin black border, intended for a student to draw or write their answer to the question about batholiths.

Question 18

(10 marks)

- (a) With the help of a labelled diagram, explain why the temperature at the earth's surface varies with latitude. (4 marks)



- (b) Name and identify the location of **one** warm ocean current and **one** cold ocean current. (4 marks)

Warm current name: _____

Warm current location: _____

Cold current name: _____

Cold current location: _____

- (c) Outline **two** possible effects of ocean currents on climate. (2 marks)

Question 19

(9 marks)

The Western Australian economy is continuing to boom, based largely on the contributions of the petroleum and minerals sectors.

- (a) In terms of value, the following are the top twelve commodities produced in Western Australia: iron ore (Fe), petroleum, natural gas, alumina/bauxite (Al), gold (Au), copper (Cu), mineral sands (e.g. Ti, Zr), zinc (Zn), cobalt (Co), diamonds, coal and salt (NaCl).

Which **one** of these resources could be considered renewable? Briefly explain your answer. (2 marks)

- (b) Outline **three** social or heritage issues relating to the mining/processing of resources in Western Australia. (3 marks)

- (c) Several countries are currently building new or additional nuclear power plants to provide electrical power. In November 2008 the Western Australian Government lifted a ban on the mining of uranium. Currently there are several uranium mining developments proposed, with production and export planned to commence in 2012–2014.


- (i) Give **two** reasons that support the mining and export of uranium. (2 marks)

- (ii) Provide **two** arguments against the mining and export of uranium. (2 marks)

Question 20

(13 marks)

- (a) Draw a labelled diagram to illustrate the circulation of the element carbon in the environment. On your diagram identify **three** reservoirs where carbon is stored and **three** processes by which carbon is passed from one reservoir to another. (6 marks)



- (b) Describe **one** of the processes by which carbon is passed from one reservoir to another. (2 marks)

- (c) The carbon cycle was roughly in balance before the industrial revolution in the eighteenth century. Describe **one** human perturbation of the carbon cycle and evaluate its effect on this balance. (5 marks)

Question 21

(10 marks)

Read the following news extract and answer the questions that follow.

For copyright reasons this text cannot be reproduced in the online version of this document but may be viewed at http://news.bbc.co.uk/2/hi/uk_news/8627253.stm

- (a) Why did the eruption have such a major impact on airports across Europe? (1 mark)

- (b) Explain why this eruption was so explosive. (3 marks)

