

BOARD OF STUDIES
NEW SOUTH WALES

HIGHER SCHOOL CERTIFICATE EXAMINATION

1998
GEOLOGY
2 UNIT

*Time allowed—Three hours
(Plus 5 minutes reading time)*

DIRECTIONS TO CANDIDATES

- Board-approved calculators may be used.

Section I—Core

- Attempt ALL questions.
- **Part A** 15 multiple-choice questions, each worth 1 mark.
Complete your answers in blue or black pen, or in pencil on the Answer Sheet provided.
- **Part B** 10 questions, each worth 3 marks.
Answer this Part in the Part B Answer Book.
- **Part C** 6 questions, each worth 5 marks.
Answer this Part in the Part C Answer Book.
- Write your Student Number and Centre Number on the cover of each Answer Book.
- You may keep this Question Book. Anything written in the Question Book will NOT be marked.

Section II—Electives

- Attempt ONE question.
- Each question is worth 25 marks.
- Answer the question in a SEPARATE Elective Answer Book.
- Write your Student Number and Centre Number on the cover of the Elective Answer Book.
- Write the Course, Elective Name, and Question Number on the cover of the Elective Answer Book.
- You may ask for extra Elective Answer Books if you need them.

SECTION I—CORE

(75 Marks)

Attempt ALL questions.

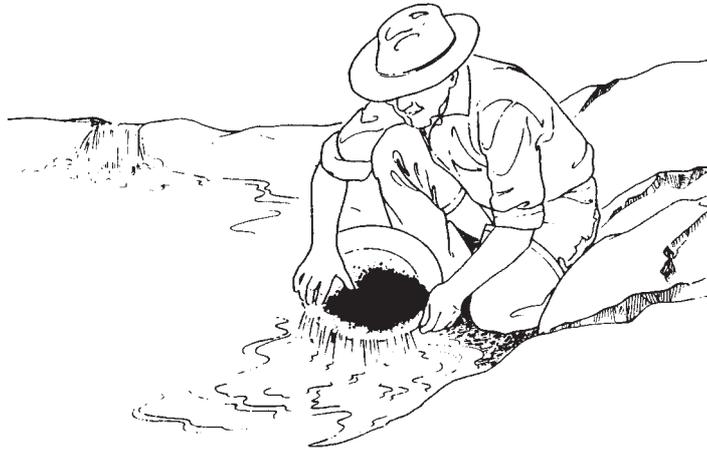
PART A

Questions 1–15 are worth 1 mark each.

Complete your answers in blue or black pen, or in pencil on the Answer Sheet provided.

Select the alternative A, B, C or D that best answers the question.

1. The diagram shows a prospector panning for gold.



*From: Earth by Press and Seiver
© 1986, 1982, 1978, 1974 by
W H Freeman and Company.
Used with Permission*

The gold is separated from other minerals such as quartz and clays because grains of gold are

- (A) usually larger than grains of most other minerals.
 - (B) usually smaller than grains of most other minerals.
 - (C) more angular than grains of most other minerals.
 - (D) more dense than grains of most other minerals.
2. Studies of remanent magnetism provide evidence of continental mobility. This remanent magnetism was most likely caused by
- (A) highly magnetised rocks in Northern Canada.
 - (B) movement of liquid iron in the Earth's outer core.
 - (C) a type of bar magnet in the core.
 - (D) convection currents in the Earth's mantle.

3. Scientists have proposed drilling into the sea floor below the Arctic ice. They hope to gain information on the tectonic processes that operate below the ice. The area has a high heat flow and shallow-focus earthquakes.

The sea floor is most likely to be

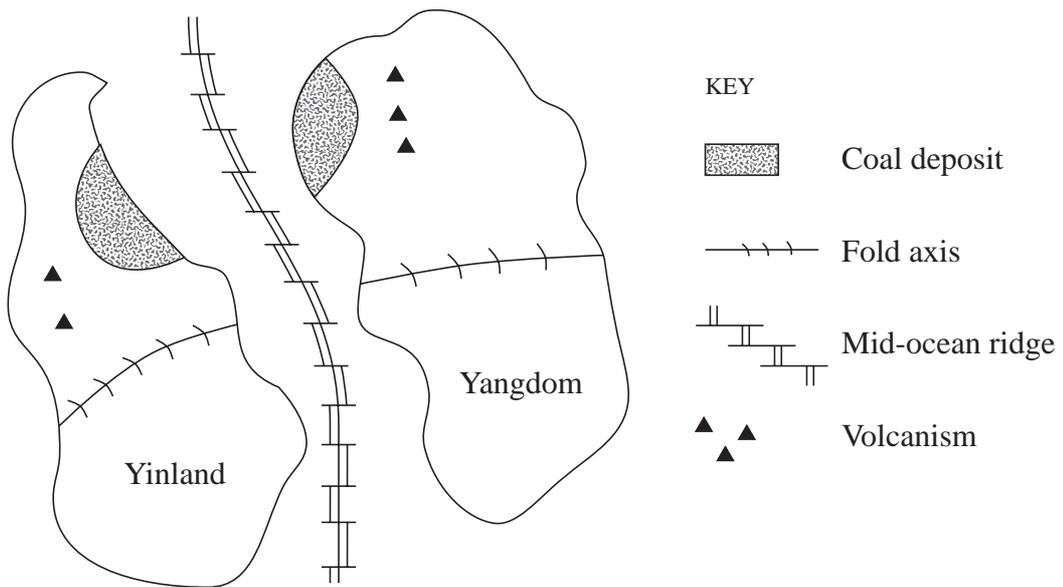
- (A) continental crust with shallow granitic intrusions.
 (B) part of the world wide mid-ocean ridge system.
 (C) a volcanic arc and associated Benioff Zone.
 (D) a craton or shield area.
4. The Japanese islands and Hawaiian islands were formed in very different settings. These settings are best described as

	<i>Japanese islands</i>	<i>Hawaiian islands</i>
(A)	hot spot	island arc
(B)	island arc	hot spot
(C)	hot spot	mid-ocean ridge
(D)	island arc	shield area

5. Whenever a large dam is built, major geologic adjustments occur as the related natural systems are altered. Which of the following geologic adjustments is NOT likely to occur when a dam is built?
- (A) Coastal deposition is reduced as deltas are deprived of sediment.
 (B) Groundwater systems are modified by the presence of an artificial lake.
 (C) Ground tremors occur due to the great weight of water in the reservoir.
 (D) Erosion increases upstream of the reservoir.

6. The 1997 sale of Australia's gold stockpile by the Reserve Bank of Australia may have caused a loss of jobs within the gold mining industry. The most likely reason for a loss of jobs is an increase in the
- (A) supply of gold to the world markets.
 - (B) price of gold on the world markets.
 - (C) price of other precious metals.
 - (D) amount of lower grade gold deposits mined.

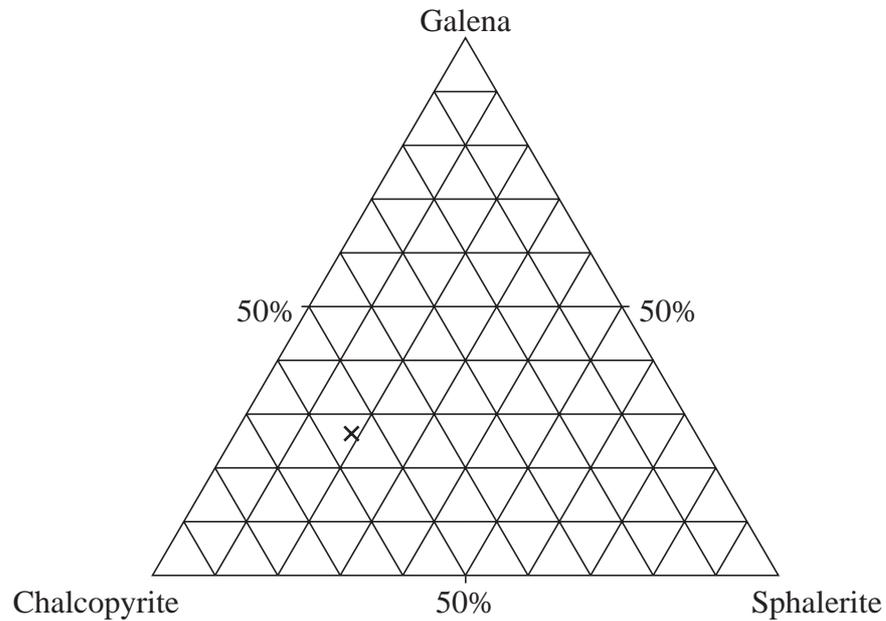
7.



It is thought that the continents Yinland and Yangdom were once joined. The feature that would be LEAST useful in supporting this hypothesis is the location of the

- (A) coal deposits.
- (B) fold axes.
- (C) mid-ocean ridge.
- (D) volcanism.

8. The diagram below shows the percentage composition of an ore sample from the Itsall mine. The ore contains galena, chalcopyrite and sphalerite.



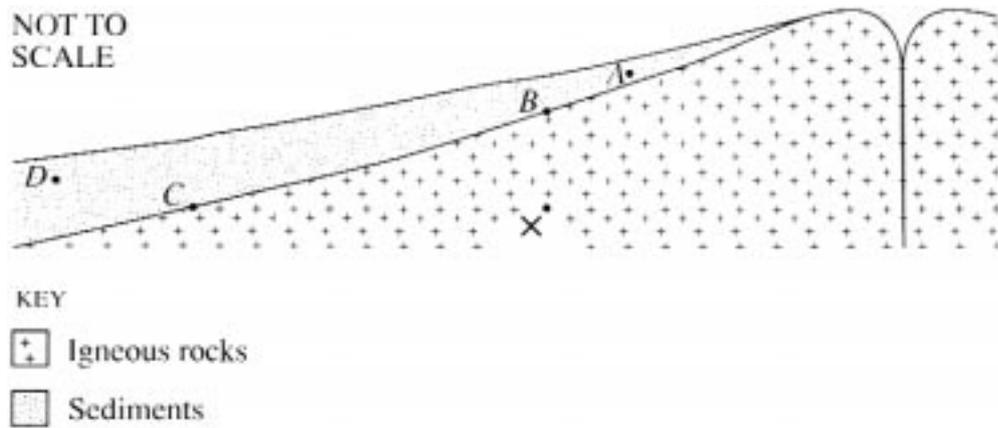
The sample plotted at point X on the diagram contains about

- (A) 72% galena, 82% sphalerite and 26% chalcopyrite.
 (B) 55% galena, 18% sphalerite and 27% chalcopyrite.
 (C) 27% galena, 18% sphalerite and 55% chalcopyrite.
 (D) 33% galena, 22% sphalerite and 45% chalcopyrite.
9. The asthenosphere is a zone in the upper mantle that allows movement of the lithosphere.

