



2012 GEOLOGY

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ATTACH SACE REGISTRATION NUMBER LABEL TO THIS BOX

Friday 9 November: 1.30 p.m.

Time: 2 hours

Pages: 23
Questions: 23

Examination material: one 23-page question booklet
one 8-page script book
one multiple-choice answer sheet
one SACE registration number label

Approved dictionaries and calculators may be used.

Instructions to Students

- You will have 10 minutes to read the paper. You must not write in your question booklets or script book or on your multiple-choice answer sheet, or use a calculator during this reading time but you may make notes on the scribbling paper provided.
- This paper is in three sections:
 - Section A: Multiple-choice Questions** (Questions 1 to 15)
Answer this section on the separate multiple-choice answer sheet, using black or blue pen.
Answer **all** questions in Section A.
 - Section B: Short-answer Questions** (Questions 16 to 22)
Answer this section in the spaces provided in this question booklet.
Answer **all** questions in Section B.
 - Section C: Extended-response Question** (Question 23)
Answer this question in the separate script book.
Include maps, diagrams, graphs, and field examples wherever possible.
- The allocation of marks and the suggested (approximate) allotment of time are as follows:

Section A	30 marks	30 minutes
Section B	70 marks	70 minutes
Section C	20 marks	20 minutes
Total	120 marks	120 minutes
- The geological time-scale is on page 23. You may remove it from this booklet before the examination begins.
- Attach your SACE registration number label to the box at the top of this page. Copy the information from your SACE registration number label into the boxes on your multiple-choice answer sheet and on the front cover of your script book.
- At the end of the examination, place your script book and multiple-choice answer sheet inside the back cover of this question booklet.

**STUDENT'S DECLARATION ON THE USE OF
CALCULATORS**

By signing the examination attendance roll I declare that:

- my calculators have been cleared of all memory
- no external storage media are in use on these calculators.

I understand that if I do not comply with the above conditions for the use of calculators I will:

- be in breach of the rules
- have my results for the examination cancelled or amended
- be liable to such further penalty, whether by exclusion from future examinations or otherwise, as the SACE Board of South Australia determines.

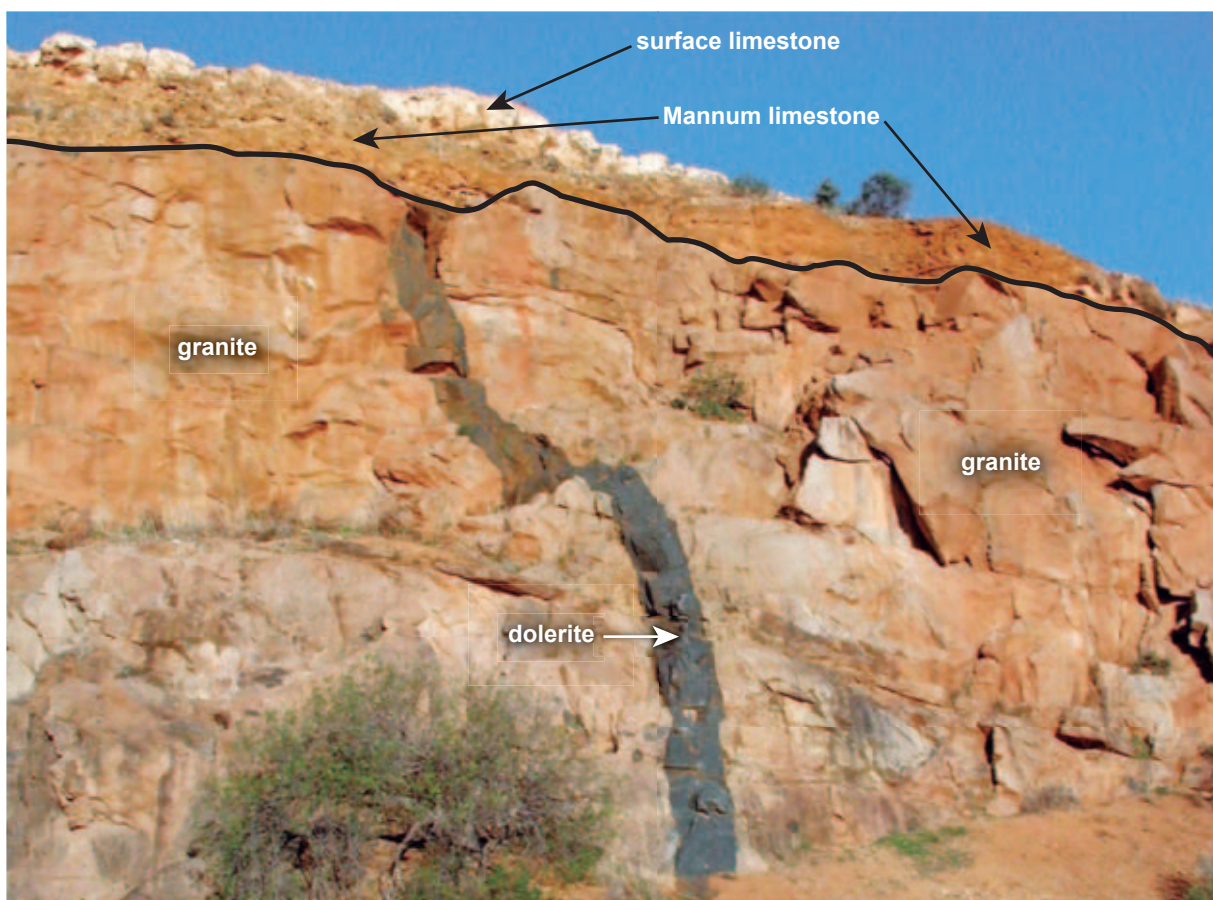
SECTION A: MULTIPLE-CHOICE QUESTIONS (Questions 1 to 15)

