

BOARD OF STUDIES
NEW SOUTH WALES

HIGHER SCHOOL CERTIFICATE EXAMINATION

1999
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 either blue or black pen 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.

Instructions for answering multiple-choice questions

- Complete your answers in either blue or black pen.
- Select the alternative A, B, C or D that best answers the question. Fill in the response oval completely.

Sample: $2 + 4 =$ (A) 2 (B) 6 (C) 8 (D) 9
A B C D

If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

A B C D

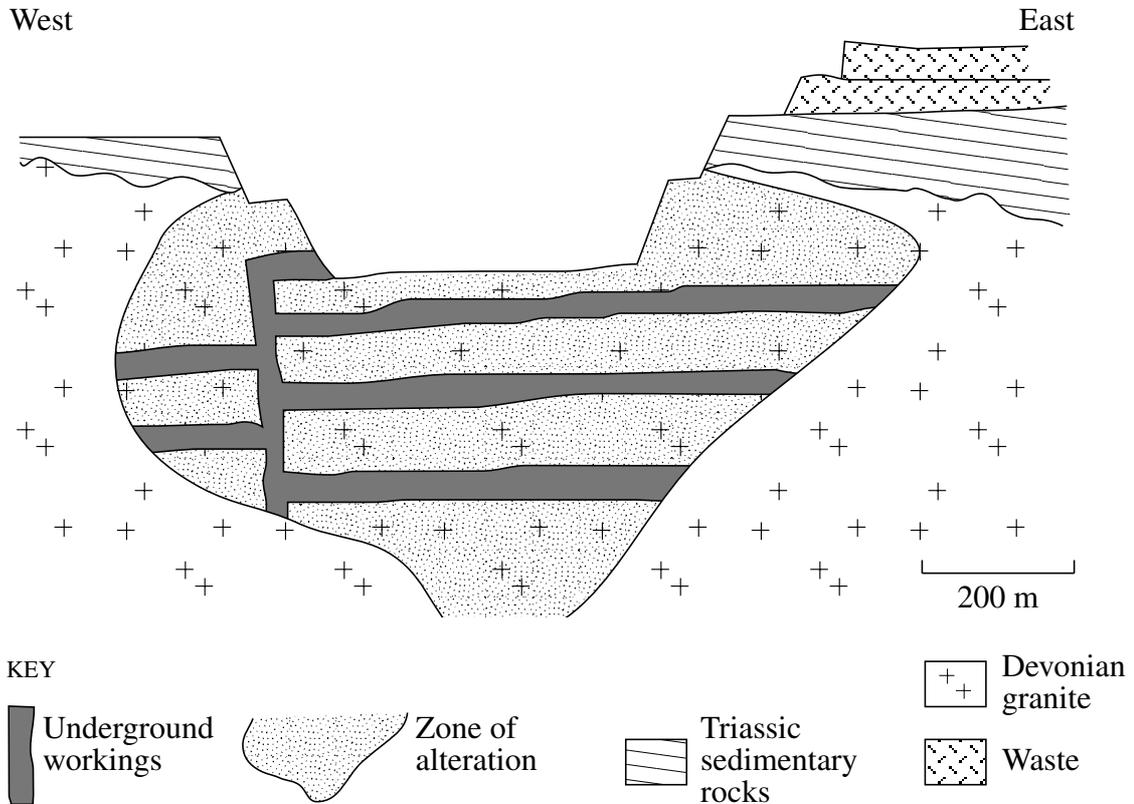
If you change your mind and have crossed out what you consider to be the correct answer, then indicate the correct answer by writing the word **correct** and drawing an arrow as follows.

A B C D
correct
↙

- 1 The Himalayas were formed as a result of the
- (A) convergence of two continental plates.
 - (B) convergence of two oceanic plates.
 - (C) divergence of two oceanic plates.
 - (D) sliding of two continental plates past each other.
- 2 Deposits of iron and manganese oxides are found in the Red Sea and along the boundary between the Nazca Plate and Pacific Plate. These deposits probably formed as
- (A) chemical precipitates on the ocean floor.
 - (B) a result of the weathering of ocean-floor sediments.
 - (C) beach placers that were transported by moving plates.
 - (D) magmatic intrusions that have been uncovered by erosion.
- 3 The asthenosphere is thought to be a
- (A) rigid layer unconnected to the crust.
 - (B) mobile zone allowing plate motion.
 - (C) partially molten layer above the mantle.
 - (D) layer of molten rock from which granites are derived.

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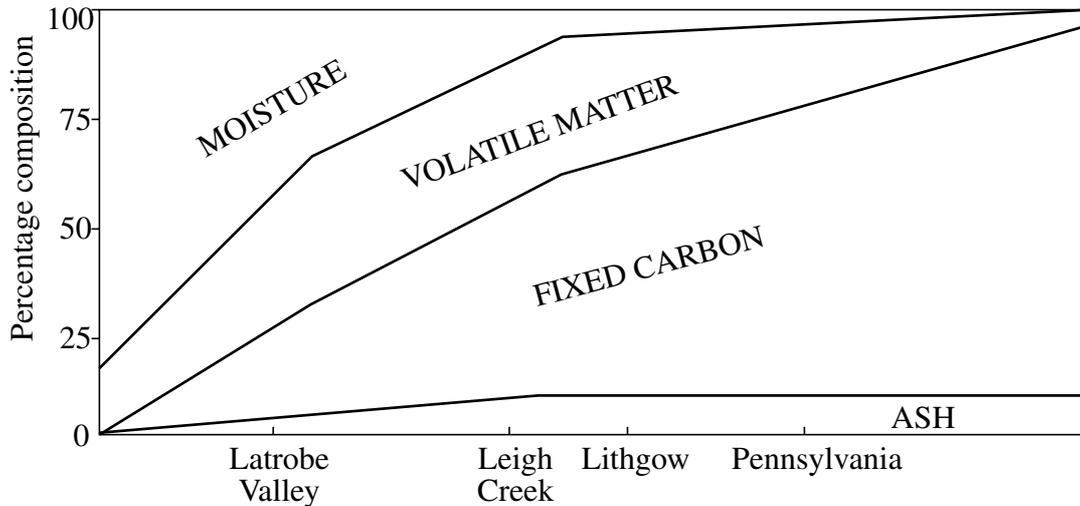
- 4 The diagram shows a mine in a sequence of Triassic sedimentary rocks and hydrothermally altered Devonian granite. Open-cut methods were used to a depth of 200 metres. Below 200 metres underground methods are now being used.



The reason the underground workings are restricted to the zone of alteration is

- (A) to limit water seepage from the Triassic sedimentary rocks into the mine.
- (B) the hardness of unaltered granite makes mining uneconomic.
- (C) only this area contains ore-grade mineralisation.
- (D) only layered rocks can be mined economically by open-cut methods.

- 5 The diagram shows the variation in four properties of coal. The composition of coal from four mining districts is shown.



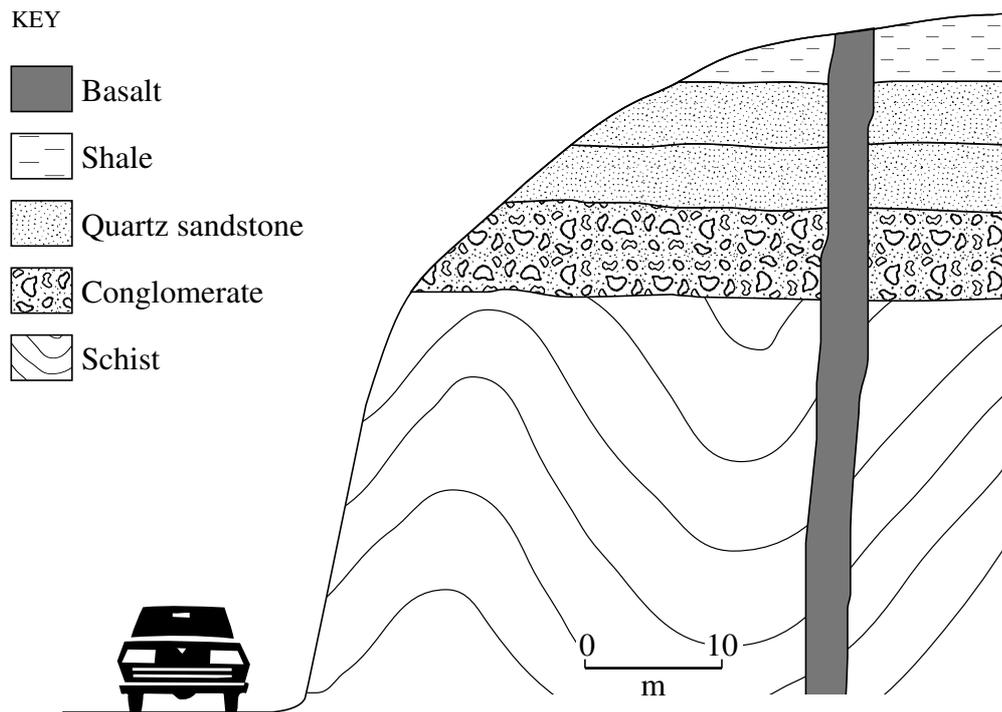
McDonnell, K S, Massey, D G and Tebbut, F H S, *Enquiring into the Earth*, Longmans, Melbourne, 1968.
 Reproduced with permission of Pearson Education Australia – Website: <http://www.longman.com.au>

Which of the following is a correct statement?