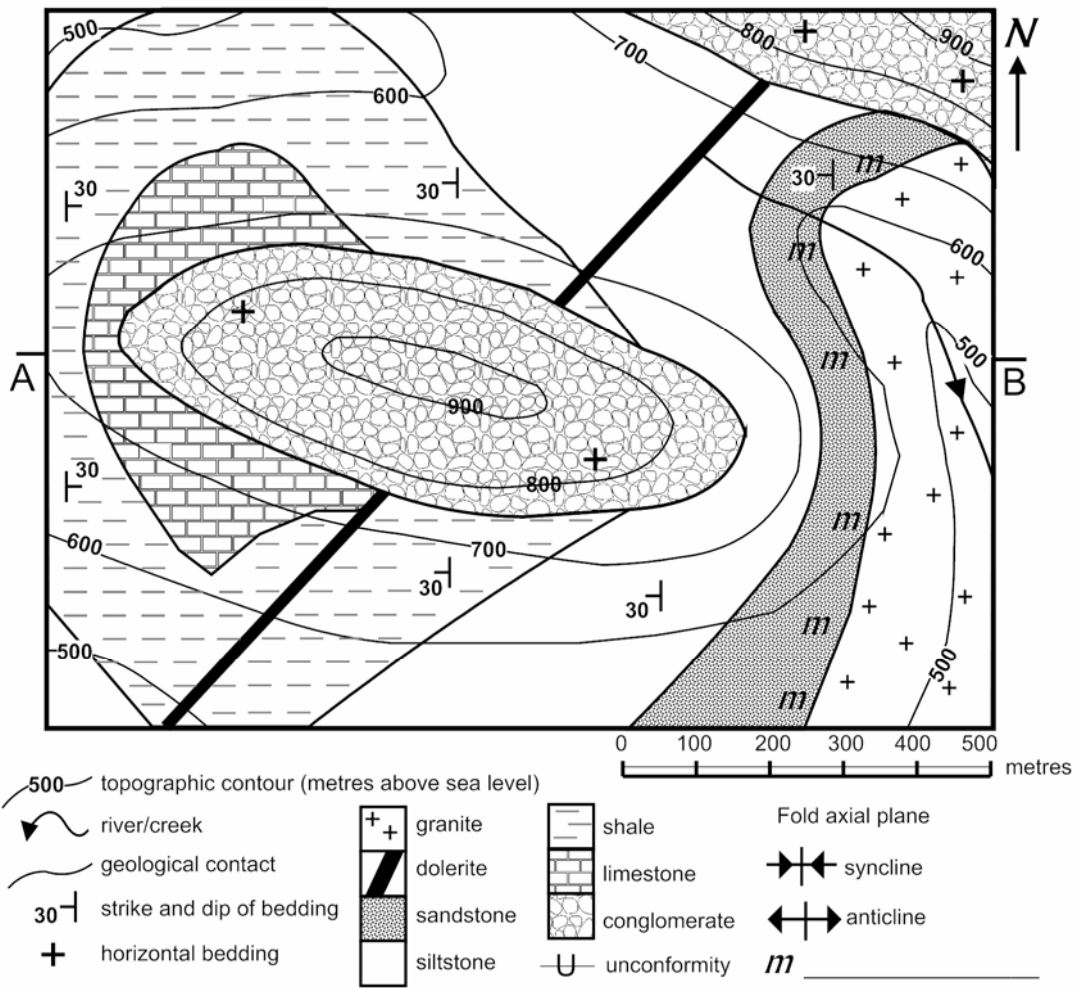
- (c) Name and describe the tectonic setting in which this volcanic eruption occurred. (2 marks)

- (d) The sudden release of meltwater caused flooding in nearby rivers as it travelled down either side of the volcano and forced the evacuation of around 500 people. Describe **two** possible effects on the biodiversity of the surrounding region. (4 marks)

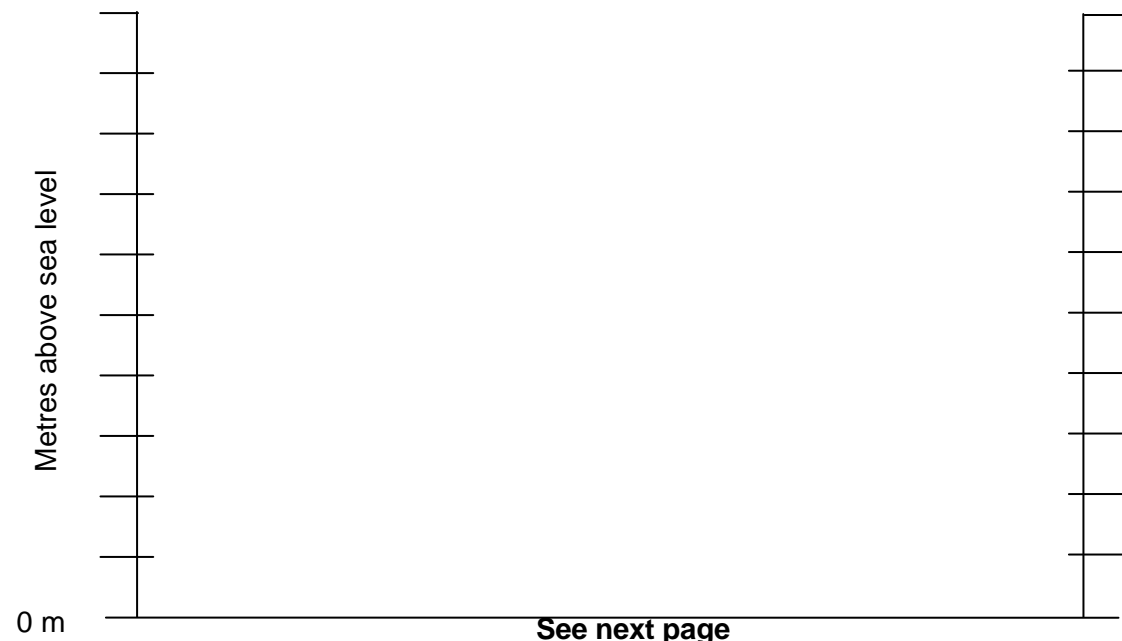
Question 22

(15 marks)