(30 marks)

Answer **all** questions in this section.

Each of the multiple-choice questions in Section A involves choosing from four alternative answers. Read each question carefully. Then indicate the **one** alternative that you consider best answers the question by shading the bubble by the appropriate letter alongside the question number on the multiple-choice answer sheet. Use black or blue pen. It is in your interest to give an answer to every question in this section of the paper, as no marks are deducted for incorrect answers. Each question is worth 2 marks. You should spend about 30 minutes on this section.

1. Refer to the following photograph, which shows one face of a quarry:



Which one of the following alternatives correctly lists the relative ages of the four rock types shown in the photograph, from youngest to oldest?

	Youngest	Increasing age		Oldest
J.	granite	dolerite	Mannum limestone	surface limestone
K.	dolerite	Mannum limestone	surface limestone	granite
L.	surface limestone	Mannum limestone	granite	dolerite
M.	surface limestone	Mannum limestone	dolerite	granite

2. In general, continental crust is:
- J. thinner than oceanic crust.
 - K. younger than oceanic crust.
 - L. less dense than oceanic crust.
 - M. more mafic than oceanic crust.
3. Which one of the following statements about Australian groundwater is correct?
- J. Groundwater is usually much older than surface water.
 - K. Groundwater exists at great depth and in unlimited quantities.
 - L. Groundwater cannot be polluted easily by humans.
 - M. Groundwater generally travels through structures called 'aquicludes'.
4. Which one of the following alternatives correctly indicates the rock types in which the mineral is most likely to be found?

	Mineral	Rock types		
		Igneous	Sedimentary	Metamorphic
J.	olivine	✓	✓	✗
K.	calcite	✗	✓	✓
L.	quartz	✗	✓	✓
M.	kaolinite	✓	✓	✓

5. Which one of the following statements best describes processes that may lead to the formation of hydrothermal ore deposits?
- J. Extensive weathering of granitic rocks in a monsoonal climate forms clay minerals, which are eroded away, and ore minerals, which remain in situ.
 - K. Hot fluids from the last stage of a cooling magma travel through rock and dissolve minerals that would otherwise be insoluble.
 - L. Extensive weathering of quartz veins next to watercourses releases heavy minerals into the water. These minerals are carried downstream and deposited where the water slows down.
 - M. The first mineral to crystallise from a cooling magma sinks to the bottom of the magma chamber and forms a layer.