The asthenosphere

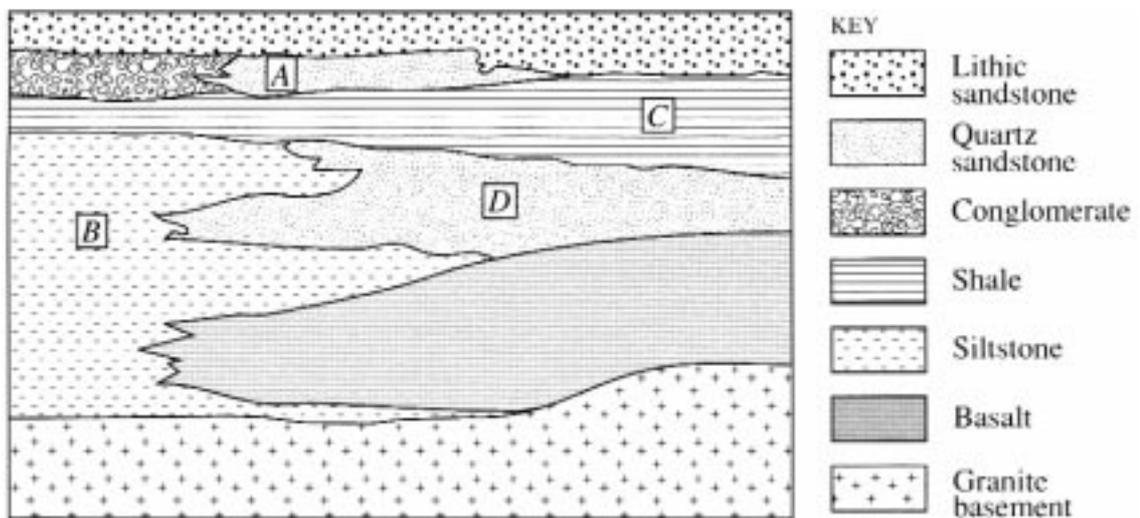
- (A) is mostly solid.
 (B) is made of molten rock.
 (C) transmits seismic waves at slightly increased velocities.
 (D) is about 2000 km below the Earth's surface.

10. The diagram below shows a mid-ocean ridge and overlying sediments.



Sediments of the same age as rock found at X would most likely be found at

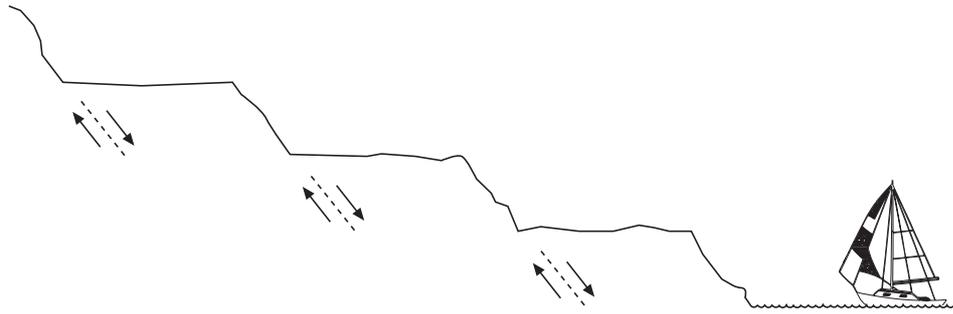
- (A) A
 - (B) B
 - (C) C
 - (D) D
11. The diagram below shows a cross-section of a sequence of sedimentary rocks.



The unit that would be the best reservoir rock for oil is

- (A) A
- (B) B
- (C) C
- (D) D

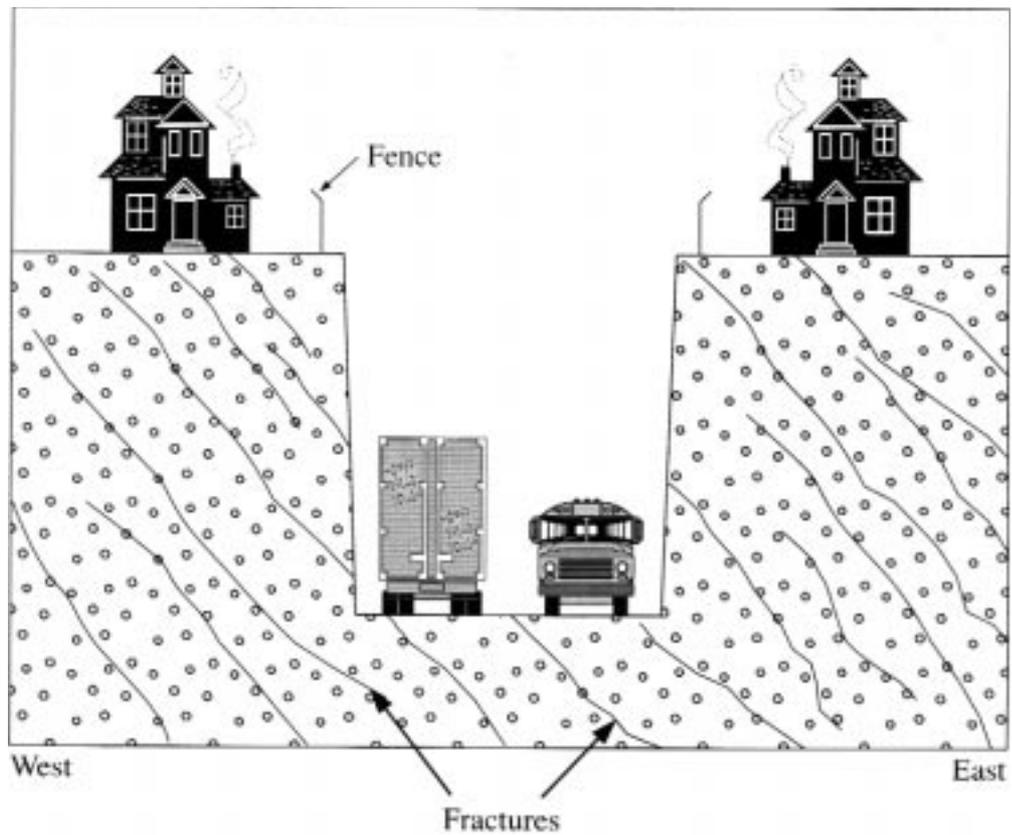
12. The diagram below shows coastal mountain escarpments and the faults that have formed them. The arrows show relative movement along the faults.



The process responsible for forming these coastal mountain escarpments is most likely to be

- (A) compression.
- (B) contractionism.
- (C) extension.
- (D) superposition.

13. The diagram below shows a highway located on the floor of an excavation that was cut into unweathered granite.



The excavation is potentially unstable and dangerous in the short term because

- (A) people might throw rocks down onto the traffic.
- (B) the granite will weather with time.
- (C) the eastern side of the excavation is likely to collapse.
- (D) the western side of the excavation is likely to collapse.

14.



The photograph above shows a volcano with a basal diameter of 7 km. The volcano is likely to be a

- (A) caldera volcano.
 - (B) cinder cone.
 - (C) composite volcano.
 - (D) shield volcano.
15. A fold mountain range is most likely to be formed
- (A) at a divergent plate boundary.
 - (B) as part of an island arc.
 - (C) when two oceanic plates collide.
 - (D) when two continental plates collide.

PART B

Questions 16–25 are worth 3 marks each.

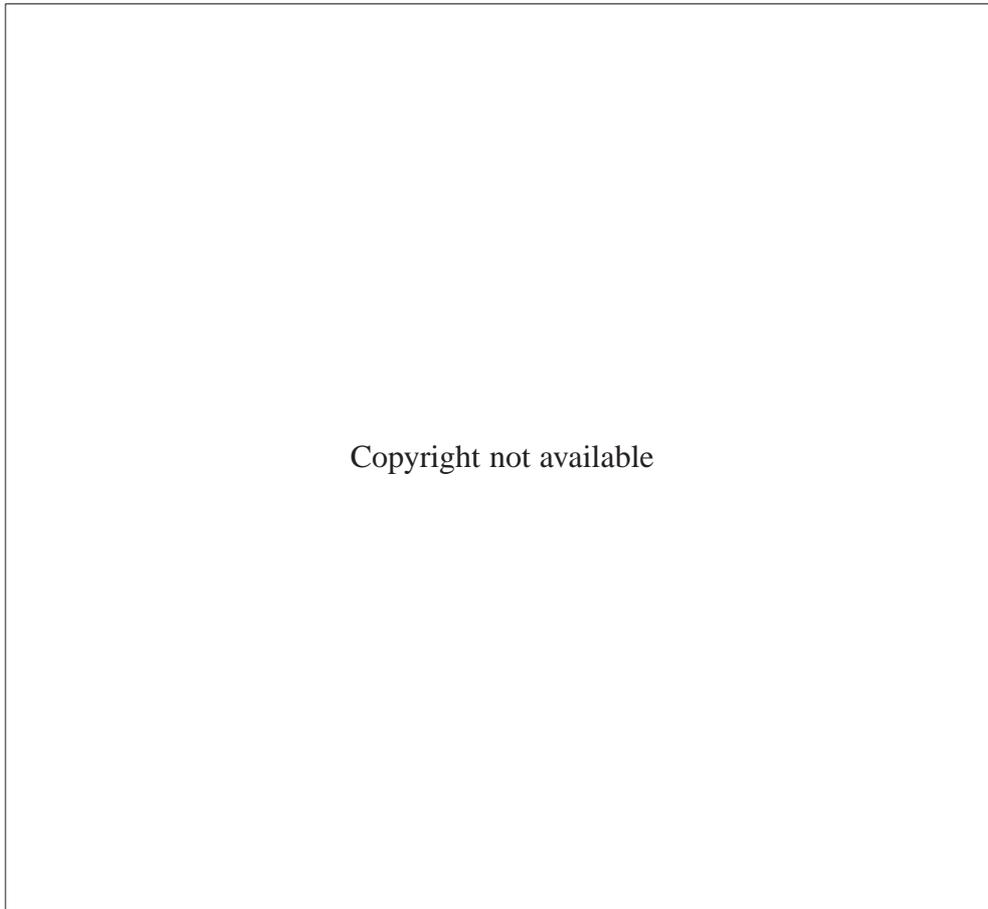
Answer this Part in the Part B Answer Book.

- 16.** The Bumpy Islands are a chain of volcanoes that rise direct from the ocean floor. As a senior research geologist you are asked to determine whether they are an island arc or a chain of hot-spot volcanoes. Your research suggests the Bumpy Islands are a chain of hot-spot volcanoes.

Describe, in detail, **THREE** pieces of evidence that would support your conclusion.

- 17.** Deep ocean sediments accumulate at an average rate of less than 3 metres per million years. If the ocean basins were as old as the continents, sediments could be many kilometres thick.
- (a) Explain why sediment thickness in deep ocean basins is typically less than two kilometres.
 - (b) Name **TWO** components of these sediments.
 - (c) Name and briefly describe **ONE** method that would be appropriate for dating the sediments.

18. This question refers to the diagram below.



- (a)
 - (i) What is the major tectonic feature indicated by the arrow labelled X?
 - (ii) Briefly describe the type of plate motion that is occurring at X.
- (b) Briefly explain why there is no active tectonic mountain range in Australia at present.
- (c) Briefly describe what is happening to the mid-ocean ridge in the region circled at the junction of the Nazca, Antarctic and South American Plates.

19. Isostasy is one process involved in the formation of a shield area.

- (a) What is isostasy?
- (b) Draw and label TWO geological structures that you would expect to find in a shield area.
- (c) Name ONE plutonic igneous rock and ONE regional metamorphic rock commonly found in shield areas.