All parts of this question refer to the geological map shown below.



- (a) On the axes below draw a geological cross-section along the line A–B (including any topography). Interpret the sub-surface geology down to sea level. Use the key above. Should you require a second attempt, a spare map is provided on page 42. (8 marks)



(b) The map and legend show the symbol *m* with no name. What is the correct term for this symbol? (1 mark)

(c) Place the following geological units and events in order of relative age.

- granite
- limestone
- folding
- unconformity
- conglomerate
- siltstone

(6 marks)

Youngest	
	
Oldest	

Question 23

(10 marks)

Ecologists recorded the following average animal population sizes in an area of coastal grassland over a six-year period. The surveys were identical in their scope and conditions and represent an accurate record of population change over this period.

		Average population		
		Rabbits	Greater Bilbies	Foxes
Year	2001	159	22	6
	2002	162	21	7
	2003	108	12	8
	2004	96	6	6
	2005	112	4	7
	2006	123	5	6

- (a) Plot **two** graphs showing the populations of rabbits and greater bilbies (one graph for each animal) as they vary with time, on the grids provided. Should you require a second attempt, spare graphs are provided on page 43. (6 marks)

- (b) In 2003, trapping was introduced for a one-year trial period, in order to reduce the number of rabbits in the area. Using the data provided in the table, identify **two** effects of this trial on the rabbit population over the years 2003–2006. (2 marks)

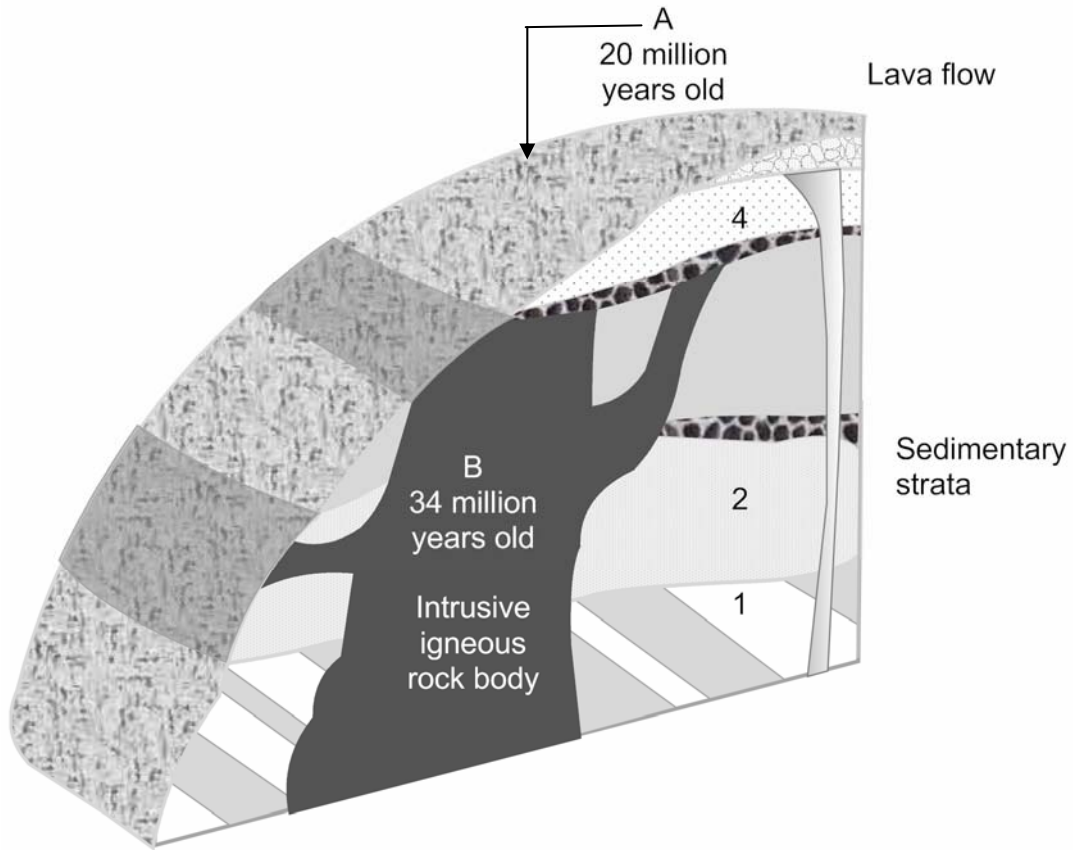
- (c) The trapping was carefully targeted at the rabbit population and no bilbies were caught during the trial period. What is the most likely reason for the number of bilbies decreasing at the same time? (1 mark)