6. Which one of the following statements about metamorphism is correct?

- J. Thermal metamorphism always results in the formation of foliated rocks.
- K. Marble is formed only by the regional metamorphism of limestone.
- L. Regional metamorphism often affects a wide area.
- M. Thermal metamorphism usually changes shales into schists.

7. Which one of the following alternatives describes the forms of tectonic activities that are likely to occur at the plate boundary specified?

	Type of plate boundary		Tectonic activity		
	Plate movement	Plate types	Igneous	Seismic	Orogenic
J.	divergent	oceanic–oceanic	intrusive	shallow focus	insignificant
K.	convergent	oceanic–oceanic	andesitic	shallow focus	insignificant
L.	convergent	oceanic–continental	andesitic	shallow and deep focus	fold mountain range formed
M.	convergent	continental–continental	intrusive	insignificant	fold mountain range formed

8. Mafic igneous rocks are generally:

- J. dark in colour and rich in feldspar.
- K. light in colour and rich in feldspar.
- L. dark in colour and rich in quartz.
- M. light in colour and rich in quartz.

9. Compared with coal-fired power plants, nuclear power plants:

- J. produce greater quantities of solid waste.
- K. cost less to construct.
- L. require less fuel.
- M. produce more greenhouse gases.

10. Refer to the following photograph, which shows a smooth rock surface with a series of almost parallel scratch marks:



Source: US Department of the Interior, US Geological Survey, viewed 11 April 2012, <<http://www.usgs.gov>>

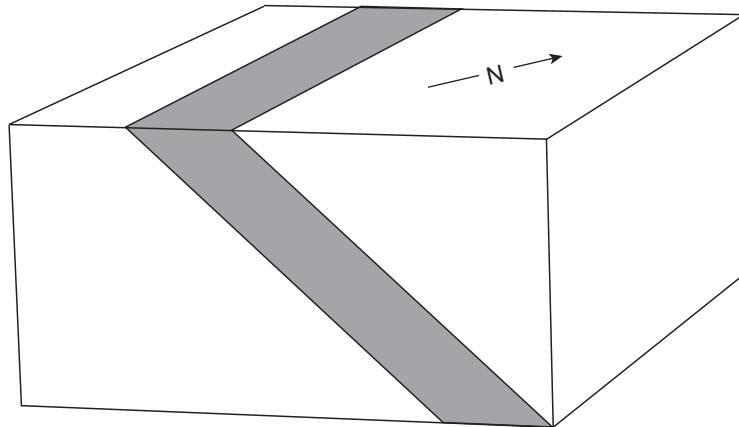
These scratch marks were probably caused by:

- J. ice travelling over the rock surface.
 - K. rocks carried along on the lower surface of a glacier.
 - L. the action of melt water in a retreating glacier.
 - M. fine sediments settling in a glacial lake.
11. A significant difference between igneous and metamorphic rock-forming processes is that:
- J. all igneous processes occur on the Earth's surface, whereas metamorphic processes take place deep below the surface.
 - K. metamorphic processes occur quickly, whereas some igneous processes take millions of years.
 - L. directed pressure is very significant in all igneous processes, but it is not involved in metamorphic processes.
 - M. igneous processes involve molten rock (magma or lava), whereas metamorphic processes take place in the solid state.

12. The principle of uniformitarianism:

- J. determines the relative ages of sedimentary rocks in an undisturbed sequence.
- K. assumes that geological processes that occurred in the past are similar to those that occur today.
- L. determines the position of the Earth's magnetic poles during plate movements.
- M. gives the sequence of mineral crystallisation from magma.