20. The Big Pit was a basalt quarry that operated for twenty-five years. It is located in a semi-rural area 10 km from a large town. The pit is 50 m deep and 500 m × 500 m in area. The quarrying has now ceased and the quarry owners are seeking ways of using the pit.

- (a) Give TWO uses for the quarried basalt.
- (b)
 - (i) Suggest ONE environmental reason why the quarry operation may have ceased.
 - (ii) Suggest ONE economic reason why the quarry operation may have ceased.
- (c) Give TWO possible, environmentally acceptable uses for the abandoned pit.

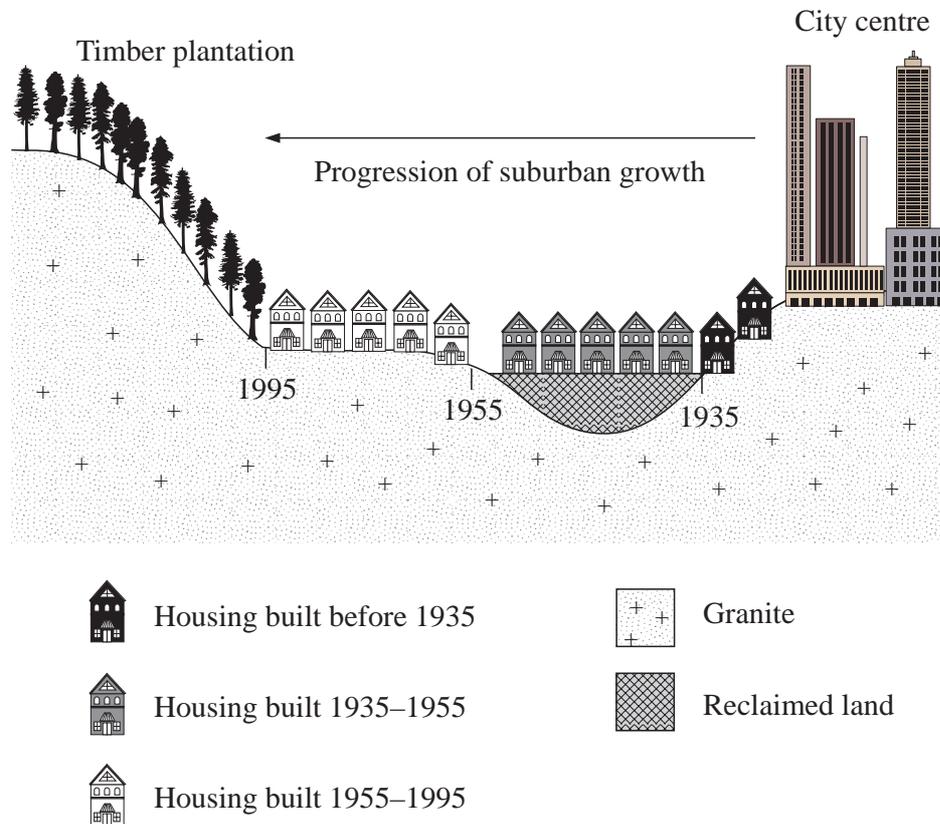
21. Magmas frequently contain useful metals in low concentrations.

Hydrothermal processes can concentrate these metals into deposits that are economic to mine.

- (a) Describe in detail how metals are concentrated by hydrothermal processes.
- (b) Name TWO metals commonly extracted from ore concentrated by hydrothermal processes.

22. The diagram below shows the historical growth of suburban development around a low-lying coastal city. The area is a tectonically stable granite shield that experiences a cyclone and extreme rainfall about once every fifty years.

In 1930, a land reclamation project used domestic rubbish to fill the low-lying swampy areas on the outskirts of the city.



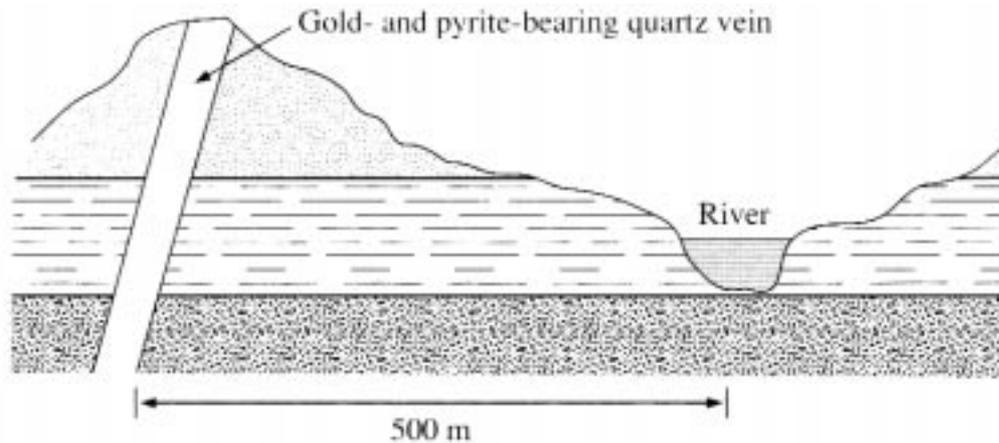
- (a) (i) Name TWO potential geological hazards likely to affect the inhabitants of housing built before 1955.
- (ii) On the diagram in your Answer Book, circle the area where one of the potential geological hazards you named in part (a) (i) is likely to have its maximum effect. Name the hazard you have chosen.
- (b) It is proposed to cut down all the trees in the timber plantation shown on the diagram.
- (i) Name the most likely geological hazard that would result from cutting down the trees.
- (ii) Briefly explain your answer to part (b) (i).

23. The diagram below represents part of the ocean floor including a mid-ocean ridge. A pattern of magnetic reversals is shown.



- (a) (i) Using thick lines, mark the locations of two transform faults on the diagram in the Answer Book.
- (ii) Shade the location of the rift valley on the diagram in the Answer Book.
- (iii) 1. Which letter (*P*, *Q* or *R*) shows the location of a point that is the same age as point *X*?
2. In which direction is the ocean floor at point *P* moving?
- (b) On the diagram in your Answer Book:
- (i) use a letter *E* to indicate a place where an earthquake would be very likely to occur;
- (ii) use a letter *V* to indicate a place where lava is most likely to be extruded.

24. The diagram below shows a gold- and pyrite-bearing quartz vein.



A Harker, Metamorphism: A Study of the transformation of Rock Masses, 3rd ed, Methuen Ltd, 1964, p 337

- (a) Discuss what is most likely to happen to the gold and to the pyrite as the vein weathers.
 - (b) Name TWO minerals, apart from gold, that are concentrated by sedimentary processes.
 - (c) Name TWO properties of minerals that allow them to accumulate as placer deposits in beach sands.
25. The diagram shows a metamorphic rock.



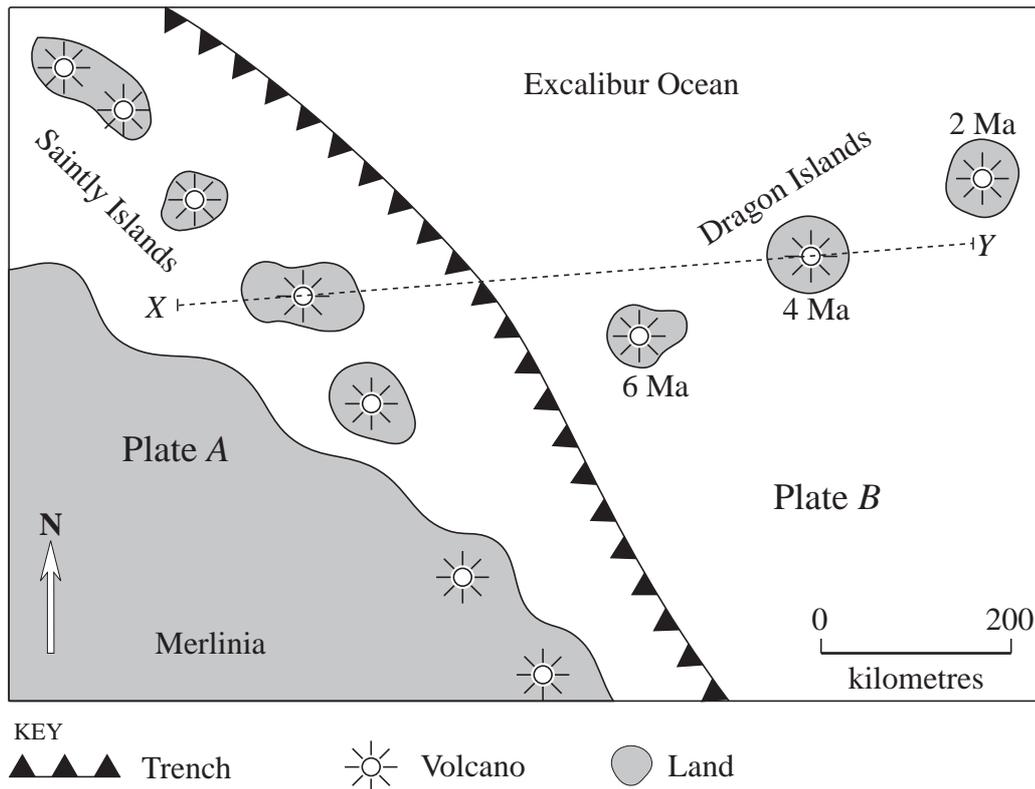
- (a) State the:
 - (i) physical conditions under which this rock is likely to have formed;
 - (ii) tectonic environment in which this rock is likely to have formed.
- (b) Name TWO metamorphic rocks that could form under the physical conditions you described in part (a) (i).
- (c) Name the type of fault that would be likely to occur in association with this rock. Draw a diagram of this type of fault, using arrows to show the direction of the forces that produce this structure.

PART C

Questions 26–31 are worth 5 marks each.

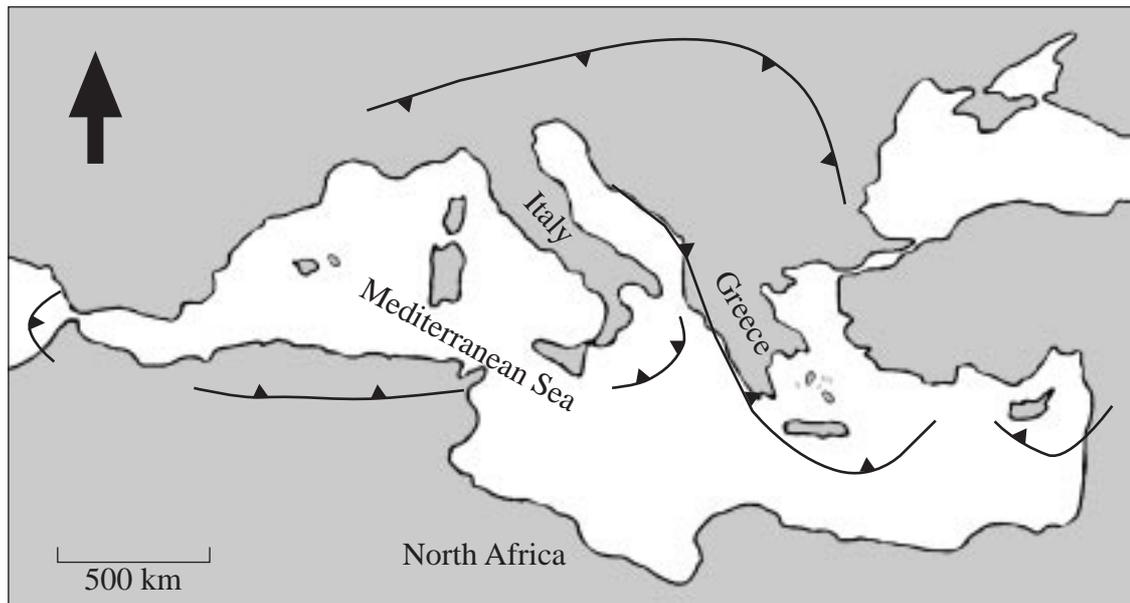
Answer this Part in the Part C Answer Book.