- (d) State one change you would recommend in subsequent pest reduction efforts to reduce the likely impact of the program on native wildlife such as the bilby. (1 mark)

Question 24

(12 marks)

- (a) Earth scientists refer to geological ages in terms of being either 'absolute' or 'relative'. Describe each term and explain the geological significance of the difference between them. (4 marks)



(b) Using the principle of cross-cutting relationships and the diagrammatic cross-section above, circle the appropriate relative age relationship, i.e. younger or older for each of the following:

Sediment 2 is **younger/older** than intrusive B.

Lava A is **younger/older** than sediment 4.

Sediment 4 is **younger/older** than intrusive B.

Sediment 1 is **younger/older** than lava A.

(4 marks)

(c) The following table gives information on half-life values of several isotope systems used to date rocks.

Parent	Daughter	$t_{1/2}$	Useful range	Type of material
^{238}U	^{206}Pb	4.47 b.y	>10 million years	Igneous and sometimes metamorphic rocks and minerals
^{235}U	^{207}Pb	707 m.y		
^{40}K	^{40}Ar and ^{40}Ca	1.28 b.y	>10 000 years	
^{87}Rb	^{87}Sr	48 b.y	>10 million years	
^{14}C	^{14}N	5730 y	100–70 000 years	Organic material

y = years, m = million, b = billion, $t_{1/2}$ = half-life

See next page

- (i) Using the data in the table, explain why uranium (U)-lead (Pb) dating techniques are not appropriate for dating archaeological samples that are less than a few thousand years old. (2 marks)

- (ii) Explain why carbon dating can only be used in relation to organic material and not to other types, such as igneous rocks. (2 marks)

End of Section Two

This page has been left blank intentionally

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 space 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)

2010 has been designated the International Year of Biodiversity.

- (a) Describe what is meant by the term 'biodiversity'. (2 marks)

- (b) With examples, explain how a natural process and **two** human activities can reduce the biodiversity of a region. (6 marks)

- (c) Name and briefly describe an area of Western Australia that you have studied, in which efforts are being made to conserve biodiversity. Evaluate the success of these efforts. (7 marks)

Answer Question 26 or Question 27.

Question 26

(15 marks)

A number of powerful earthquakes have occurred recently in different parts of the world. Some examples are summarised in the table below.

Date	August 2009	January 2010	June 1992
Location	Izu Islands, Japan	Haiti	Landers, California
Magnitude	7.1	7.0	7.3
Depth	303 km	13 km	1.1 km
Local population density	Low	High	Low
Distance to major population centres	300 km from Tokyo (population 8 million)	25 km from Port-au-Prince (population 705 000)	175 km from Los Angeles (population 3.8 million)
Fault type	Thrust	Strike-slip	Strike-slip
Casualties	None	230 000 dead 300 000 injured	3 dead 400 injured
Damage to property and infrastructure	None	250 000 homes destroyed 30 000 commercial buildings destroyed	Local road buckling and chimney damage

Although all are similar in magnitude (a measure of the amount of energy released at the point of fault rupture), these three earthquakes produced widely varying casualties and damage to property.