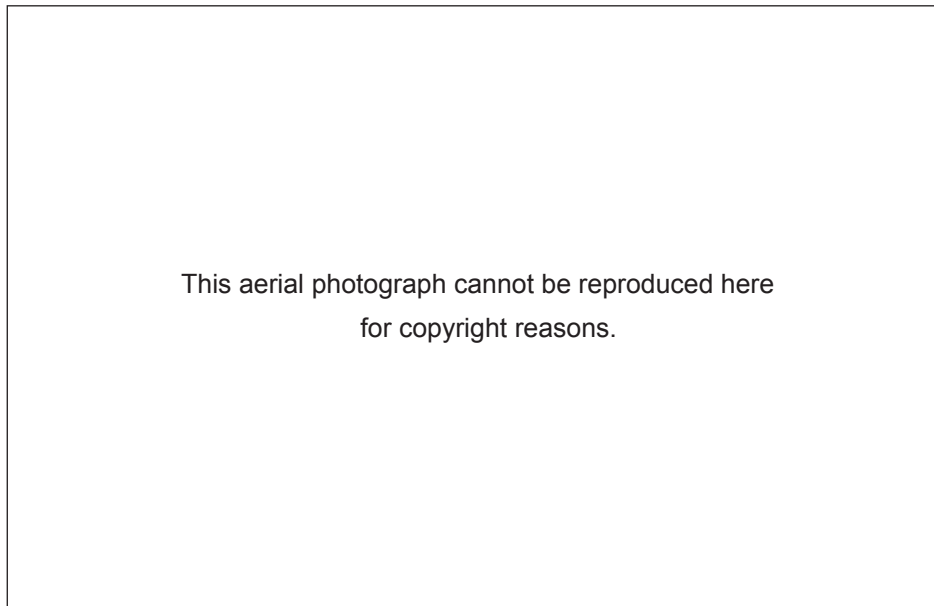
13. Refer to the following diagram, which shows a bedding plane:



Which one of the following alternatives correctly identifies the dip and strike of the bedding plane shown in the diagram?

	Dip	Strike
J.	60° N	NE-SW
K.	45° NE	NW-SE
L.	45° E	N-S
M.	60° N	E-W

14. Refer to the following aerial photograph:



Source: 'Geology by Lightplane', Department of Geoscience, University of Wisconsin–Madison © Louis J. Maher jun.

The major features in the photograph are most likely:

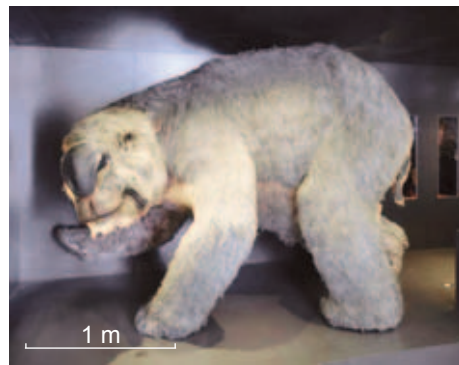
- J. normal and reverse faults.
- K. lava flows from an ancient volcano.
- L. plunging synclines and anticlines.
- M. caused by a meandering stream.

15. Refer to the following photographs:

A

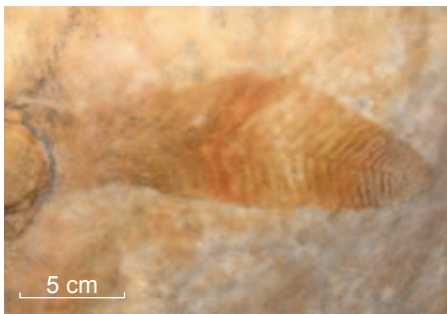


B



Source: James King © Australian Museum

C



D



Which one of the photographs represents an organism that became extinct at the same time as the dinosaurs?

- J. A.
- K. B.
- L. C.
- M. D.

SECTION B: SHORT-ANSWER QUESTIONS (Questions 16 to 22)

(70 marks)

Answer **all** questions in this section. Write your answers in the spaces provided under each question. The allocation of marks is shown in brackets at the end of each part of each question. You should spend about 70 minutes on this section.