26. The diagram below is a map showing part of the hypothetical planet called Camelot. There are two chains of volcanic islands, the Saintly Islands and the Dragon Islands. The ages of the Dragon Islands are given in millions of years (Ma).



- (a) (i) Draw a clearly labelled cross-section between *X* and *Y*. Include a scale.
- (ii) Briefly describe the source of the magma for the Dragon and the Saintly island groups.
- (b) (i) In which direction is Plate *B* moving?
- (ii) Calculate the rate of movement of Plate *B*. Show your working.

27. The diagram below shows a map of North Africa, the Mediterranean Sea and southern Europe. Plate tectonic theory suggests that the Mediterranean Sea is closing.



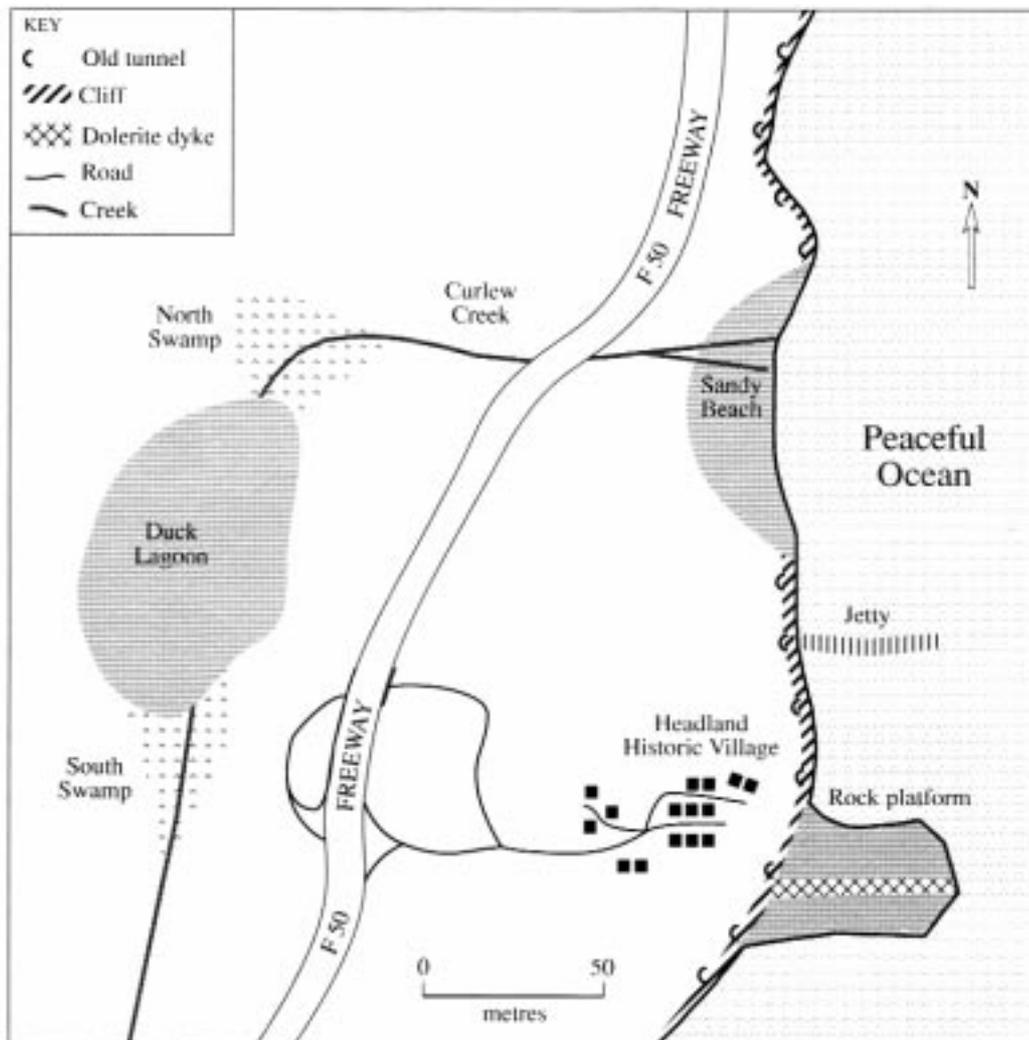
KEY

▲▲▲ Plate boundary

1994 Version 9401 Mountain High, Map Frontiers, Digital Wisdom, Inc

- (a) Describe the eruptive style of volcanoes such as those found in Italy and the Greek islands.
- (b) (i) Draw a fully labelled diagram showing the shape and internal structure of a typical Greek or Italian volcano.
- (ii) Relate the features shown in your diagram to the chemical composition of the magma that formed this volcano.
- (c) During and after the closure of the Mediterranean Sea, a new mountain range will form.
- (i) Name a mountain range that formed in the same way.
- (ii) Name ONE metamorphic rock and ONE igneous rock characteristic of the mountain range named in part (c) (i) above.

28. The map below shows an area that is underlain by a 3 m coal seam. The seam outcrops at the base of the cliff and dips at 3° to the west. The seam was mined from 1900 to 1945 using underground tunnels that entered the seam from the cliff face.



- (a) List TWO problems likely to have been encountered when the seam was mined.
- (b) If the same seam were to be mined today, it would probably be mined by open-cut methods.
- State TWO reasons why open-cut methods would be used.
 - Describe ONE geological problem that would have to be overcome to allow mining to take place.
 - Suggest two valid reasons that local people would give to oppose mining.

29. The photograph below shows Barnacle Bill, a rock on Mars, being analysed by the robot vehicle, Sojourner, during the recent Pathfinder mission. Barnacle Bill has the chemical composition of andesite, but it is not necessarily an igneous rock. Future work on Mars includes taking close-up photographs of Barnacle Bill so that scientists can examine its texture.

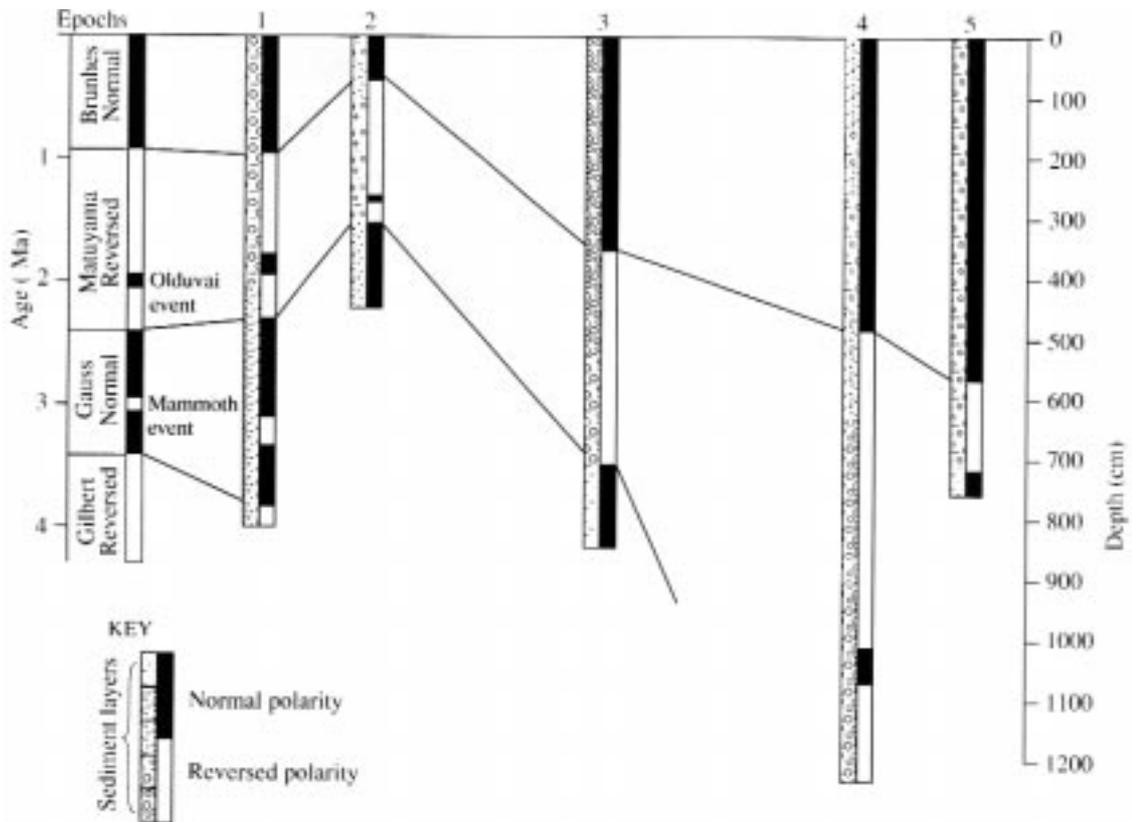


NASA Internet Website: <http://mars.jpl.nasa.gov/ops/81000.full.jpg>

- (a) Describe the textures you would see in the photographs if Barnacle Bill is:
- (i) an igneous rock;
 - (ii) a metamorphic rock;
 - (iii) a sedimentary rock.
- (b) Name TWO minerals you would expect to find in Barnacle Bill if it is an andesite.
- (c) If the rock is igneous, what information might this provide about geologic processes on Mars?
30. Irish peat bogs and the Florida Everglades swamp region are places where coal could be forming today.
- (a) Describe the conditions and processes required for swamp vegetation to be changed into high grade coal.
 - (b) Distinguish between the organisms that form coal and those that form oil.
 - (c) The presence of oil and gas fields on the border of South Australia and Queensland gives geologists information about the environmental conditions that existed in that region during the Mesozoic.

Describe the environment that could have existed in the Mesozoic that resulted in the formation of this oil and gas field.

31. The stratigraphy, type of sediment and the magnetic polarity signatures of five sediment cores from the Atlantic Ocean are shown below.



*R A Phinney, The history of the Earth's Crust: A Symposium, Princeton University Press 1968, p 63, fig 2.
Reprinted by permission of Princeton University Press*

- (a) Examine the log for Core 5. What is the rate of sedimentation during the Bruhnes epoch? Give your answer in centimetres per million years. Show your working.
- (b) (i) At what time did the Matuyama reversed epoch end?
(ii) In Core 4, at what depth does the top of the Matuyama reversed epoch occur?
- (c) Suggest one possible reason why the Olduvai event is not recorded in Core 3.
- (d) (i) What is the approximate age of the Mammoth event?
(ii) Why is evidence of this event present in Core 1 but not in the other cores?