- (A) Ash content decreases with increasing rank.
 (B) Leigh Creek coal has more fixed carbon than Lithgow coal.
 (C) Latrobe Valley coal contains less moisture than Lithgow coal.
 (D) Leigh Creek coal has more volatile matter than Pennsylvania coal.
- 6 Choose the alternative in which the geological feature best fits the geographical location.

	<i>Geological feature</i>	<i>Geographical location</i>
(A)	fold mountain range	Iceland
(B)	mid-ocean ridge	Japan / Tongan Islands
(C)	active subduction zone	Himalayas
(D)	transform fault	Mid-Atlantic Ridge

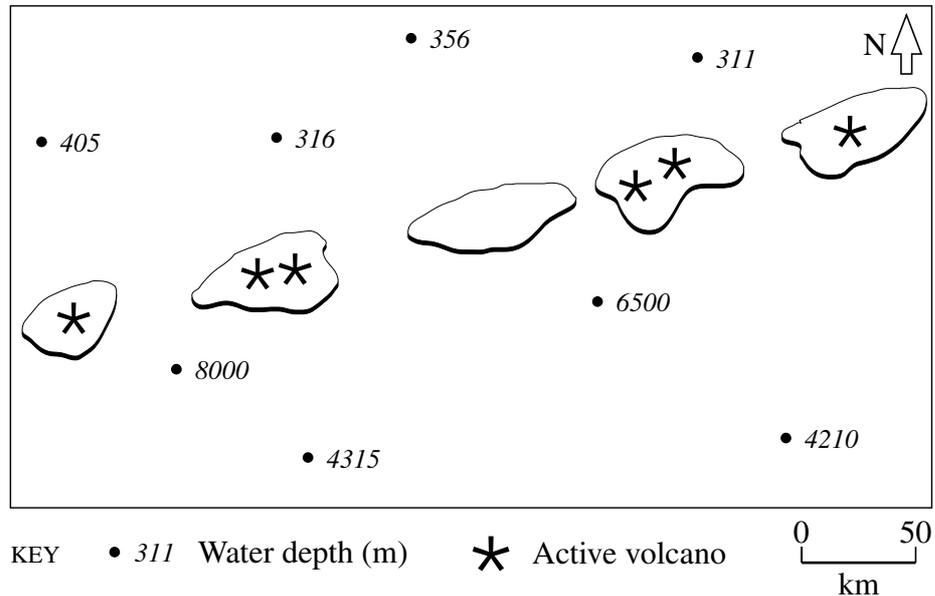
- 7 At what type of boundary have highest heat flow readings been recorded?
- (A) Convergent boundaries above the subducting plate
 (B) Convergent boundaries above the non-subducting plate
 (C) Divergent boundaries at the rift
 (D) Conservative boundaries at the fault zone
- 8 The diagram shows a cross-section of an embankment along a new highway.



The rock unit most likely to cause problems is the

- (A) basalt, as the mineral constituents are easily weathered.
 (B) shale, as slabs may fall as it weathers along bedding planes.
 (C) quartz sandstone, as water may permeate the pores.
 (D) schist, as the bedding plane dips towards the road.

- 9 The map is a copy of one drawn in 1850. It shows several islands in an oceanic region located near Siberia. It gives information useful for determining the type of plate boundary that occurs there.



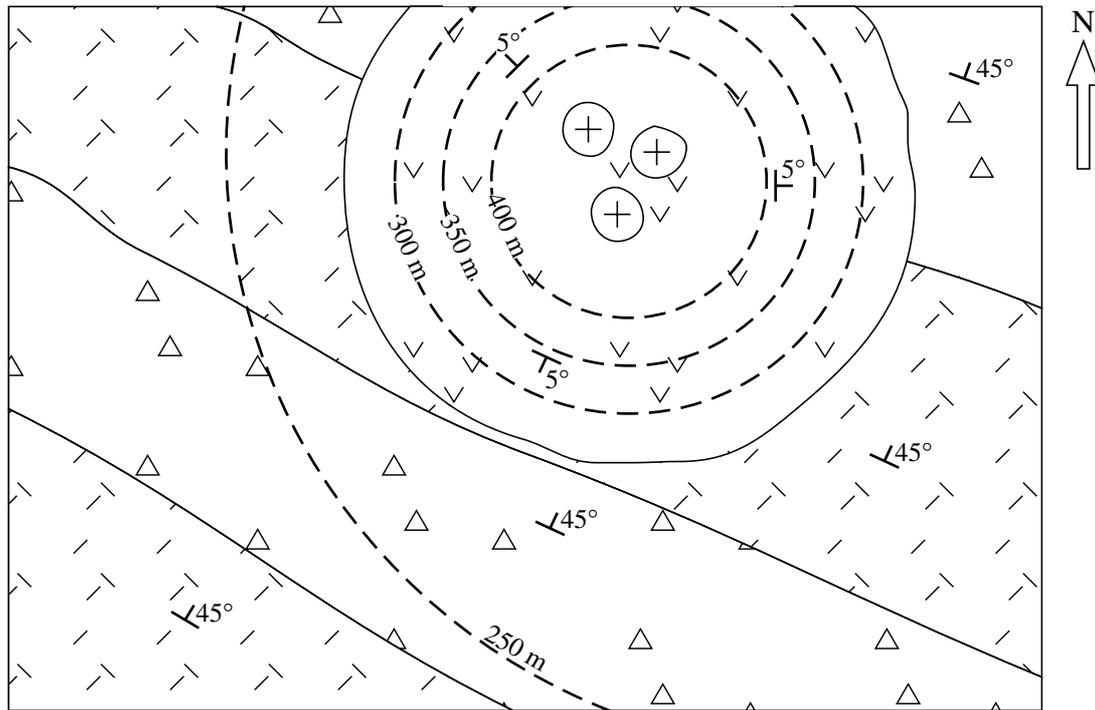
The plate boundary in the area shown is a

- (A) transform boundary.
 (B) convergent boundary.
 (C) divergent boundary.
 (D) conservative boundary.
- 10 The 'Last Chance' copper mine in central Queensland has opened and closed several times since discovery of the mineralisation in 1890. The mineralisation occurs as chalcopyrite, a copper sulfide, disseminated through a granite. The original mine was open cut but the most recent operation has been underground. The mine closed again in February this year. A number of factors contributed to this closing of the mine.

The factor *least* likely to have caused the mine to close is

- (A) a fall in copper prices worldwide.
 (B) lower grades of copper ore with depth.
 (C) environmental problems associated with the storage of new overburden.
 (D) increased costs of the mining operation as the mine becomes deeper.

11 The map shows an extinct volcano.



KEY

T Dip symbol

- - - Contour lines



Basalt



Trachyte



Andesite



Pyroclastic rocks

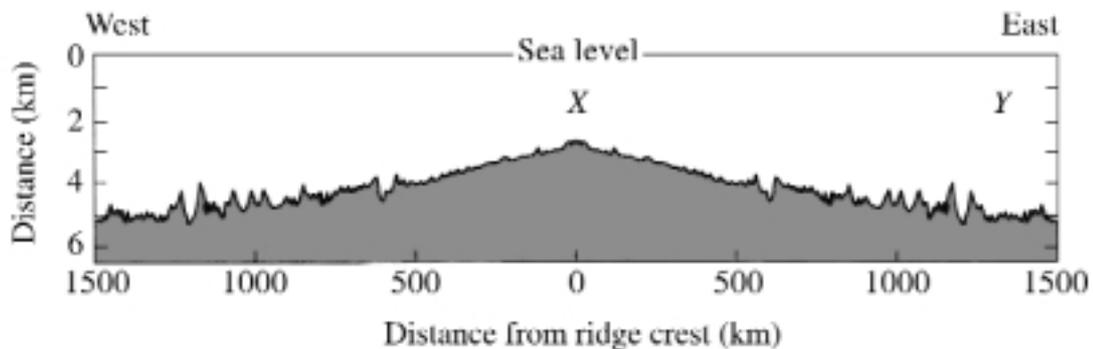
} Palaeocene

} Devonian

The volcano is a

- (A) shield volcano.
- (B) cinder cone.
- (C) composite volcano.
- (D) parasitic cone.