- (a) With reference to the events detailed in the table above, name and discuss **three** factors that influenced the impact of the earthquakes on people living in those areas. (6 marks)
- (b) Outline **two** measures that can be taken to reduce the impact of earthquakes in the future for **each** of Haiti and California. (4 marks)
- (c) When an earthquake occurs, one of the first questions scientists want to answer is 'Where was it?' Describe a method of locating where an earthquake occurred. Explain a source of inaccuracy for scientists in using this method. (5 marks)

or

Question 27

(15 marks)

The Western Australian mining industry is worth in excess of \$61 billion per year and represents approximately 30 per cent of the State's gross worth and around 90 per cent of its commodity export value. Mining for a variety of minerals takes place in several different areas of the State.

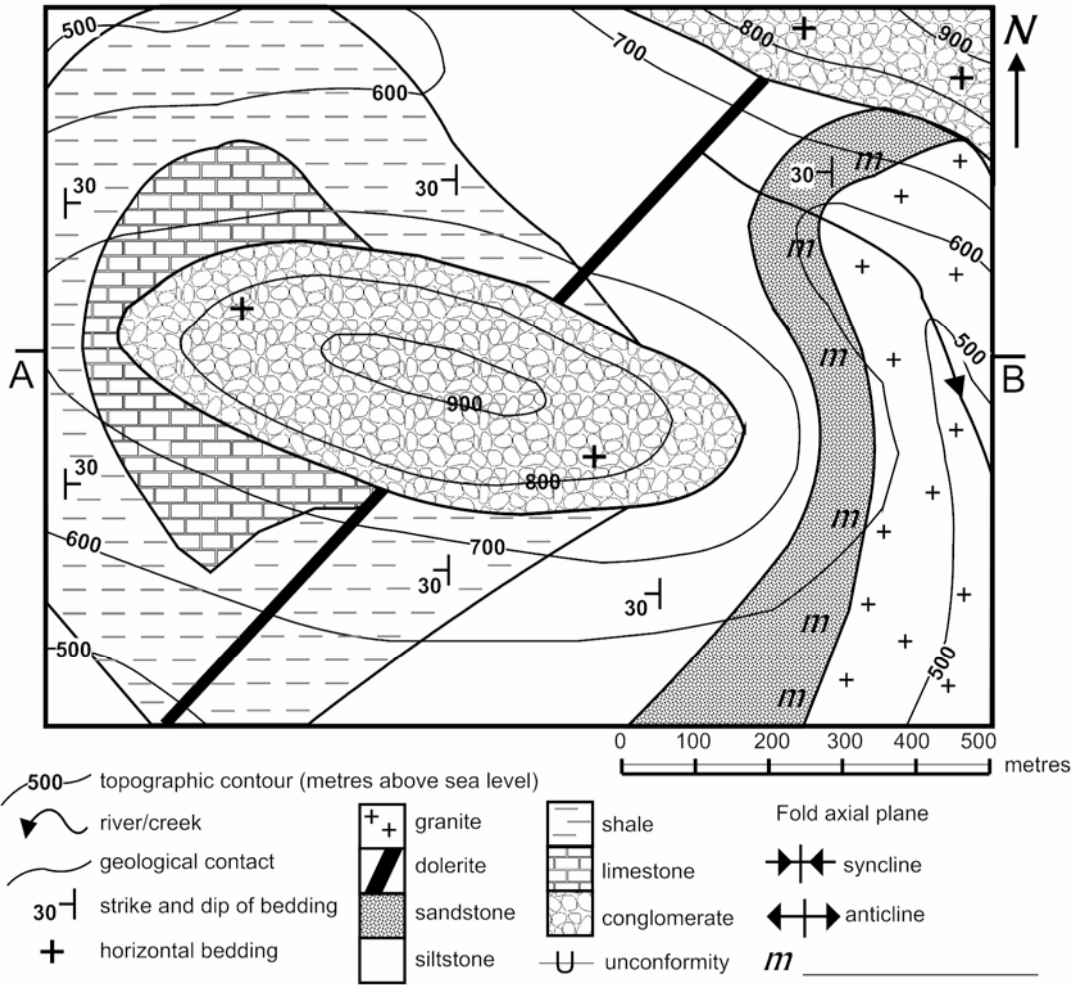
Choose **one** of the following mineral deposits:

- gold
- nickel
- copper
- aluminium (bauxite).