SECTION II—ELECTIVES

(25 Marks)

Attempt ONE question.

Answer the question in a SEPARATE Elective Answer Book.

	Pages
QUESTION 32. Contemporary Sedimentary Processes	22–25
QUESTION 33. Igneous Rocks	26–29
QUESTION 34. Economic Geology	30–33
QUESTION 35. Regional Geology	34–36
QUESTION 36. Palaeontology	37–41

QUESTION 32. Contemporary Sedimentary Processes**Marks**

In this elective, you will have studied ONE of the following depositional environments:

- a river/stream
- a beach
- a lagoon/lake
- a bay/estuary/delta
- a desert.

- (a) (i) Name the environment you have studied. **14**
- (ii) Draw a sketch map of the area at least 10 cm × 10 cm. On the map include:
1. a north arrow;
 2. a scale;
 3. a nearby geographic feature, for example, a town or homestead;
 4. the dominant sediment transport direction(s).
- (iii) Describe the source(s) of sediment in your environment. Include the:
1. distance of the source area(s) from the area you have studied;
 2. rock types in the source area(s);
 3. type and degree of weathering the source(s) has undergone.
- (iv) Select the site you have studied that is closest to the source(s) of the sediment. Label this as site *A* on the map drawn in part (a) (ii). Describe the sediment at site *A* in terms of the:
1. grain size;
 2. grain shape;
 3. grain composition.

Question 32 continues on page 23

QUESTION 32. (Continued)

Marks

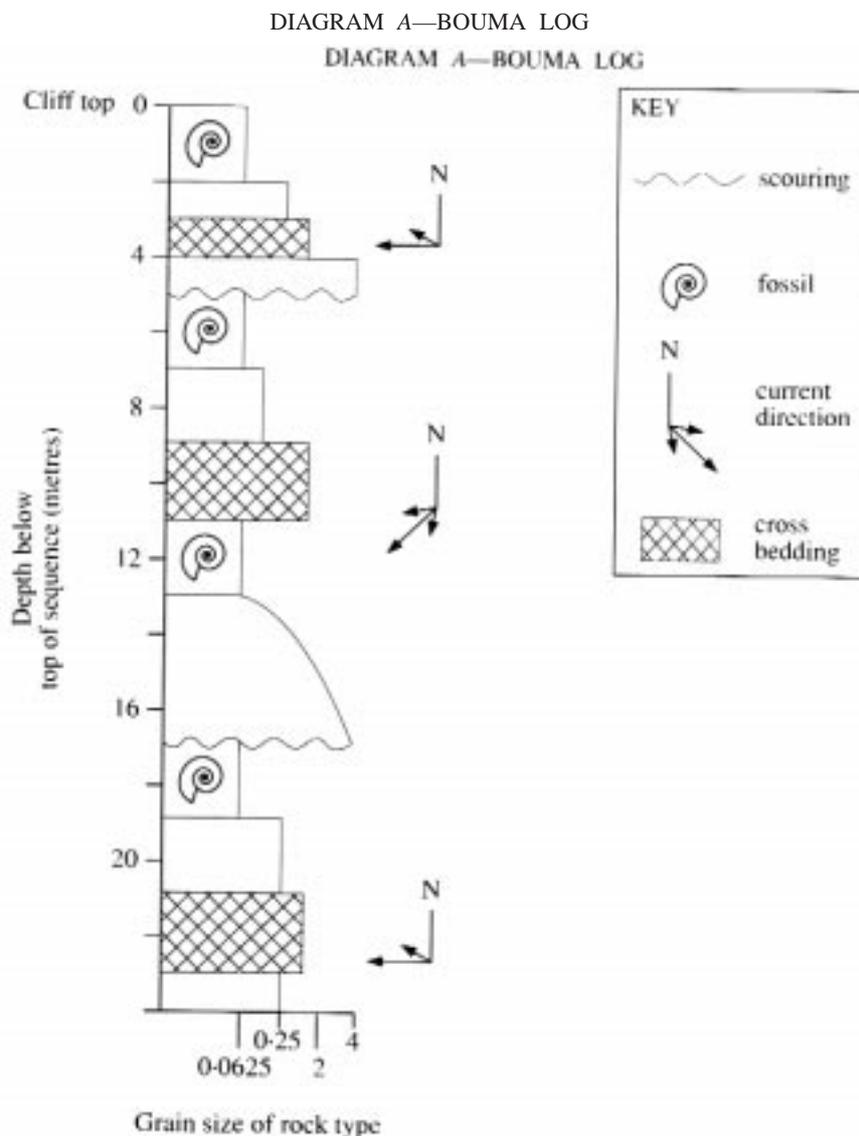
- (v) Describe the changes the sediment has undergone since it left the source(s) in terms of:
1. size;
 2. shape;
 3. composition.
- (vi) Give details of the processes that caused the changes in part (a) (v) above.
- (vii) Select the site you have studied that is farthest from the source(s) of the sediment. Mark this as site *B* on your map drawn in part (a) (ii). Describe the sediment at site *B* in terms of:
1. size;
 2. shape;
 3. composition.
- (viii) 1. What is the dominant transporting medium in the environment you have studied?
2. Describe the steps you took (or could have taken) to measure the energy of the transporting medium.
3. Draw and fully label a sedimentary structure that was or could be produced at each of:
- (a) site *A*;
 - (b) site *B*.

Question 32 continues on page 24

QUESTION 32. (Continued)

Marks

- (b) People have an effect on the sedimentary environment either directly or from a distance. 2
- (i) List TWO ways in which people have modified the environment you have studied.
- (ii) What effect did each of these modifications have on the transporting medium?
- (c) Diagram A shows a 'Bouma' log of a sequence of Devonian rocks. The log shows the average grain size of the sedimentary rock at a given depth below the top of the sequence. Beside the log are arrows that indicate water current direction when the sediment was deposited. They are drawn with the direction of north up the page. Diagram B on page 25 shows a modified Wentworth Grade Scale that gives a classification of rock type based on grain size. 7



QUESTION 32. (Continued)

Marks

DIAGRAM B—MODIFIED WENTWORTH GRADE SCALE

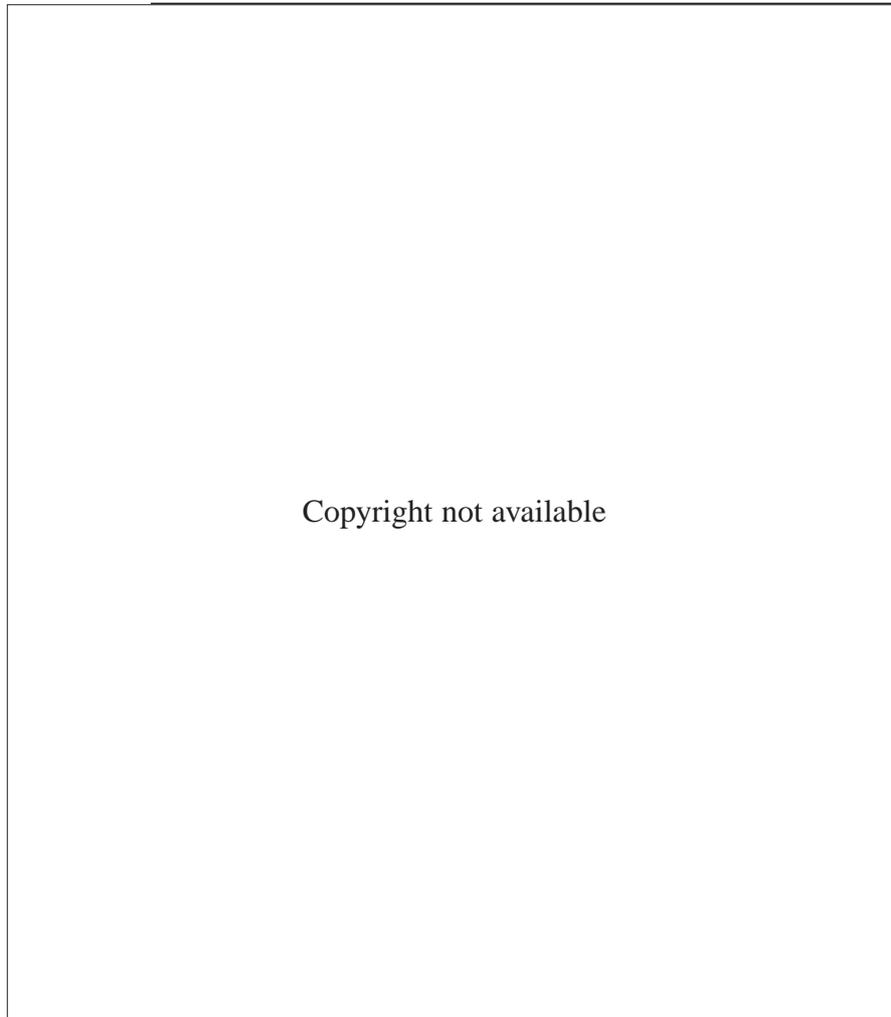
<i>Grain size</i> (millimetres)	<i>Rock name</i>
2.....	Conglomerate
0.5.....	Coarse sandstone
0.25.....	Medium sandstone
0.0625.....	Fine sandstone
	Siltstone

- (i) Using the modified Wentworth Grade Scale shown in Diagram B, give an appropriate name for the rock found 8 metres below the cliff top.
- (ii) 1. State the depth range over which sediment was deposited as a single graded bed, that is, coarse grained at the bottom and finer grained at the top.
2. What is the grain size, in millimetres, of the sediment deposited at the base of the graded bed?
3. Describe the way in which the grain size of the rock at the base of the graded bed could be measured.
- (iii) Give a depth at which conglomerate occurs.
- (iv) 1. State the relationship between fossils and grain size in this sequence.
2. Give ONE reason to explain this relationship.
- (v) 1. What was the dominant transport direction at 10 metres below the cliff top?
2. Suggest how the transport direction may have been measured in the field.
- (vi) Give ONE reason to explain the relationship between the scouring and a grain size of 4 mm.
- (d) The present is the key to the past. 2

Discuss this statement with reference to an ancient sedimentary environment similar to the environment you have studied.

QUESTION 33. Igneous Rocks**Marks**

(a) The diagram below is from a thin section of an igneous rock.

10

- (i) Name the minerals *A* and *B* and state characteristics of each that helped you make the identification.
- (ii) Name the texture illustrated.
- (iii) Describe in detail how this texture forms.
- (iv) Classify this rock as felsic, intermediate or mafic, and support your answer.

Question 33 continues on page 27

QUESTION 33. (Continued)

Marks

- (v) The table below shows the chemical composition of an igneous rock as percentage by weight of oxides.

<i>Oxides</i>	<i>Weight (%)</i>
SiO ₂	46.62
TiO ₂	1.71
Al ₂ O ₃	4.68
Fe ₂ O ₃ } FeO }	14.56
MgO	22.86
CaO	7.15
Na ₂ O	1.41
K ₂ O	0.28
P ₂ O ₅	0.14
MnO	0.14
H ₂ O	0.23
Other constituents	0.22

Could the analysis given in the table above have been obtained from the rock in the diagram? With reference to any TWO oxides, support your answer.