16. Minerals are the constituents of rocks.

(a) Complete the following table by identifying whether each item is a mineral and state *one* reason for your decision.

Item	Is it a mineral?	Reason
coal		
granite		
petroleum		
quartz		

(4 marks)

(b) Refer to the following photograph, which shows a common sedimentary rock:



(i) (1) State the correct geological name for the rock shown.

_____ (1 mark)

(2) State the position in the soil profile in which this rock is usually found.

_____ (1 mark)

(3) Identify the climate in which this rock is formed.

_____ (1 mark)

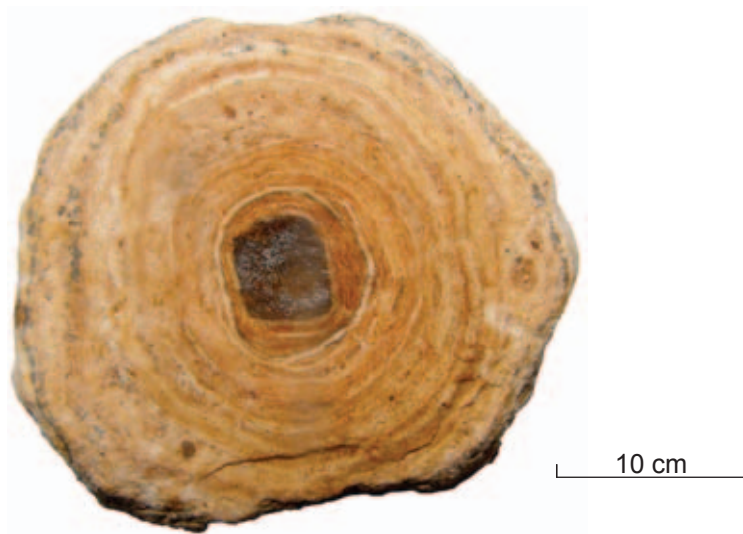
(ii) (1) Name the mineral that is the main constituent of this rock.

_____ (1 mark)

(2) Describe a test that would confirm the identity of this mineral.

_____ (2 marks)

(iii) Refer to the following photograph, which shows a sample of this sedimentary rock cut in half:



This cross-section shows a series of rings. Explain how these rings were probably formed.

_____ (2 marks)

17. Refer to the following photograph, which shows a rock outcrop formed by a volcanic eruption on El Hierro in the Canary Islands:



Source: Klemetti, E. 2011, 'Earthquakes under El Hierro in the Canary Islands: What can we expect?' Big Think, viewed 11 April 2012, <<http://bigthink.com/ideas/39546>>

El Hierro is a small island that is not near a plate boundary and that registered over 8000 earthquakes in a short period. These earthquakes had not been noticeable to the local inhabitants, but recently thirty magnitude 3–4 earthquakes occurred on one day.

- (a) Suggest a geological reason for so many earthquakes occurring on one day.

_____ (1 mark)

- (b) (i) State the correct geological name for the rock shown in the photograph.

_____ (1 mark)

- (ii) Describe how this rock forms.

_____ (2 marks)

(iii) Explain the surface appearance of this rock.

_____ (1 mark)

(iv) State whether this type of eruption is likely to cause harm to people.

_____ (1 mark)

(c) (i) Geologists use seismographs to monitor earthquake activity on the island. Name one other instrument that might be used by a geologist to monitor the activity of the volcano.

_____ (1 mark)

(ii) Describe how the instrument named in your answer to part (c)(i) would indicate that an eruption is likely.

_____ (2 marks)

18. Refer to the following photograph, which shows a creek bed in the Adelaide Hills:



(a) State the degree of sorting and rounding of the rock fragments in and around the creek.

(i) Sorting: _____ (1 mark)

(ii) Rounding: _____ (1 mark)

(b) Identify the information that this degree of sorting and rounding provides about the distance that the rock fragments have travelled from their source.

_____ (1 mark)

(c) (i) From the photograph, identify the present energy level of the water in the creek.