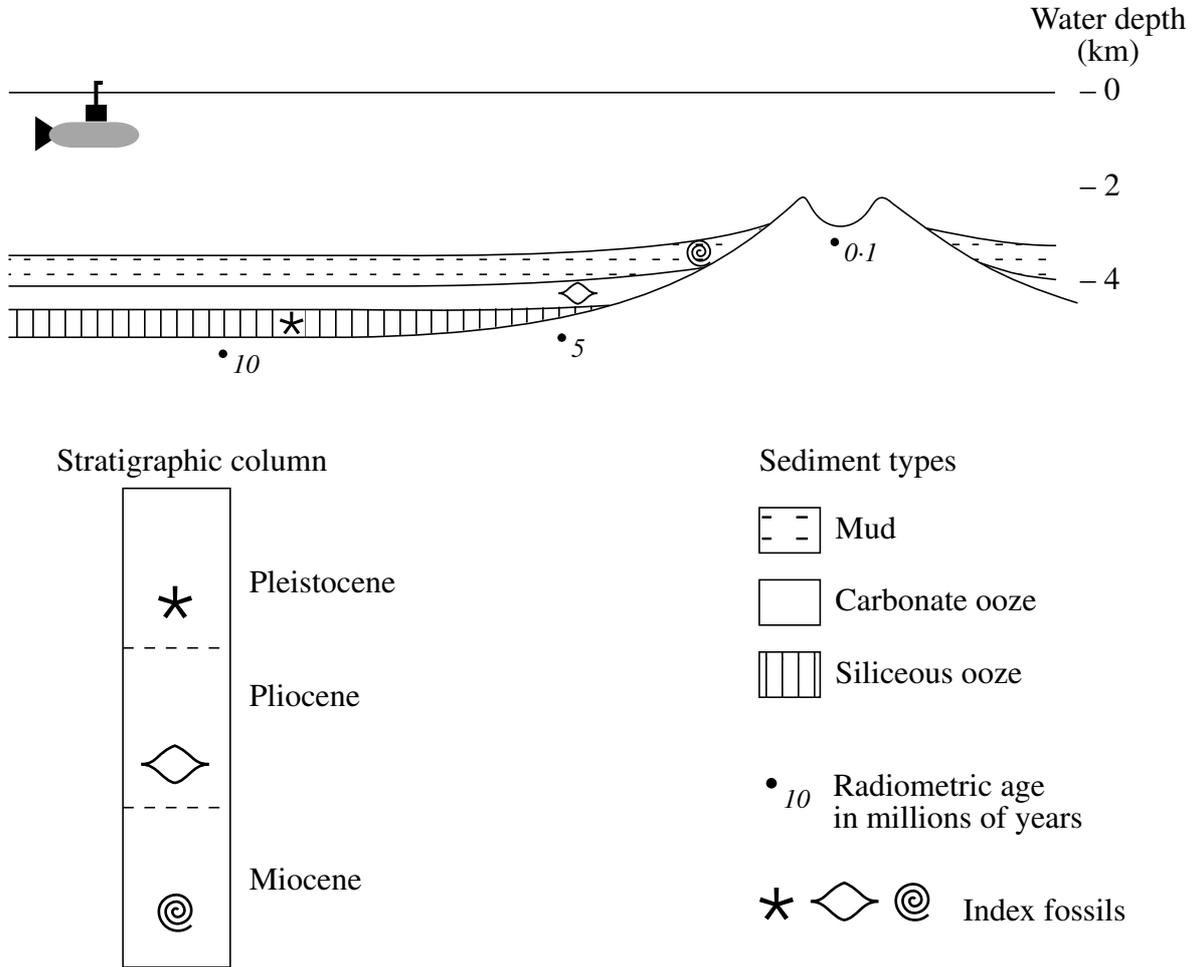
- 12 The Canadian Shield is dominated by intrusive and high-grade metamorphic rocks. The explanation for the formation of the Canadian Shield is
- (A) a period of intense deformation in the Precambrian, followed by a long period of uplift and erosion.
 - (B) uplift and block faulting in the Cretaceous, followed by granite intrusions in the Tertiary.
 - (C) recent volcanic activity along an island arc, followed by major erosion during the Cainozoic.
 - (D) emplacement of granite along a major fault during the Tertiary, followed by a period of stability.
- 13 The diagram shows a cross-section through the Pacific–Antarctic Rise in the southern Pacific Ocean.



The most likely cause of the topographic high below point X is

- (A) more sediment is present at X than at Y.
 - (B) the crust at X is much hotter than the crust at Y, which has contracted.
 - (C) the molten crust is more viscous at X, causing a mountain chain to form.
 - (D) granite intrusions are pushing up the crust beneath point X.
- 14 Maxwell Montes is an 11 kilometre high peak in the Ishtar Highlands on Venus. The Ishtar Highlands have been interpreted as a mountain chain that formed in a similar way to the Himalayas. The evidence that would convince you this theory is correct is that Maxwell Montes is
- (A) higher than Mount Everest.
 - (B) composed of andesitic and pyroclastic rocks.
 - (C) composed of deformed and metamorphosed sedimentary rocks.
 - (D) a volcanic plug composed of basalt.

- 15 A student copied a diagram showing a cross-section of a typical oceanic rise, the accepted stratigraphic column for the ocean floor around the rise, sediment types, and radiometric ages for the basalt below the sediment. Some information on the cross-section is incorrect.



Which information was *incorrectly copied* onto the cross-section?

- (A) The depth of the water
- (B) The fossil data
- (C) The radiometric ages
- (D) The sediment types

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PART B

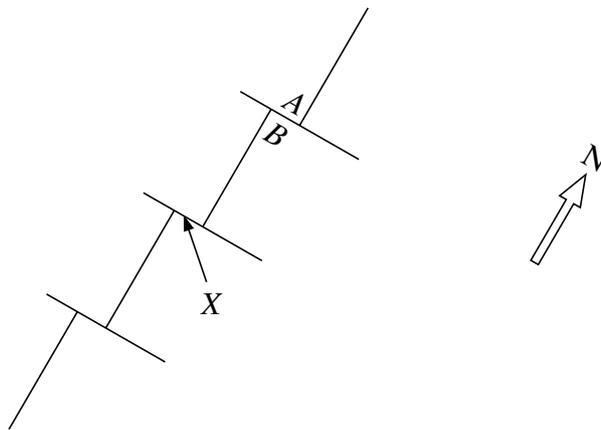
Questions 16–25 are worth 3 marks each.

Answer this Part in the Part B Answer Book.

- 16** Plate tectonics is thought to be responsible for the formation of large-scale features of the Earth's surface.

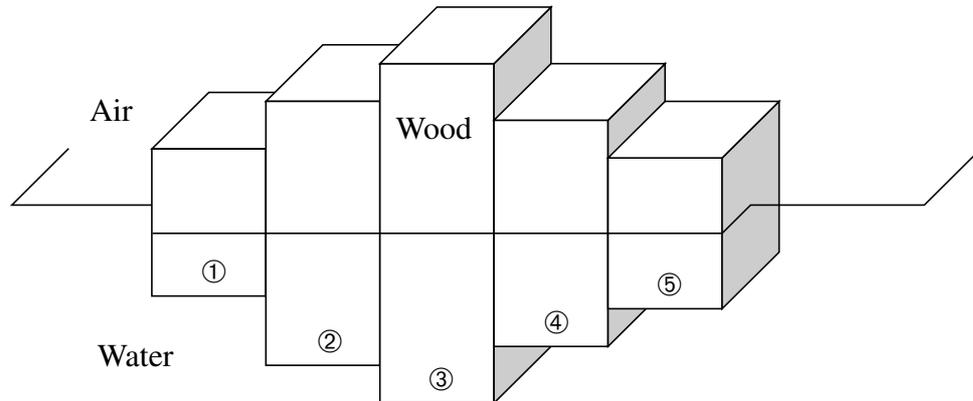
Name **THREE** large-scale geological features and briefly explain the role of plate tectonics in the formation of each one.

- 17** The diagram is a plan view of an ocean–ocean plate boundary.



- (a) (i) In which direction is point *A* moving?
(ii) In which direction is point *B* moving?
- (b) Name the feature indicated by *X* above.
- (c) The feature named in part (b) appears to be necessary for plate motion at this type of boundary. Briefly explain the role of this structure in plate motion.
- 18** A geologist has been employed to investigate two continents. It has been hypothesised that the two continents were once joined.
- (a) State **TWO** pieces of geological evidence the geologist could use to support this hypothesis.
- (b) Choose **ONE** of these pieces of evidence and describe in detail how it could support the hypothesis.
- (c) Palaeozoic sandstone beds have been found on both continents.
- (i) Explain how this observation would contribute to the geologist's investigation.
- (ii) State features of the sandstone that would support this hypothesis.