- (vi) Describe how the zoning in mineral X would have formed.
- (vii) 1. In which plate tectonic setting would the rock shown in the sketch be most likely to occur?
2. Describe in detail how magmas of this composition are generated.

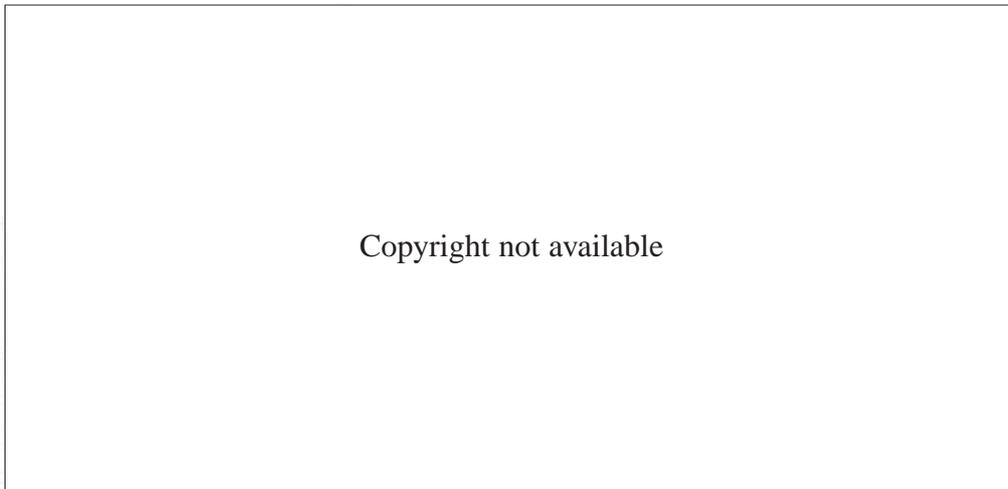
Question 33 continues on page 28

QUESTION 33. (Continued)

Marks

- (b) The diagram below is a cross-section of a complex intrusion found on the south coast of New South Wales.

8



- (i) Describe the process by which one magma body could produce quartz syenite at the top of the intrusion and olivine monzonite at the bottom.
- (ii)
 1. Briefly describe the likely texture and grain size of the igneous rock at the base of the magma body.
 2. Account for the occurrence of this texture.
- (iii) How could a geologist determine the composition of the parent magma from which this intrusion formed?
- (iv) Name TWO economic minerals commonly found at the base of this type of intrusion.
- (v) List FOUR minerals commonly found in ultramafic rocks.

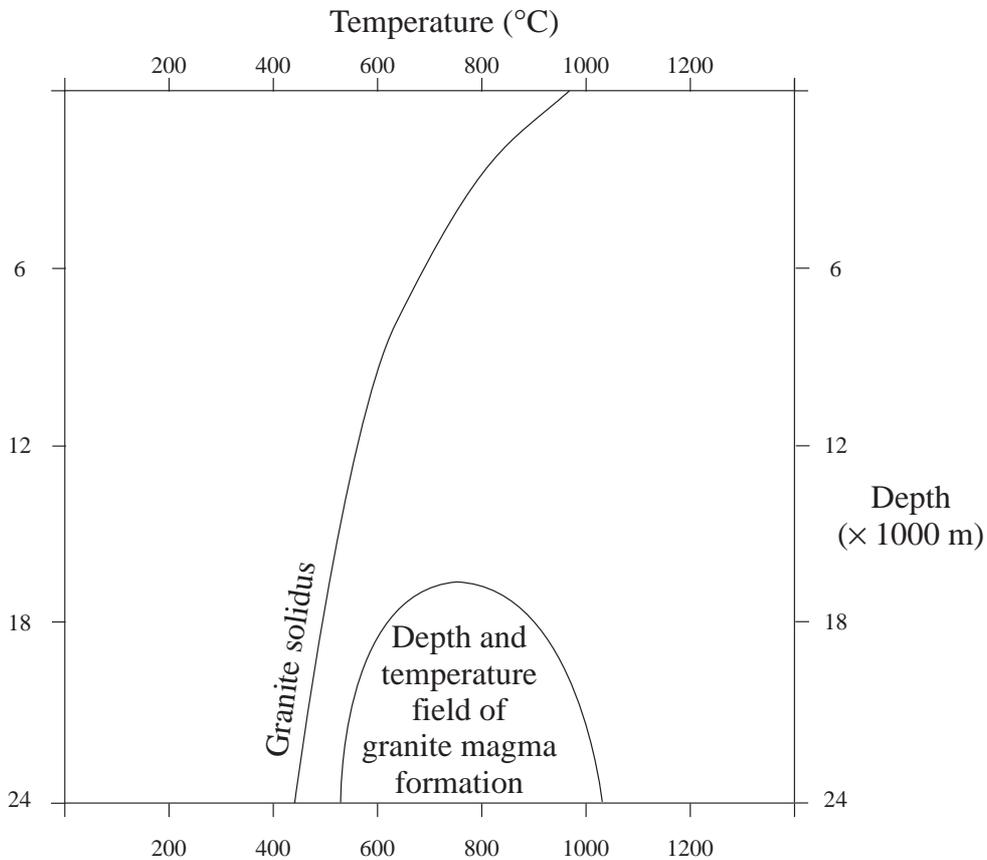
Question 33 continues on page 29

QUESTION 33. (Continued)

Marks

(c) Examine the diagram below.

7

*A definition:*

The granite solidus is the curve that marks the depth and temperature at which granite magma becomes completely solid. (For example a granite found at 12 km depth and 570°C will be completely solid.)

A quotation:

‘Most granite magma is intruded into the crust at depths greater than five kilometres below the surface.’

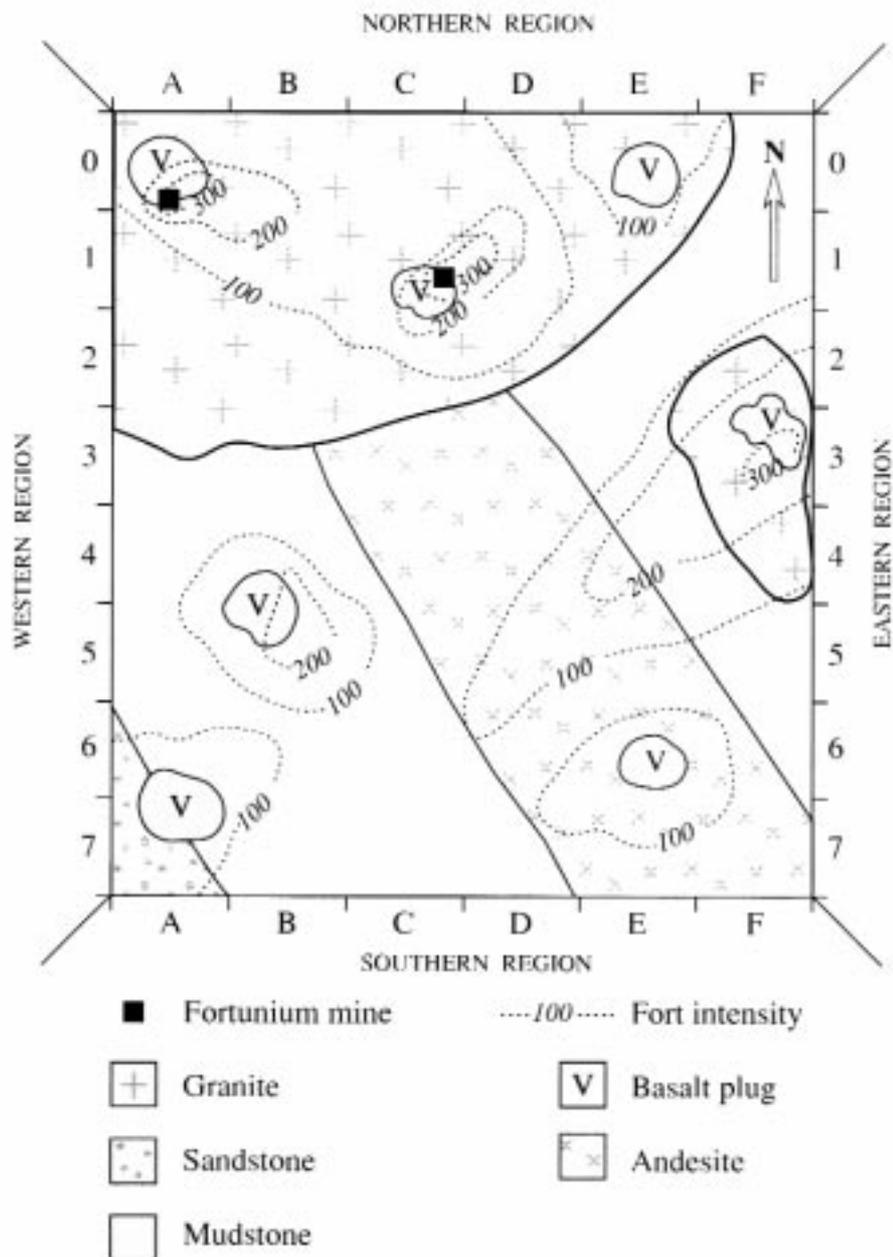
Discuss in detail the intrusion, cooling and mineralogy of granites with reference to the diagram, the definition, the quotation and Bowen’s reaction series.

QUESTION 34. Economic Geology**Marks**

- (a) It is the year 2196. A new substance called fortunium has been discovered and is universally used as money. Until 2194 fortunium deposits were discovered accidentally by prospectors. In 2195 an exploration technique for finding fortunium was developed. The technique is called fortuning and it consists of taking measurements with a specialised instrument known as a fortunometer. The measurements (in forts) are plotted on a map, contoured, and then compared to the geology of the area. The map given below shows:

7

1. the geology of the first area in which fortuning was used;
2. the location of two mines discovered before fortuning was developed (grid sectors A0 and C1);
3. contours indicating fort intensity.



Question 34 continues on page 31

QUESTION 34. (Continued)

Marks

- (i) Describe the characteristics of the fort intensity pattern in the vicinity of the fortunium mines.
- (ii) Describe the geology of the known fortunium deposits.
- (iii)
 - 1. Indicate the grid sector in which you would first prospect for a new fortunium deposit.
 - 2. Describe in detail where you would expect to find that deposit within that grid sector.
 - 3. On arriving at the location you identified in part (iii) 2. above, you find that there are no fortunium outcrops. Describe a technique you could use to confirm the presence of fortunium at this location.
- (iv) In which region(s) adjacent to the map would fortunium deposits be likely to occur? Explain your answer.
- (v) Compare or contrast the technique of fortuning with an exploration technique you have studied.

Question 34 continues on page 32

QUESTION 34. (Continued)

Marks

In this elective, you have studied TWO of the following:

- an economic deposit formed by igneous and/or metamorphic processes;
- an economic deposit formed or concentrated by weathering or sedimentary processes;
- an engineering project.

(b) For an economic deposit you have studied, answer the following questions. **10**

- (i) Name the deposit and list the materials extracted from it.
- (ii) Describe in detail how the deposit was discovered, or the exploration methods that could be used to discover a similar deposit.
- (iii)
 1. List the factors that were necessary for the materials to be extracted from the deposit.
 2. What factors are necessary for the deposit to be economically viable?
- (iv)
 1. Describe in detail how the materials were extracted from the economic deposit.
 2. Indicate what features of the deposit were important in selecting the method of extraction.