_____ (1 mark)

(ii) Explain whether the energy level of the water in the creek has changed over time.

_____ (2 marks)

19. Refer to the following photograph, which shows coastal erosion in NSW:



Source: Howden, S. 2010, 'Hungry Mother Nature bares her teeth', *Sydney Morning Herald*, photo by Edwina Pickles, viewed 11 April 2012, <<http://www.smh.com.au/environment>>

(a) Give two environmental factors that could have caused the road to collapse as shown in the photograph.

(i) _____
_____ (1 mark)

(ii) _____
_____ (1 mark)

(b) Suggest how the local council might stabilise the damaged foreshore area shown.

_____ (1 mark)

(c) Suggest what a civil engineer might advise the council about building along this foreshore.

_____ (1 mark)

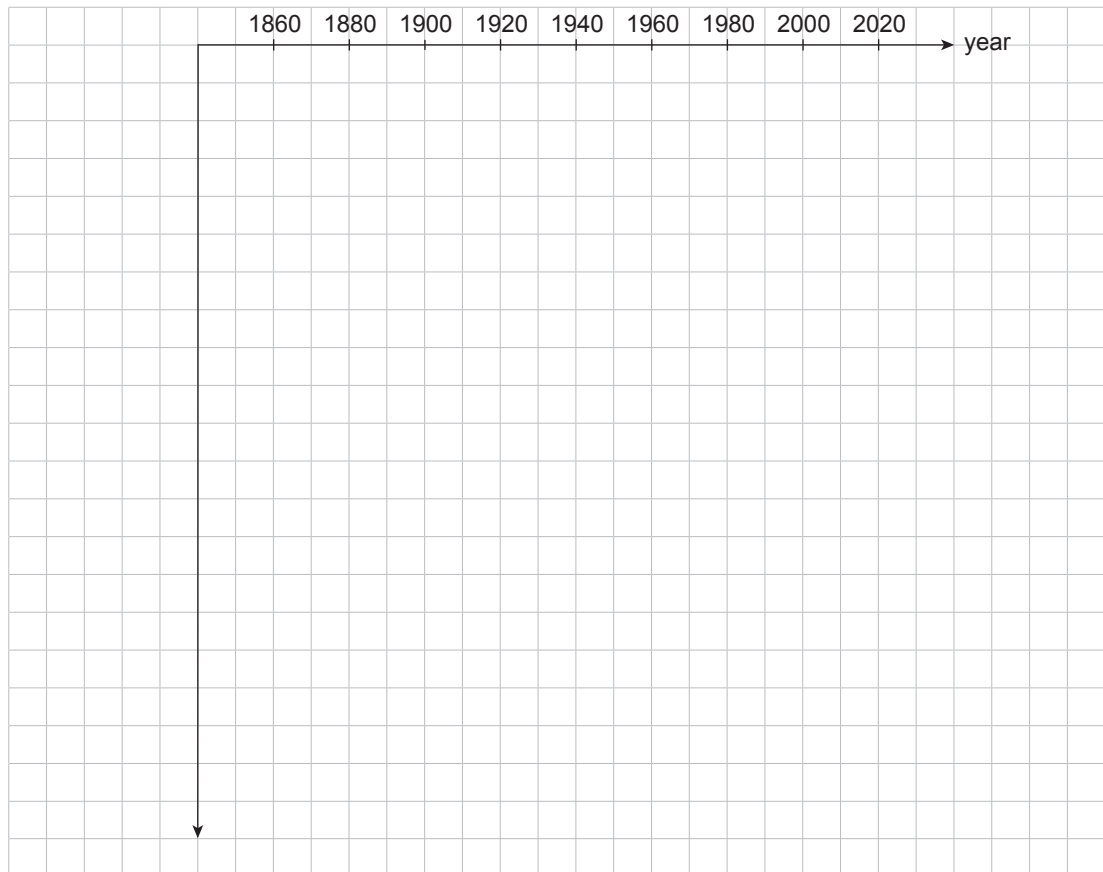
20. Changes in various atmospheric factors over time can be determined by analysing ice cores.