- 19 The model shows a set of blocks floating in water. This model is commonly used to illustrate isostasy.

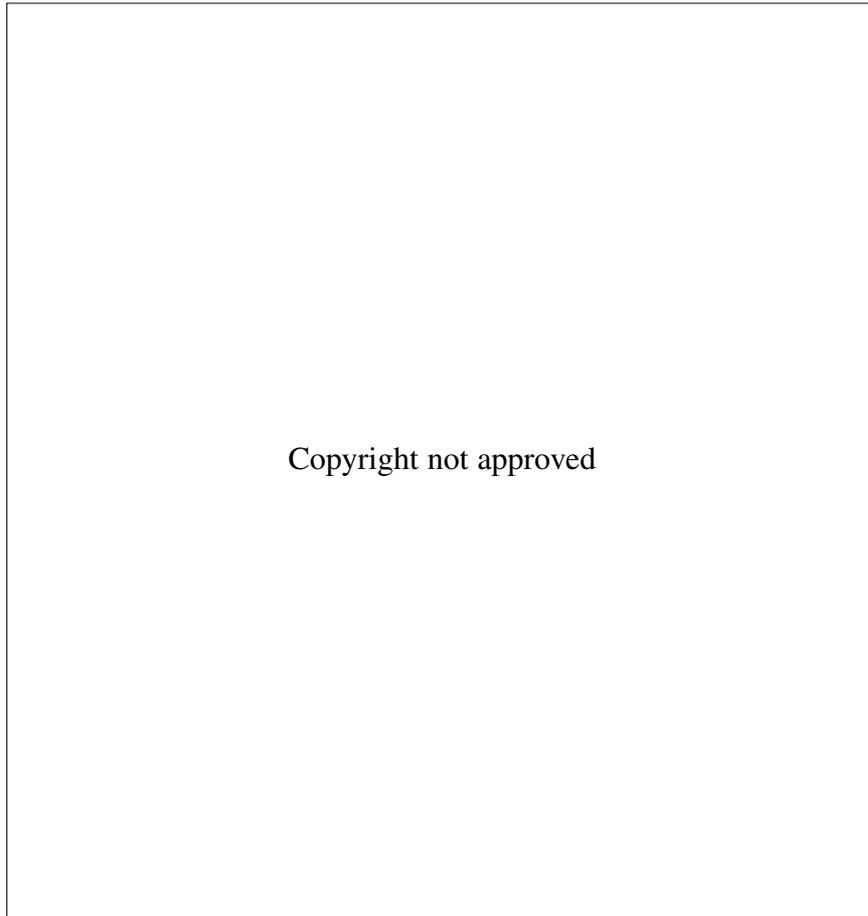


- (a) Is this a realistic model to illustrate isostasy? Briefly explain your answer.
- (b) The diagram in your Part B Answer Book shows only blocks ① and ②. The original location of blocks ③, ④ and ⑤ is shown by dotted lines.

If the continental mass represented by blocks ③ and ④ is eroded, and the sediment is deposited on block ⑤, complete the diagram to show this. Explain your answer.

Please turn over

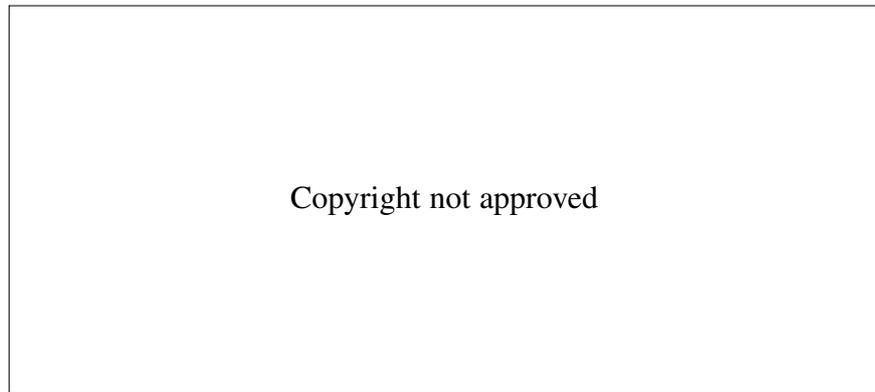
- 20** The graph shows estimates of the number of years various metal reserves will last.



- (a) Briefly describe TWO reasons why the estimates for various metals are different. Choose examples from the graph to illustrate your answer.
- (b) Briefly describe TWO ways by which the expected life of metal reserves can be extended.
- (c) Give ONE reason why the figures shown in the graph are only approximations.

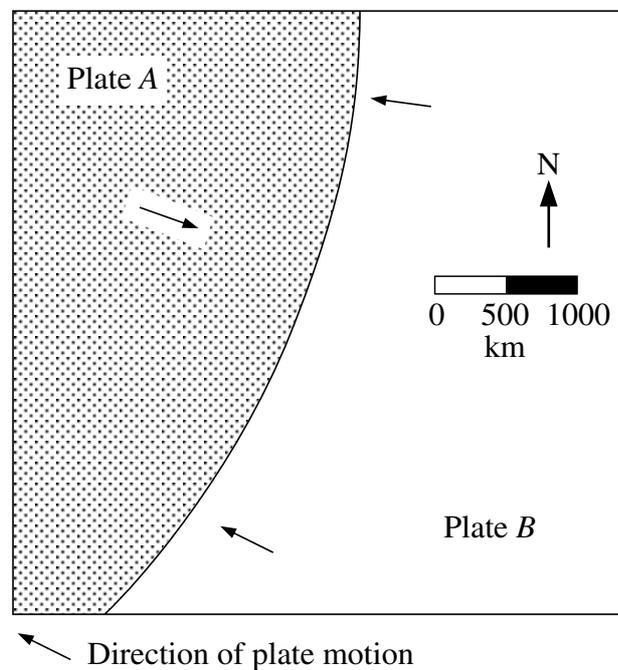
21 The diagram shows a sandstone in which oil is trapped.

- (a) State the properties of a *sandstone*, such as the one shown in the diagram, that would make it a useful reservoir rock for oil.
- (b) (i) Name ONE rock that might surround the reservoir.
- (ii) Explain why the top *sandstone* cannot be a reservoir rock for oil.