(c) Answer EITHER part (i) OR part (ii). **8**

EITHER

- (i) Choose a different economic deposit to the one you wrote about in part (b), and answer the following questions.
 1. Name the deposit and list the ores or materials extracted from it.
 2. Draw a labelled cross-section of the deposit.
 3. Describe in detail how the materials extracted from the deposit are processed or refined. If they are not processed or refined, explain why this is not necessary.
 4. (I) What are the proved reserves of the deposit?
(II) How do the proved reserves differ from the indicated reserves of this deposit?
 5. Describe and discuss the environmental issues that this economic deposit presents.

OR

Question 34 continues on page 33

QUESTION 34. (Continued)

Marks

- (ii) For an engineering project, answer the following questions.
1. Describe the project you have studied.
 2. Sketch a map and a cross-section of the site you have studied that shows the important geological or topographic features of the site.
 3. Indicate how the features you sketched in part (ii) 2. influenced the design of the project.
 4. Indicate how the features you sketched in part (ii) 2. influenced the construction methods used in the project.
 5. *Either* describe how environmental considerations affected the project *or* describe the exploration and testing methods used in planning for the project.

QUESTION 35. Regional Geology**Marks**

In this elective, you have studied ONE of the following regions:

- North-western Fold Belt
- Central and Southern Fold Belt (northern areas)
- Central and Southern Fold Belt (southern areas)
- New England Fold Belt
- Sydney Basin.

Name the geological region you have studied.

- (a) This region has boundaries with other regions. **3**
- (i) State the name of one of these adjoining regions.
 - (ii) In terms of tectonic setting, describe why this region is different from the one you have studied.
 - (iii) Describe the nature of the boundary between the two regions.
 - (iv) Explain how the age relationship between the two regions was, or may be, determined.
- (b) Choose ONE igneous unit from the region you have studied. **3**
- For this unit:
- (i) name the unit and state where it is located in the region;
 - (ii) describe the source(s) of the material that makes up the unit;
 - (iii) draw and label ONE igneous structure found in this unit.
- (c) Choose ONE sedimentary unit from the region you have studied. **3**
- For this unit:
- (i) name the unit and state where it is located in the region;
 - (ii) describe the source(s) of the material that makes up the unit;
 - (iii) draw and label ONE sedimentary structure found in this unit.

Question 35 continues on page 35

- | QUESTION 35. (Continued) | Marks |
|--|----------|
| (d) In the region, there are features of special geological interest. | 2 |
| (i) Name ONE significant scenic feature or major economic deposit. | |
| (ii) Explain why the feature is of special geological interest. | |
| (iii) Describe in detail how it was formed. | |
|
 | |
| (e) Describe in detail how you used TWO of the following to obtain specific information about your region. | 3 |
| • Field work | |
| • Laboratory investigations | |
| • Aerial photographs | |
| • Maps | |
| • Library studies | |
|
 | |
| (f) The topography of the region is influenced in part by the rocks found within it. | 2 |
| Explain this statement with reference to TWO specific landforms. | |
|
 | |
| (g) Name ONE large-scale structural feature found in the region. | 3 |
| (i) Draw a labelled cross-section of this structure. | |
| (ii) Explain its formation with reference to tectonic processes. | |

Question 35 continues on page 36

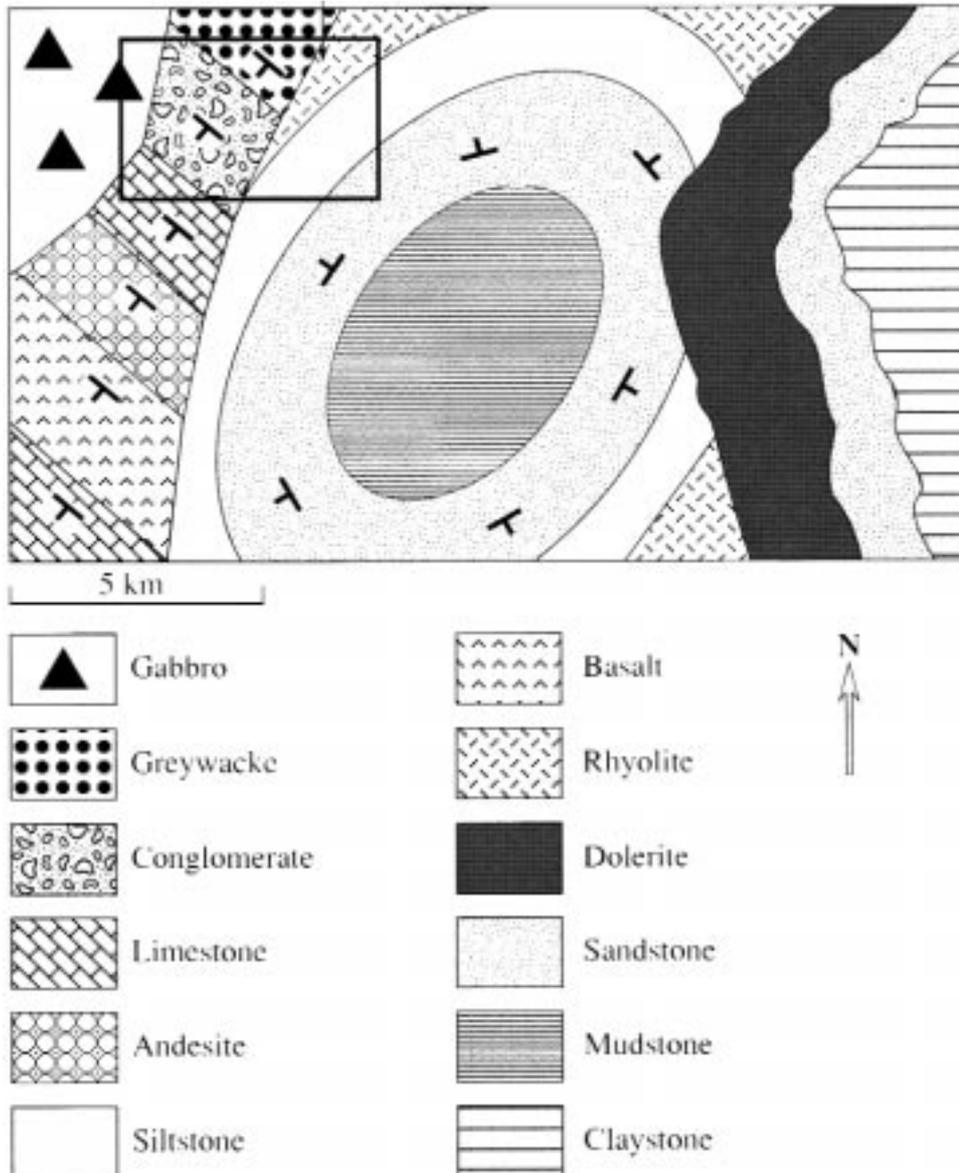
QUESTION 35. (Continued)

Marks

- (h) Imagine you are a geologist working for a geological exploration company. 6

The company has a licence to explore an area (indicated on the map below) that is known to contain several mineral deposits.

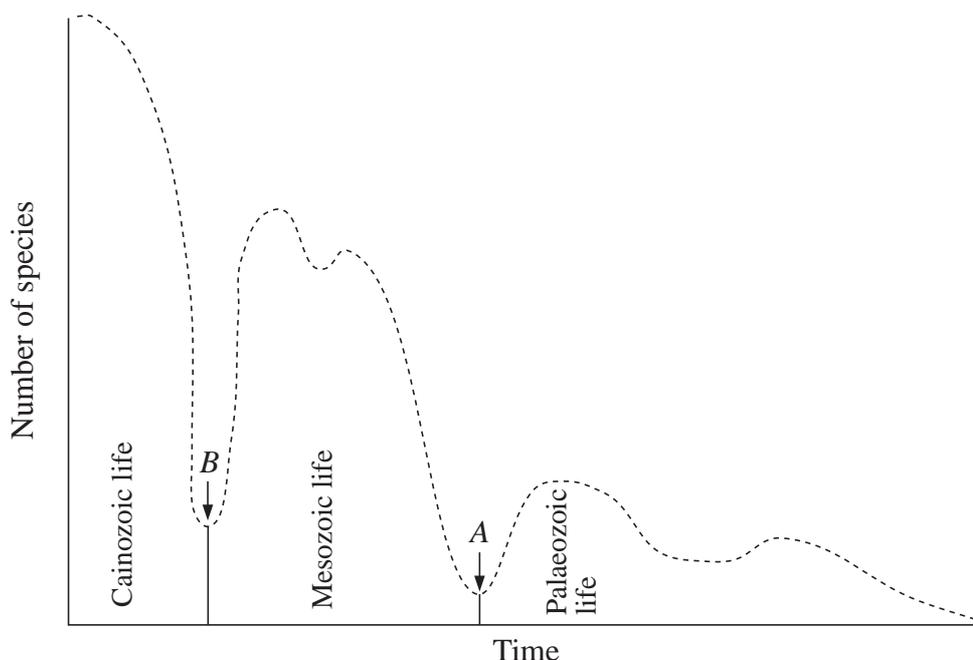
You and your team are given a wide variety of resources and a generous budget.



- (i) Describe in detail the steps you would take to obtain an understanding of the large-scale geology of this region. Explain why you have chosen each procedure.
- (ii) Describe the steps you would take to obtain a detailed understanding of the geology of the area indicated by Box B.

QUESTION 36. Palaeontology**Marks**

- (a) Give a one sentence definition of *palaeontology*. **1**
- (b) In the mid-nineteenth century, John Phillips produced the following graph to show total number of species through time. **3**



W A Berggren & J A Van Couvering, *Catastrophes and Earth History*, © Princeton UP, 1984, p 117 fig 6.1.
Reprinted by permission of Princeton University Press

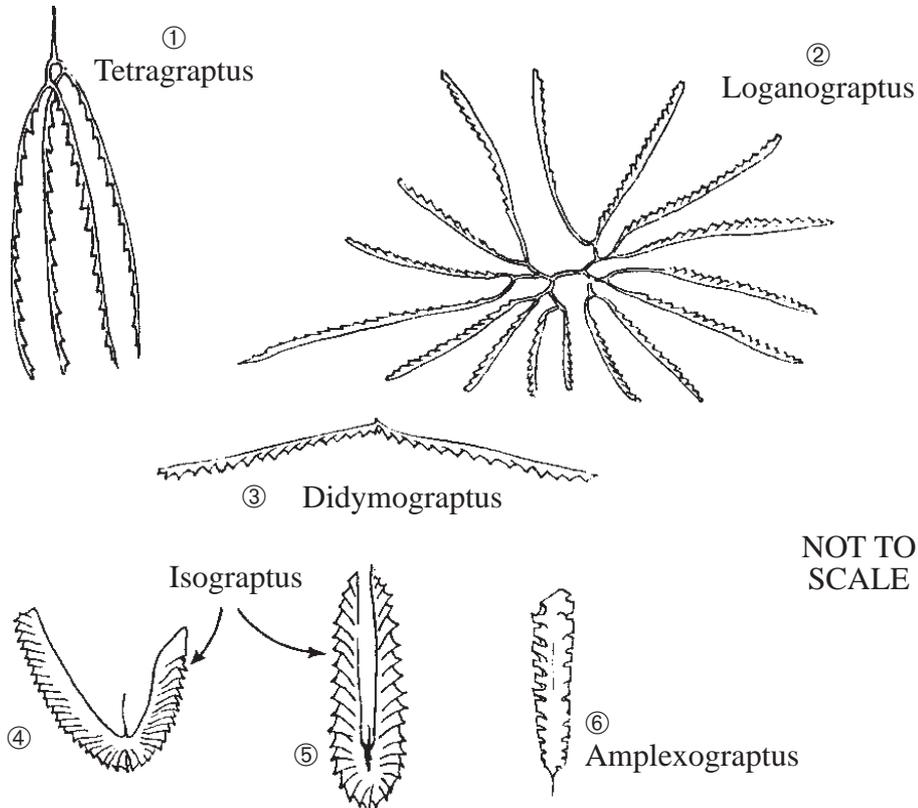
- (i) What is represented by the shape of the graph at A and B?
- (ii) Outline TWO theories to account for your answer to part (i).
- (iii) Describe ONE other idea that John Phillips might have been trying to show with this graph.
- (iv) During Earth's history, groups of animals became extinct. Name TWO such groups, and give the times when these extinctions occurred.
- (c) (i) Name TWO people other than John Phillips and Charles Darwin who have made a significant contribution to the science or study of palaeontology. **3**
- (ii) Discuss the contribution made by the people you named in part (c) (i).