(a) Refer to the following table, which shows atmospheric temperature values calculated from an Antarctic ice core:

Year	Temperature (°C)
1860	-23.0
1880	-24.1
1900	-23.5
1920	-23.2
1940	-22.5
1960	-23.2
1980	-22.1
2000	-21.3
2005	-21.0

Using the following grid, draw a line graph of the data shown in the table. Complete the vertical axis and title.

Title: _____



(5 marks)

(b) (i) State the overall trend in atmospheric temperature represented by the graph.

_____ (1 mark)

(ii) Suggest two reasons for this trend.

(1) _____ (1 mark)

(2) _____ (1 mark)

(c) Explain how the level of one atmospheric factor can be determined by analysing ice cores.

_____ (2 marks)

21. Refer to the following newspaper article, which describes the problems of a family living near a Queensland coal mine:

This article, 'Living in the dusty shadow of coal mining' cannot be reproduced here for copyright reasons

Source: Adapted from Cleary, P. 2012, 'Living in the dusty shadow of coal mining', *The Australian*, viewed 11 April 2012, <<http://www.theaustralian.com.au/news/features>>

(a) Name two features of coal seams necessary for mining to be viable.

(i) _____ (1 mark)

(ii) _____ (1 mark)

(b) From the information in the article, name the mining method that is most likely used in the New Acland coal mine.

_____ (1 mark)

(c) Describe two ways in which the mine has negatively affected the Plant family.

(i) _____

_____ (2 marks)

(ii) _____

_____ (2 marks)

(d) The New Hope Corporation (NHC) was required to submit environmental impact statements to the government.

(i) Discuss possible rehabilitation procedures the NHC could undertake to comply with government regulations.

_____ (5 marks)

(ii) Describe two key features, other than environmental rehabilitation, that must be addressed in an environmental impact statement.