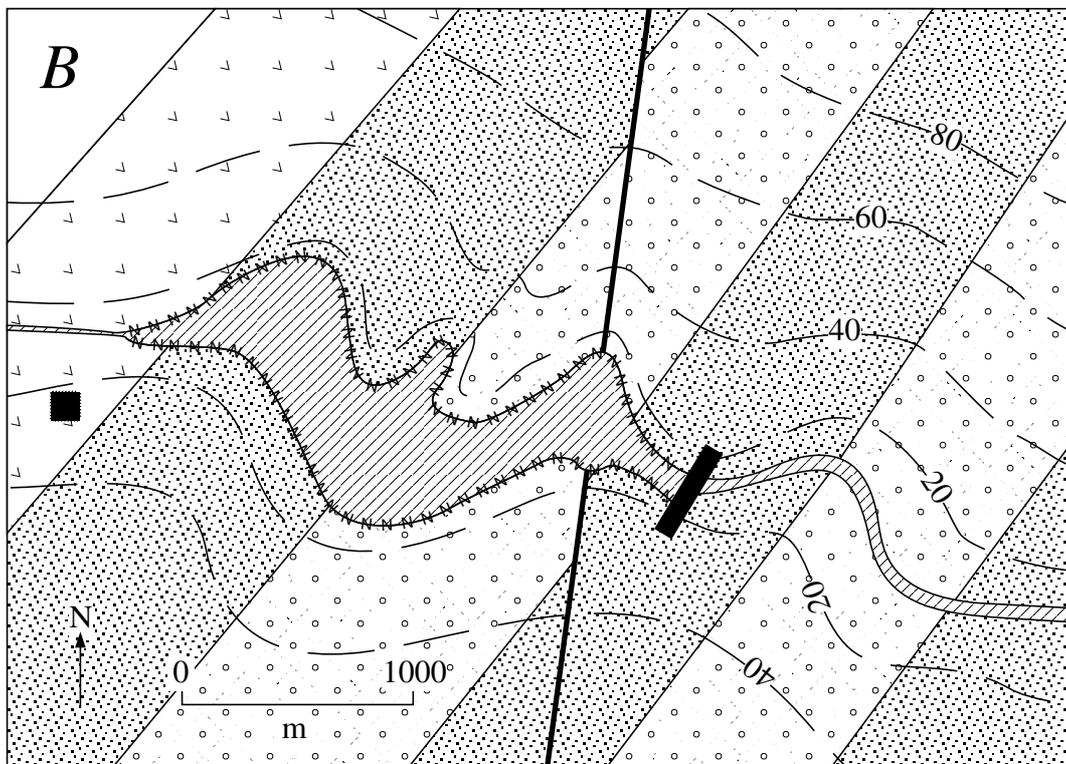
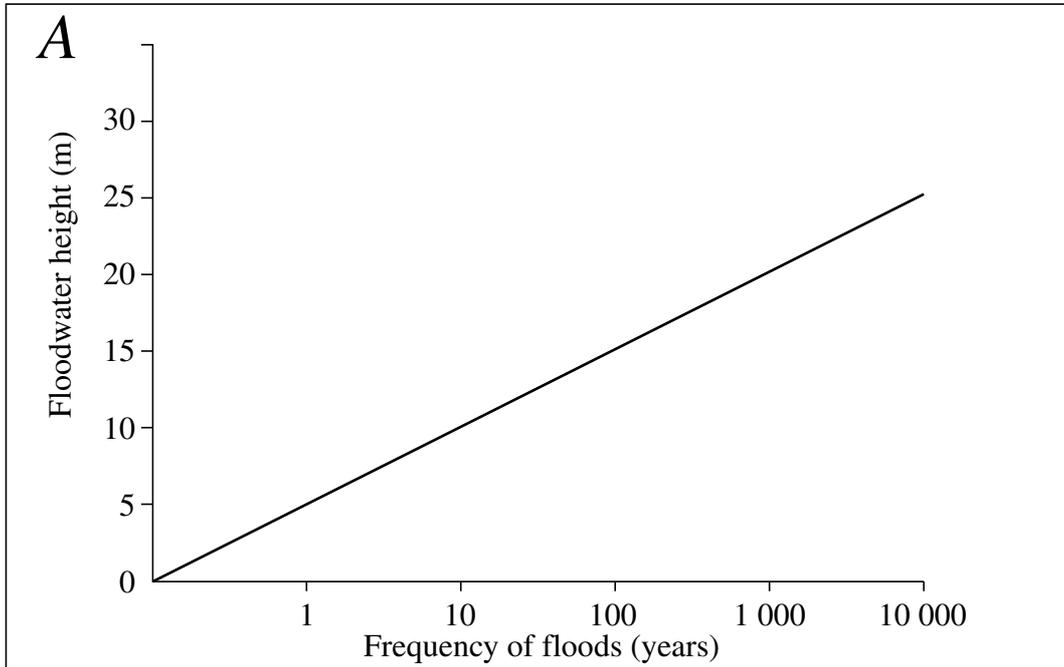
- (c) Briefly explain how this oil may have formed.

22 The diagram shows two plates, *A* and *B*. The upper crust of both Plate *A* and Plate *B* is composed of felsic igneous, metamorphic and sedimentary rocks.

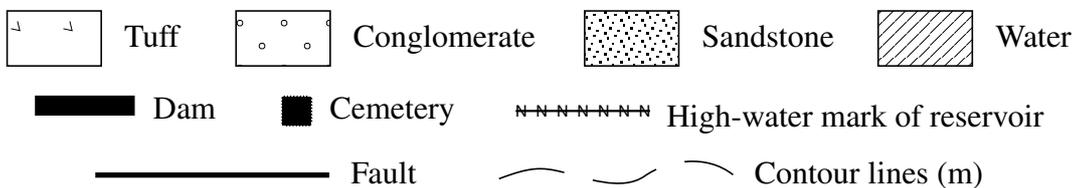


- (a) Name the type of plate boundary that separates Plate *A* from Plate *B*.
- (b) A mountain range is forming at the boundary between Plate *A* and Plate *B*. Describe the processes involved in the formation of the mountain range.

- 23 Graph A shows the height and frequency of floodwaters from the river shown on the geological map B. The map also shows the position of a major dam across the river and topographic contours for the area. The location of an old cemetery is shown by the square.



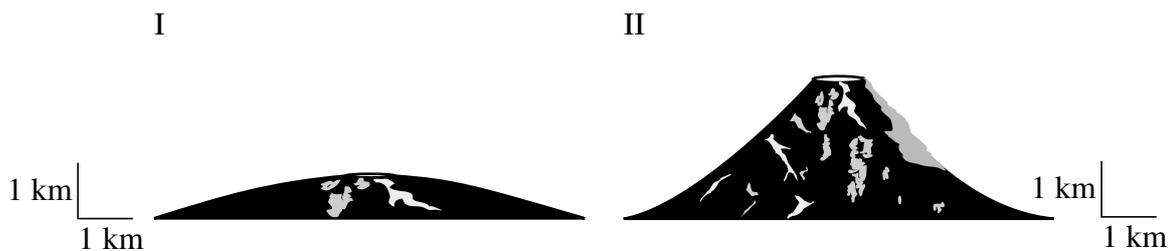
KEY



QUESTION 23 (Continued)

- (a) (i) How often do floodwaters reach a height of 20 metres?
- (ii) The river flooded in 1984 and the water reached a height of 15 metres. In what year would you expect that a flood of this magnitude might occur again?
- (b) Is the cemetery likely to be flooded by the water from a
- (i) one in 1000 year flood?
- (ii) one in 10 000 year flood?
- (c) Briefly describe ONE geological problem that could have been encountered if the dam had been constructed 500 m to the north-west of its present location.

24 Examine the two profiles and data given below.



VOLCANO I

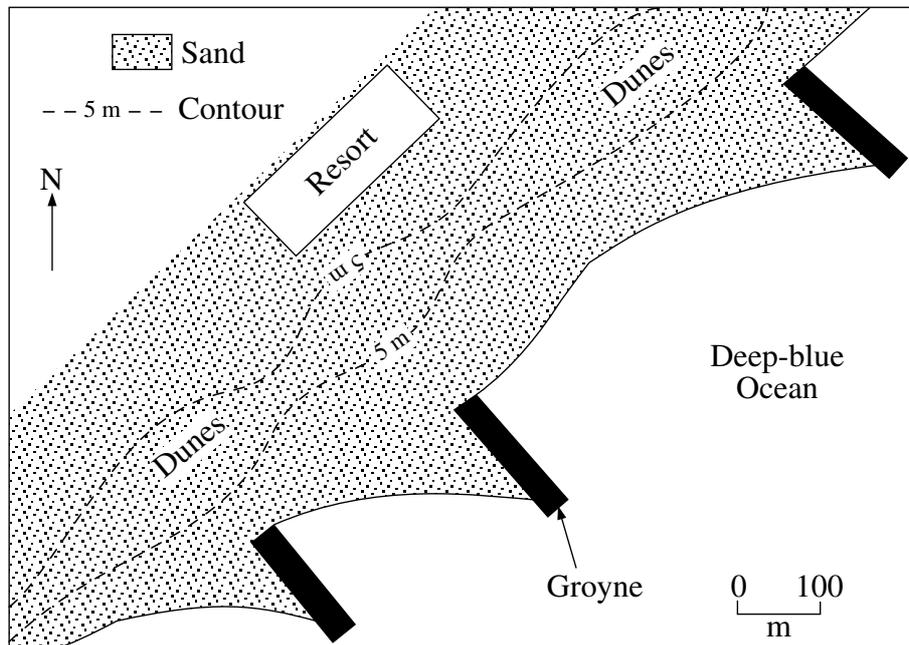
VOLCANO II

Eruptive style	Relatively quiet outpourings of highly mobile lava. Minor eruptions of ash or pyroclastic material.	Alternating slow-moving lava flows and explosive ash falls or pyroclastic flows. Rare catastrophic blast eruptions.
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Eruptive product	Lava 95% Pyroclastics Ash 5% Other 0%	Lava 50% Pyroclastics Ash 20% Other 30%
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- (a) Name the type of volcano shown in each diagram.
- (b) Name the rock(s) formed when the lava from each of the volcanoes cools.
- (c) Account for the difference in shape between Volcano I and Volcano II.

- 25 The diagram shows a section of coastline with dunes up to 10 m in height. Storms and winds strike the coastline from the south.