Question 36 continues on page 38

QUESTION 36. (Continued)

Marks

- (d) Charles Darwin made a significant contribution to the theory of evolution. He believed that evolution was the 'descent of organisms with modification'. Below is a group of Ordovician fossils arranged in order of decreasing age with fossil ① the oldest and fossil ⑥ the youngest. 5



D F Branagon (ed), Beneath the scenery, Science Press, 1971, p 53

- (i) What fossil group is shown? Are there any members of this group of organisms alive today?
- (ii) How do you think Darwin would have explained the changes shown in the group illustrated above?
- (iii) For the group of organisms shown above, the fossil record is very incomplete. Give TWO reasons why the record might be incomplete.
- (iv) For the above or any other group of organisms, discuss why most fossils are classified to order or genus level, but few of the group are classified to species level.

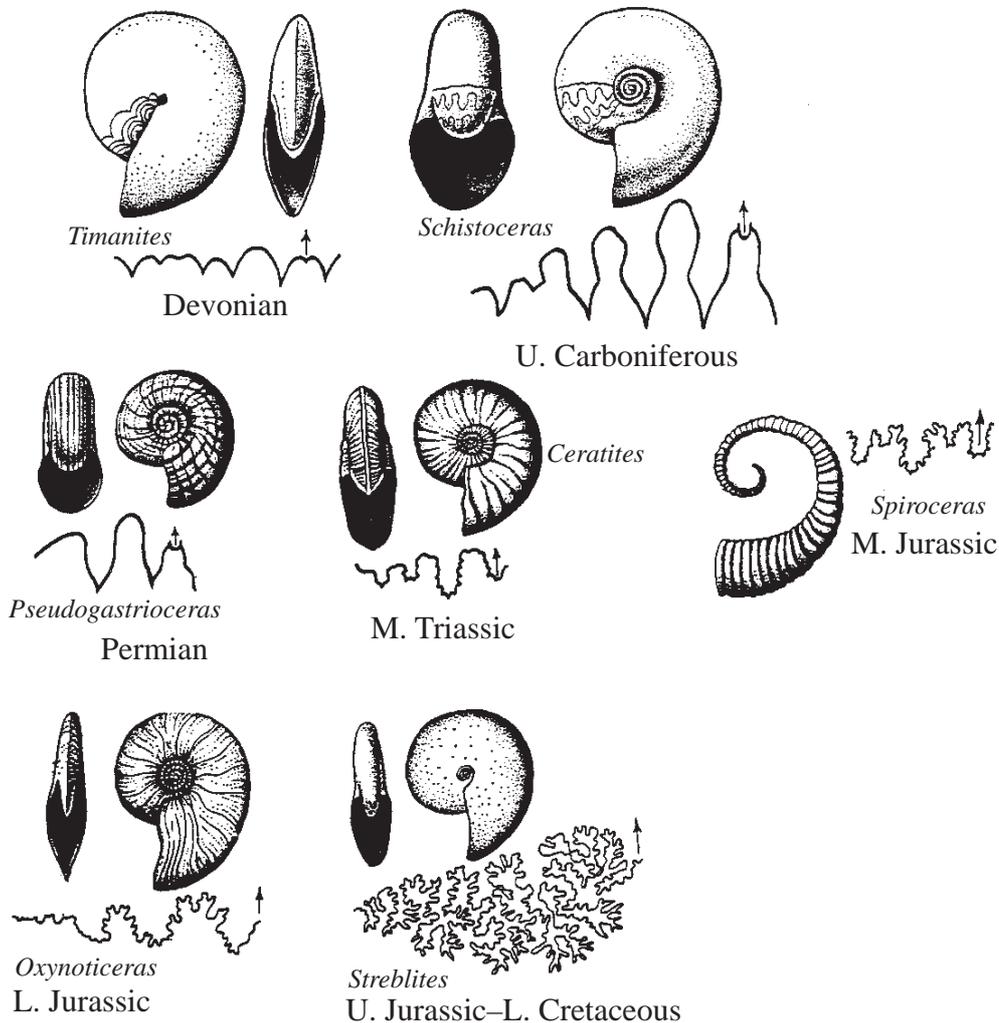
Question 36 continues on page 39

QUESTION 36. (Continued)

Marks

(e) The following diagrams show the shells and suture lines of seven ammonites.

5



Enquiring Into The Earth, McDonnell, Massey & Tebutt, Addison Wesley Longman Australia Pty Ltd

- (i)
 1. In what environment did ammonites live?
 2. How would their lifestyle have influenced the distribution of ammonites?
 3. Would ammonites be useful in stratigraphic correlation? Explain your answer.
- (ii) Describe the changes in shell morphology that occurred between the Devonian and the Cretaceous periods.
- (iii) Give a possible reason why these changes occurred.
- (iv) Suggest why the ammonite *Spiroceras* might have developed a different shape to the others.

QUESTION 36. (Continued)

Marks

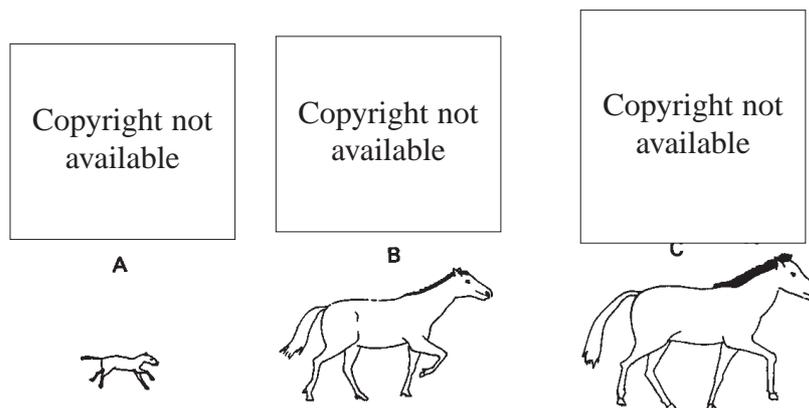
- (f) (i) Draw a diagram of a trilobite and label the glabella, eye, pygidium, thorax and cephalon (or head). 5
- (ii) Describe ONE evolutionary change that is shown by the glabella of trilobites.
- (iii) In one evolutionary line of trilobites, the eyes became smaller over time with the most recent of the trilobites in the line not having any eyes. In another evolutionary line, the eyes became larger. Account for these two evolutionary trends.
- (g) Answer EITHER (i) OR (ii) OR (iii). 3

EITHER

- (i) The time at which the Aboriginal Australians came to the continent has been debated for many years. Last year a group of researchers claimed it was as long ago as 170 000 years ago, although some researchers argued that this date was in error and the correct time was 40 000 to 80 000 years ago. Discuss how the application of palaeontological principles might be used to outline the history of the Aboriginal Australians on the Australian continent and thus contribute to this debate.

OR

- (ii) The diagrams show three fossils that illustrate the evolution of the horse. Details of the forelimbs and teeth are shown.



NOT TO SCALE

*Gass et al, Understanding the Earth, 2nd ed Open Uni Press by Artemis, 1972, P 198, fig 14.5.
 Reproduced by permission TheOpen University – author & publisher*

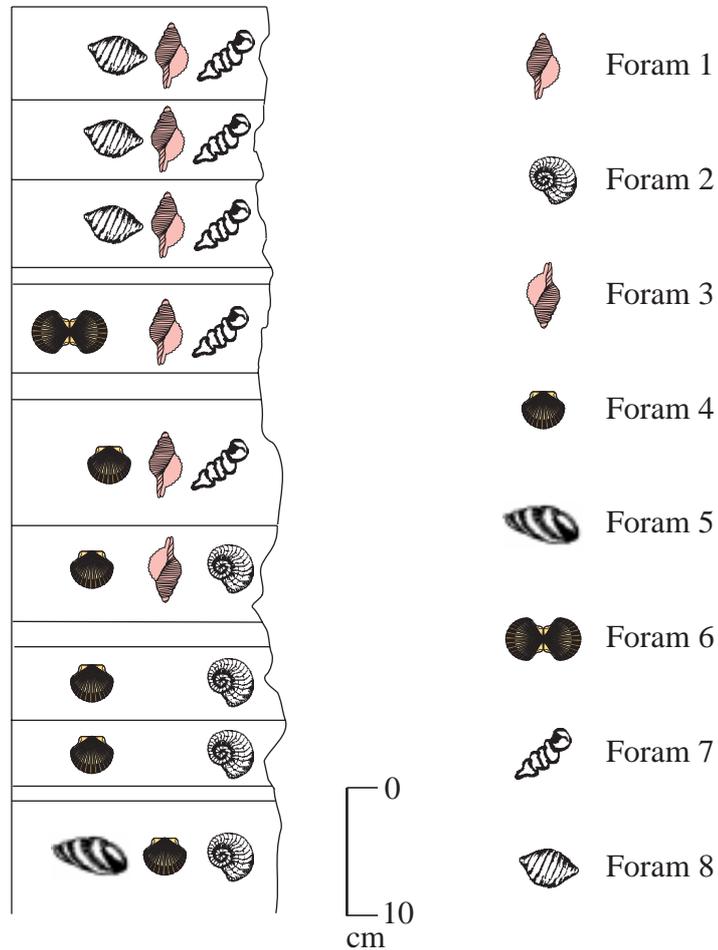
- How might a geologist use the fossils of the horse to determine the palaeoecology of these animals?
- What other evidence might a palaeontologist use to interpret the palaeoecology?

OR

QUESTION 36. (Continued)

Marks

- (iii) A petroleum company drilled an oil well and found the following vertical distributions of forams (foraminifera) in the very top part of the recent sediment.



1. Which foram is potentially the best index fossil? Why would it be the best index fossil?
2. Discuss the way in which geologists use microfossils in oil exploration.

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