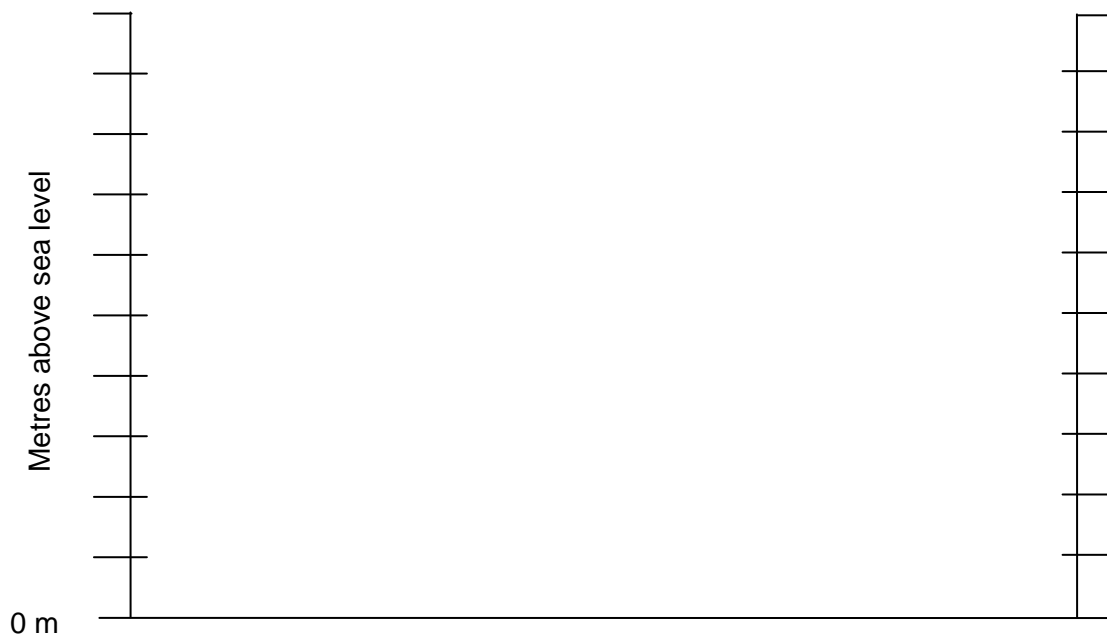
- (a) Discuss its formation with reference to a location in Western Australia. (3 marks)
- (b) Describe **two** exploration techniques used to locate these deposits, giving reasons why these methods are used. (6 marks)
- (c) Discuss **three** possible environmental concerns related to the extraction/mining of this resource and the methods used to address these concerns. (6 marks)