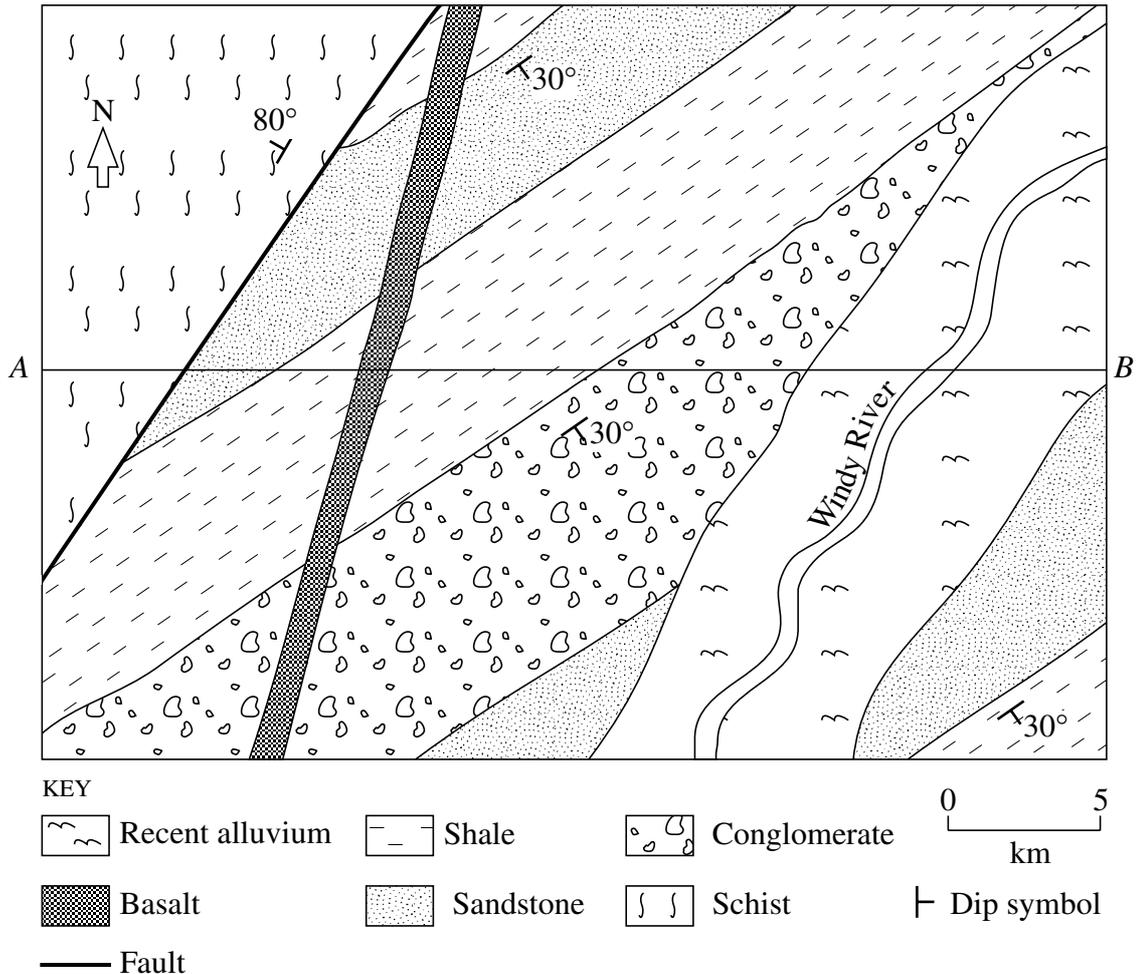
- On the diagram in your Part B Answer Book, draw an arrow to show the direction of sediment transport along the beachfront.
- Describe ONE geological problem that may have been encountered when constructing the resort.
- It is proposed to remove all the dunes for use as construction sand. Describe ONE geological problem that might be encountered by the resort after the sand has been removed.

PART C

Questions 26–31 are worth 5 marks each.

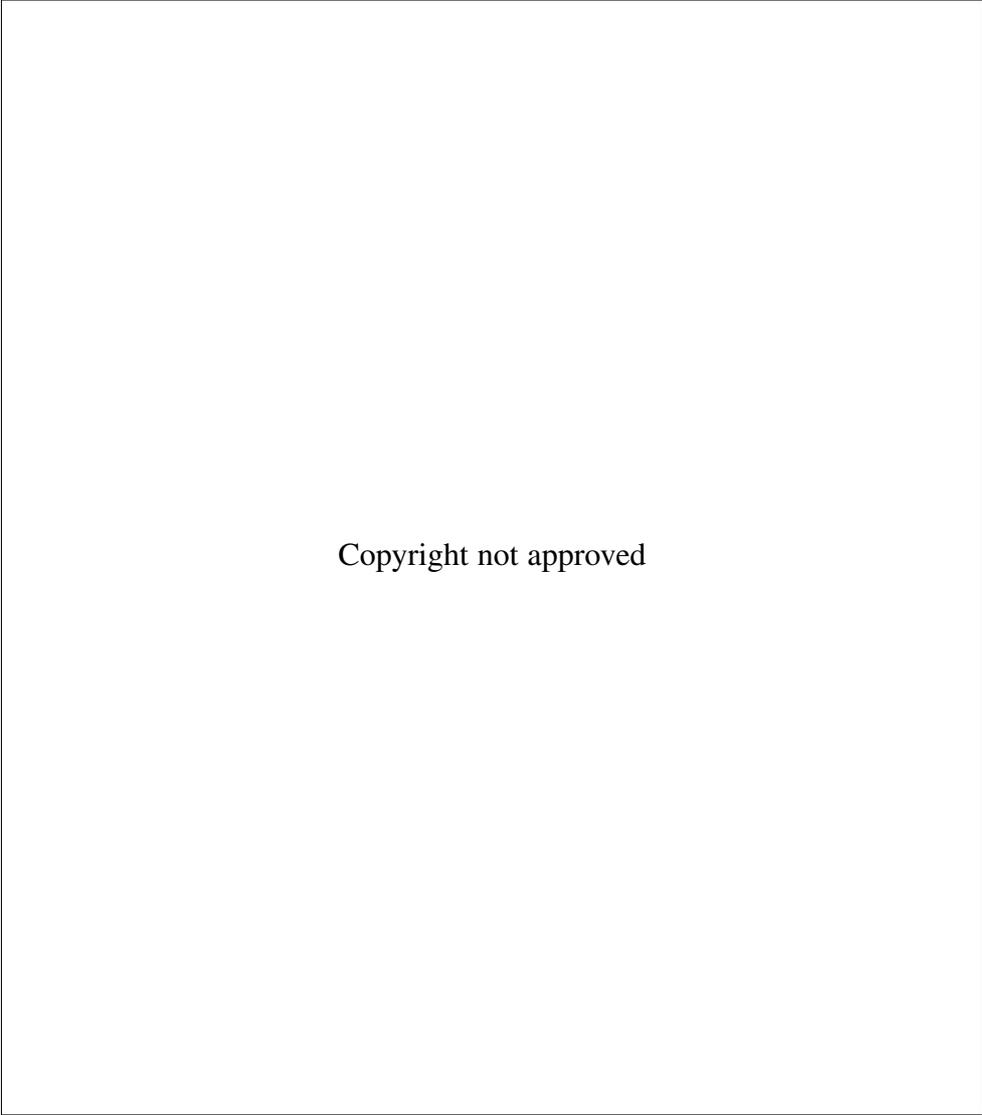
Answer this Part in the Part C Answer Book.

- 26 Imagine you are an engineering geologist employed by a major construction company. The company is building a large gas pipeline along the line A—B as shown on the geological map. The climate of the area is hot and wet. You will need to dig a trench 2 metres deep in which to bury the pipeline.



- (a) Choose ONE rock type shown on the map, other than the Recent alluvium.
- Name the rock type you have chosen.
 - Describe how the minerals in the rock might be affected by weathering.
 - Describe a possible geological problem the weathering may cause for the gas pipeline project.
- (b) Describe ONE geological problem that might be encountered when digging the trench in the Recent alluvium.
- (c) Describe ONE geological problem, other than those covered in parts (a) and (b), that may be encountered when digging the trench along the line A—B.

- 27** This question refers to the map below and the cross-sections on page 21. The location of each cross-section is shown on the map.
- (a) On the map in the Part C Answer Book, mark accurately the position of the trench, using the information given in the cross-sections $A-A'$, $B-B'$ and $C-C'$.
 - (b) In the Part C Answer Book, draw to scale a labelled geological cross-section to show the type of plate boundary along $A-A'$. Incorporate the information given on page 21.