(1) _____

_____ (2 marks)

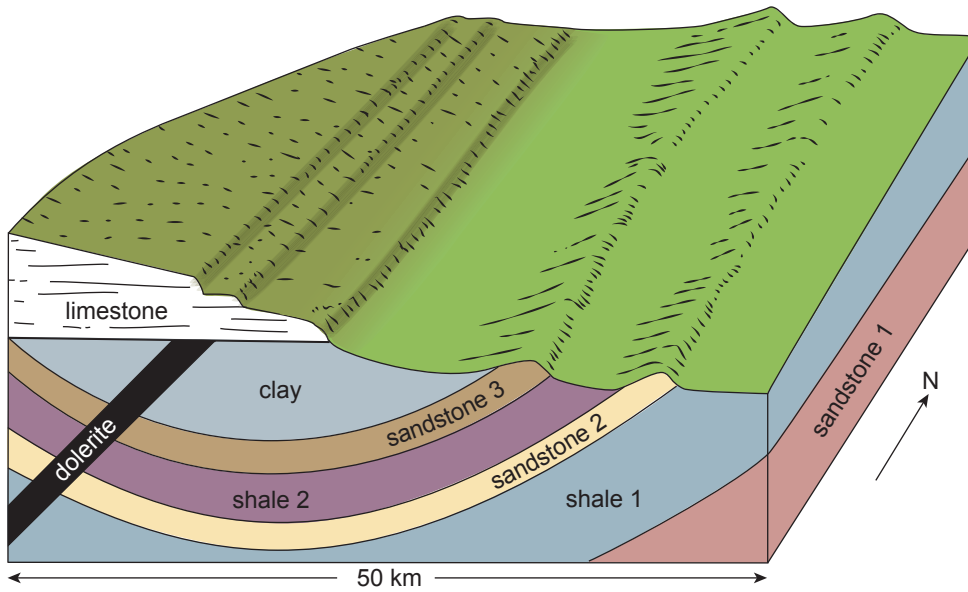
(2) _____

_____ (2 marks)

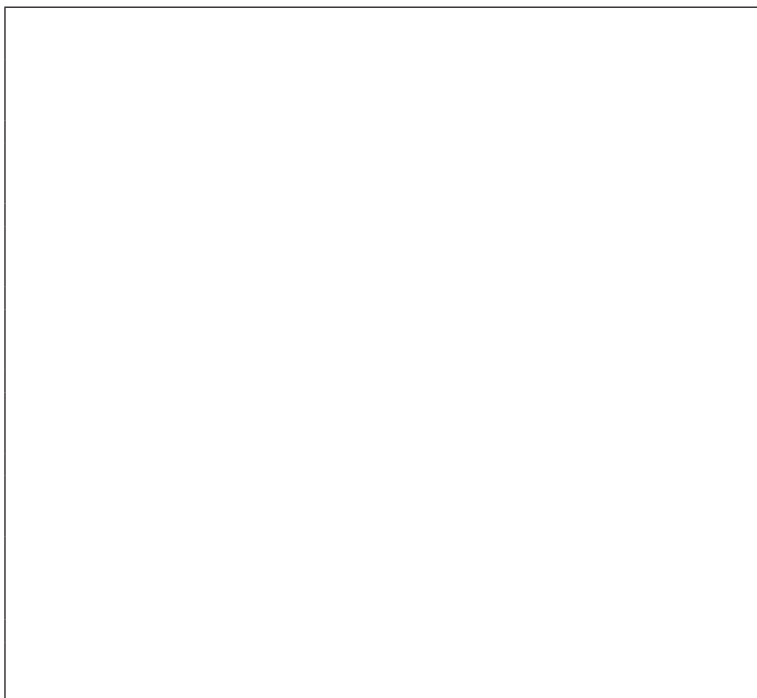
(iii) Explain why the environmental impact statement did not prevent the mining operations from affecting the Plant family in the ways described in your answer to part (c).

_____ (2 marks)

22. Refer to the following block diagram, which shows a region consisting of sedimentary rocks:



(a) In the box provided, draw a well-labelled geological map, indicating the locations of the rock types exposed at the Earth's surface in this region, and complete the reference key to indicate the relative ages of all the rocks in this region.



Reference key

<input type="checkbox"/>	_____
<input type="checkbox"/>	_____
<input type="checkbox"/>	_____
<input type="checkbox"/>	_____
<input type="checkbox"/>	_____
<input type="checkbox"/>	_____
<input type="checkbox"/>	_____
<input type="checkbox"/>	_____

(8 marks)

(b) Estimate the angle of dip of each of the beds at the surface, and draw dip and strike symbols in appropriate places on your map in part (a).

(3 marks)

SECTION C: EXTENDED-RESPONSE QUESTION (Question 23)

(20 marks)

Answer this section in the separate script book. You should spend about 20 minutes on this section.

You should present a clear, logical, and well-illustrated response to this question. Include maps, diagrams, graphs, and field examples wherever possible.

23. The Earth's crust contains many valuable mineral and energy resources that have become essential to modern society.

Two of these resources are aggregate and uranium. For each of these describe:

- one method of extraction
- the environmental impact of the extraction method you have nominated
- how the resource is used
- the sustainability of supplies.

You may remove this page from the question booklet by tearing along the perforations so that you will have the information in front of you for easy reference.

THE GEOLOGICAL TIME-SCALE

Eon	Era	Period	Epoch	Date at boundary (million years)
Phanerozoic	Cainozoic	Neogene (previously Quaternary)	Holocene	0.01
			Pleistocene	
		<i>Old Tertiary–Quaternary boundary</i>	Pliocene	1.5
			Miocene	5
			Oligocene	24
		Palaeogene (previously Tertiary)	Eocene	35
			Palaeocene	55
			65	
	Mesozoic	Cretaceous	145	
		Jurassic	210	
		Triassic	250	
	Palaeozoic	Permian	300	
		Carboniferous	350	
		Devonian	400	
		Silurian	440	
		Ordovician	500	
		Cambrian	540	
Proterozoic	Ediacaran	600		
		2500		
Archaean		4500		