End of questions

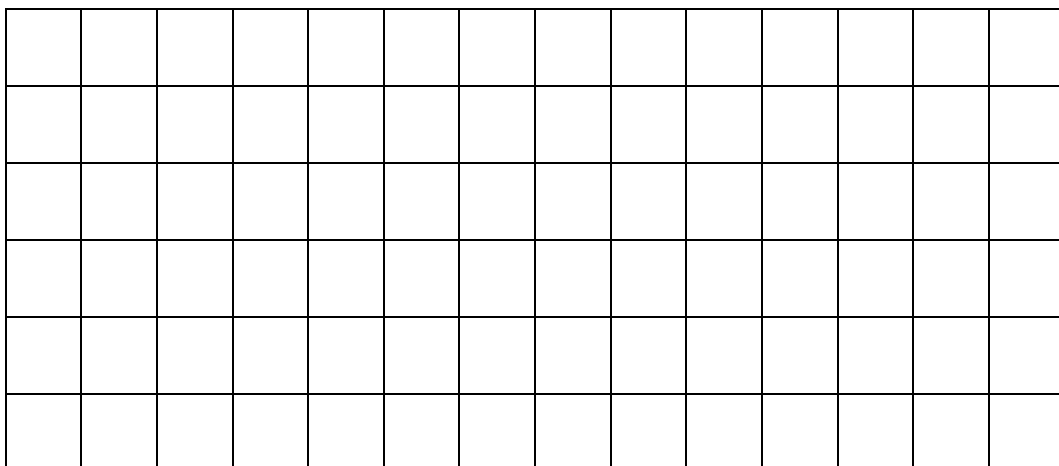
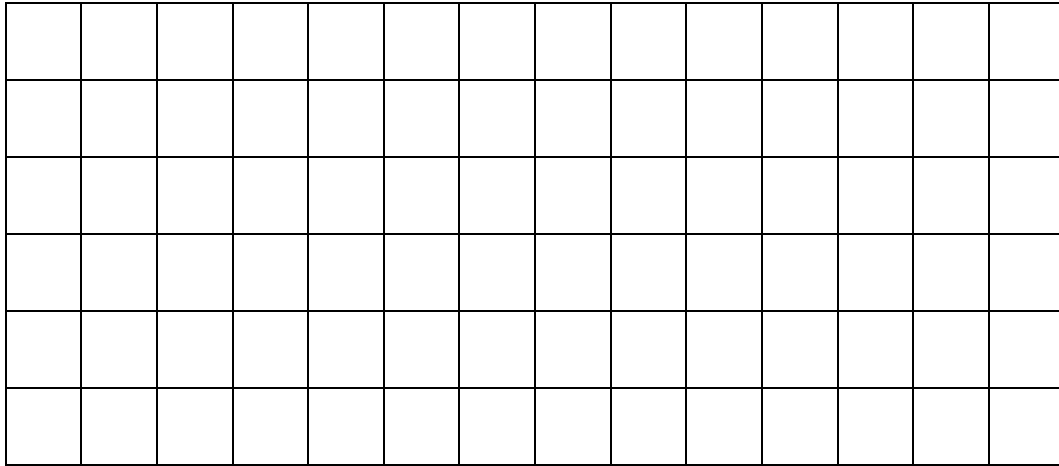
Section Two
Question 22 spare map



(a)



Section Two
Question 23 spare grid paper



ACKNOWLEDGEMENTS

Section One

Question 6 Encyclopaedia Britannica, Inc. (1998). *Graded bedding: bedding types*. Retrieved June, 2010, from <http://www.britannica.com/EBchecked/topic-art/532232/2465/Graded-bedding>

Question 13 Frakes, L. A., Francis, J. E., and Syktus, J. I. (1992). *Climate modes of the Phanerozoic: the history of the earth's climate over the past 600 million years*. Cambridge: Cambridge University Press.

Section Two

Question 21 Extract from: BBC NEWS. (2010). *How long will cloud last?* Retrieved June, 2010, from http://news.bbc.co.uk/2/hi/uk_news/8627253.stm

Section Three

Question 27 Text adapted from: Department of Mines and Petroleum Western Australia. (2010). *Latest Statistics Release*. Retrieved March, 2010, from <http://www.dmp.wa.gov.au/1525.aspx>

This examination paper – apart from any third party copyright material contained in it – may be freely copied, or communicated on an intranet, for non-commercial purposes in educational institutions, provided that it is not changed and that the Curriculum Council is acknowledged as the copyright owner. Teachers in schools offering the Western Australian Certificate of Education (WACE) may change the examination paper, provided that the Curriculum Council's moral rights are not infringed.

Copying or communication for any other purpose can be done only within the terms of the Copyright Act or with prior written permission of the Curriculum Council. Copying or communication of any third party copyright material can be done only within the terms of the Copyright Act or with permission of the copyright owners.