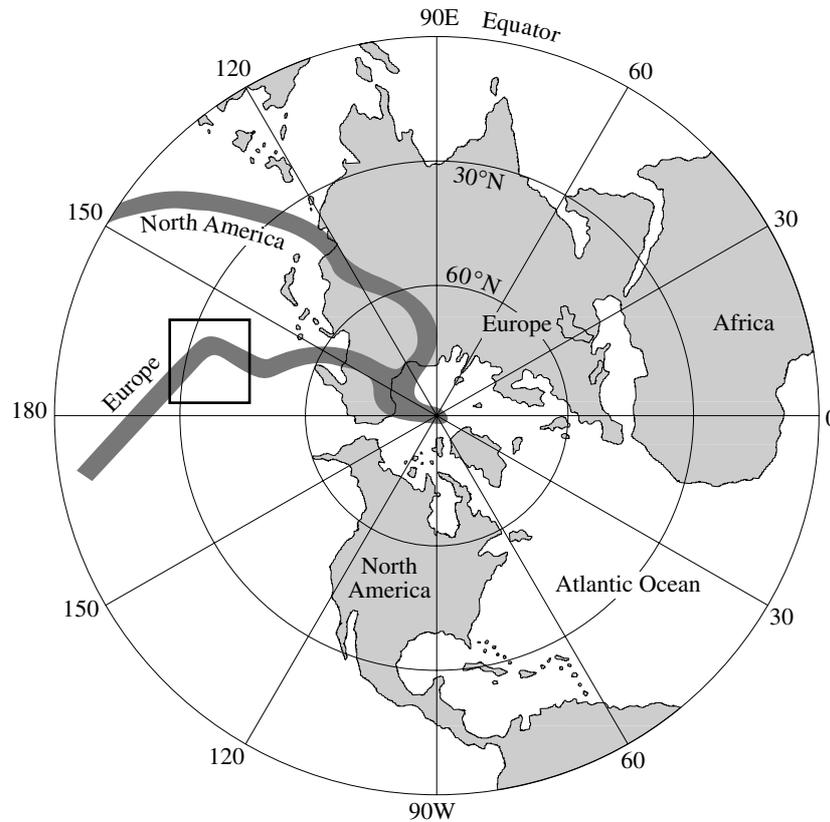


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QUESTION 27 (Continued)

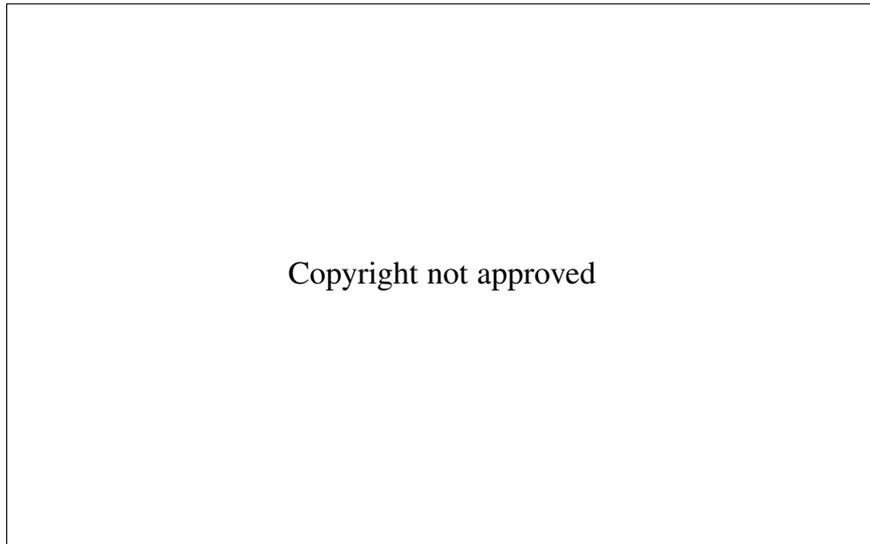
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- 28 The diagram shows apparent polar wandering curves for the North American and European Plates for the last 500 million years.



- (a) Briefly explain how magnetism is 'frozen' into rocks on continents.
- (b) What information does this magnetism provide for geologists constructing apparent polar wandering curves?
- (c) (i) Give an explanation for the shape of the polar wandering curve in the area shown by the box.
- (ii) Explain why the polar wandering curves shown above diverge.

29 The photograph shows a mountain in North America.

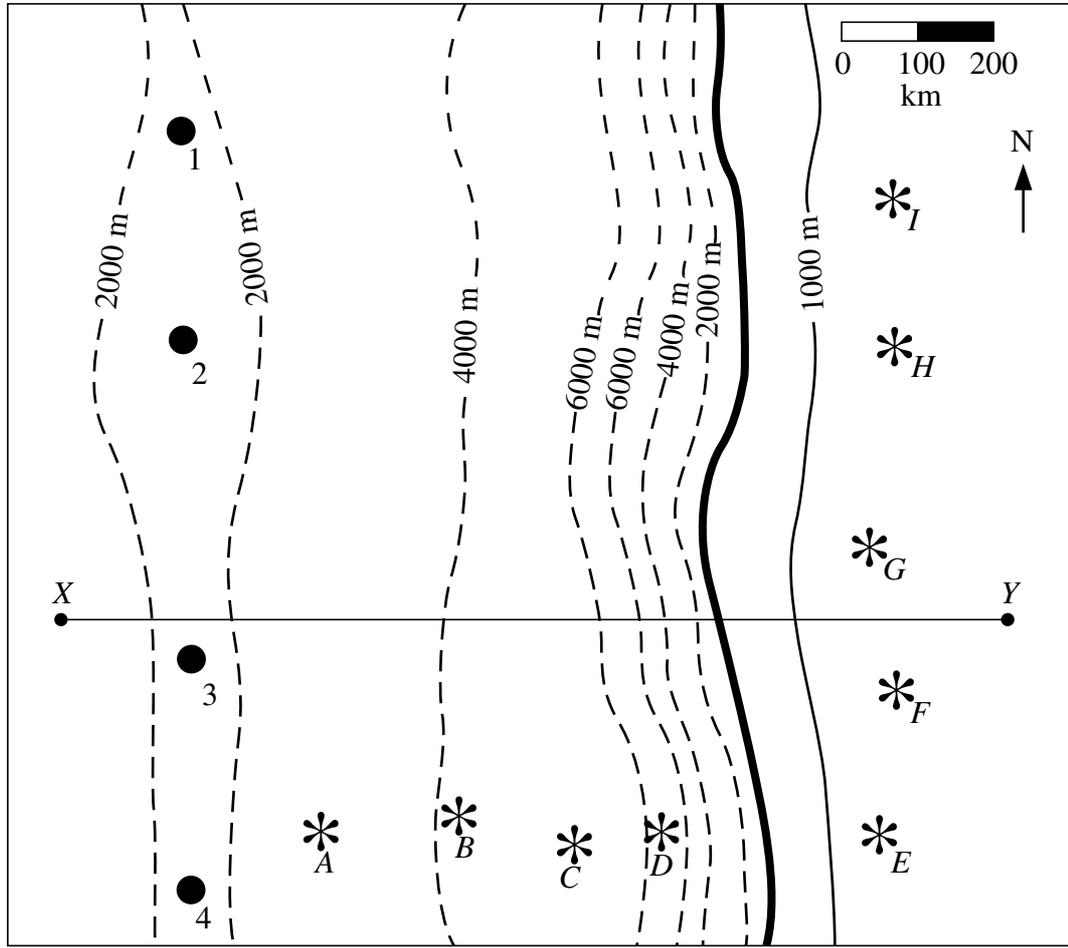


- (a) The structure shown in the photograph is typical of those found in a type of mountain range. Name:
- (i) this geological structure;
 - (ii) the type of mountain range in which it is found.
- (b) Name ONE rock type typically found in this type of mountain range. Justify your answer.
- (c) Draw a fully labelled diagram of another structure found in this type of mountain range.

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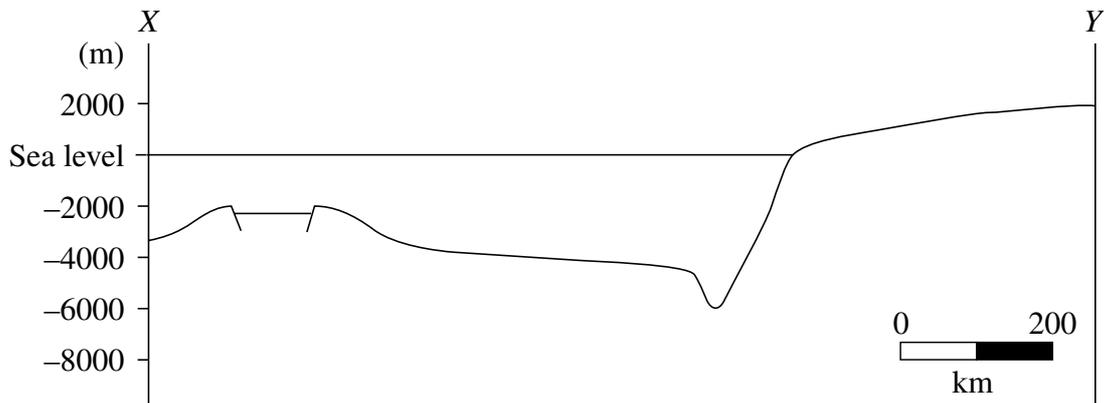
30 The contour map shows the location of dredge samples, volcanoes and the cross-section X—Y.

The table shows the age of volcanic rocks, in millions of years, collected from a number of sites shown on the map.



KEY

- 2000 m --- Bathymetric contour (depth below sea level)
- 1000 m — Topographic contour (height above sea level)
- Site of dredged volcanic rock
- * Volcano (active or extinct)
- ⎓ Coastline

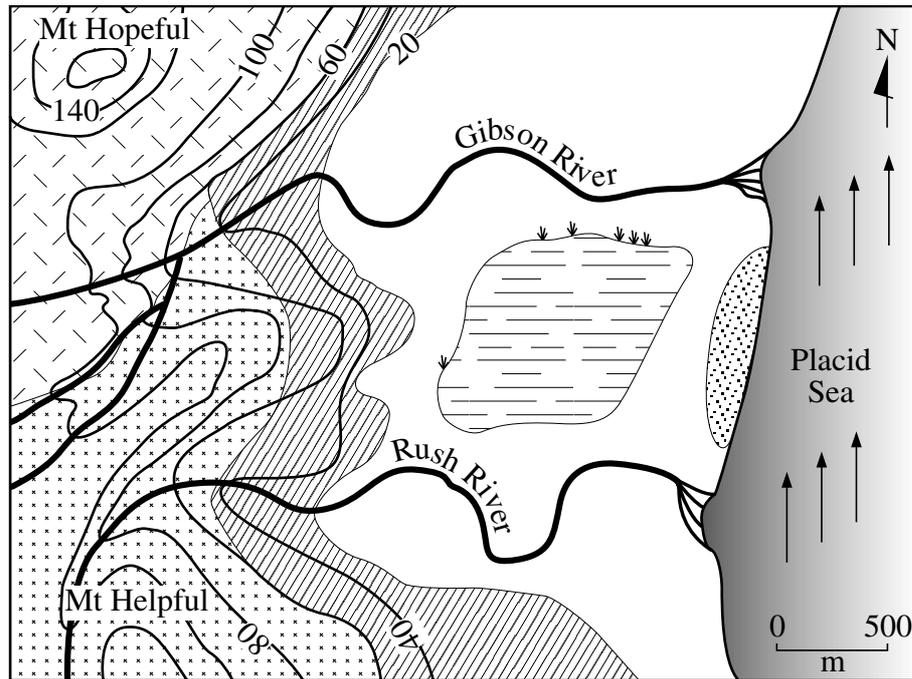


QUESTION 30 (Continued)

<i>Site</i>	● ₂	* _A	* _B	* _D	* _F	* _H
<i>Age of volcanic rock (million years)</i>	0.1	3	7	15	0.01	0.02

- (a) Name a volcanic rock type that you would expect to find at:
- site ●₂
 - site *_C
 - site *_H
- (b) Name the type of regional (larger scale) feature that occurs at:
- site ●₂
 - site *_C
 - site *_H
- (c) (i) What is the most likely age for a volcanic rock found at site *_E ?
- (ii) Justify your answer to part (c) (i).

- 31 The map shows the location of a beach placer platinum deposit in a coastal setting. The source of the platinum is usually within a layered mafic intrusion.



KEY

Contour interval = 20 m



Ocean currents



Lagoon



Placer deposit



Coastal plain sediments



Gabbro



Granite



Palaeozoic sedimentary rocks

- Describe ONE mechanism by which platinum could be concentrated in a layered mafic intrusion.
- On the copy of the map in the Part C Answer Book, place an X at a likely location of the source of the platinum.
- State TWO properties of placer minerals.
- Describe how these properties help in the concentration of the placer minerals.

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SECTION II—ELECTIVES

(25 Marks)

Attempt ONE question.

Answer the question in a SEPARATE Elective Answer Book.

	Pages
QUESTION 32 Contemporary Sedimentary Processes	29–31
QUESTION 33 Igneous Rocks	32–35
QUESTION 34 Economic Geology	37–40
QUESTION 35 Regional Geology	41–43
QUESTION 36 Palaeontology	44–49

QUESTION 32 Contemporary Sedimentary Processes**Marks**

- (a) While studying this elective, you produced a report on a sedimentary environment. **4**
- (i) Name the sedimentary environment.
 - (ii) Draw a fully labelled map showing the location of this environment. Make sure you include features such as:
 - townships
 - geographical features
 - watercourses
 - locations of the sites you investigated.
- (b) Sedimentary structures are produced as a result of a number of factors. **5**
- (i) Name a sedimentary structure you observed during your field investigation.
 - (ii) Draw a labelled cross-section of this sedimentary structure in your Elective Answer Book.
 - (iii) Describe the environment in which it was formed.
 - (iv) Explain the role that the energy of the transporting medium had in the formation of this structure.
- (c) Sediments provide information useful to geologists. With reference to the sedimentary environment that you studied: **6**
- (i) name **THREE** properties of the sediment that can provide useful information;
 - (ii) for **TWO** of these properties, describe the method you used to determine variation in the property;
 - (iii) for **ONE** of these properties, describe the information it provided about the environment;
 - (iv) describe how the source of the sediment was or could be determined.

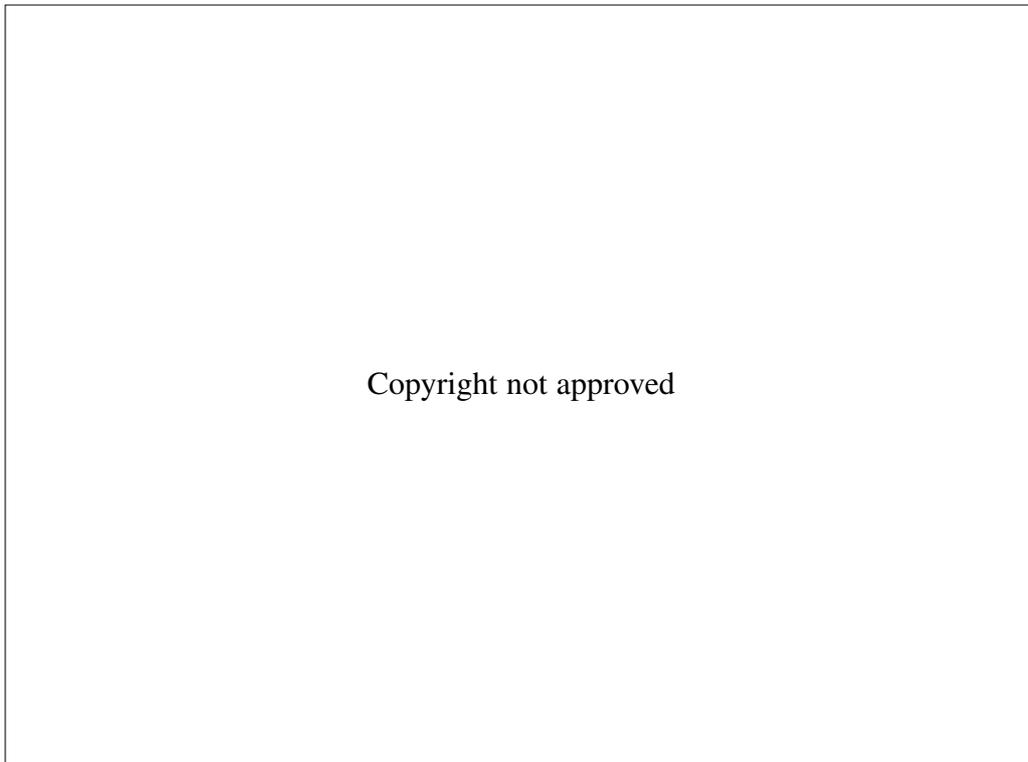
Question 32 continues on page 30

QUESTION 32 (Continued)

Marks

- (d) Examining sedimentary structures that are forming today is of great use to geologists who study ancient sedimentary environments. **5**
- (i) Draw a labelled diagram of a sedimentary structure, other than the one you described in part (b) (ii), that occurs in an ancient sedimentary environment you studied.
 - (ii) Describe **THREE** pieces of information that this structure gives you about the ancient environment in which it was formed.
 - (iii) For one of the pieces of information in part (d) (ii), compare and contrast the properties of the ancient structure with those of a similar structure you studied in a modern environment.
- (e) A fan delta is an alluvial fan of sediment that has been derived from a highland and is transported by water and deposited into an adjacent standing body of water such as a lake or sea. **5**

Graph 1 shows the relationship between grain size and distance from the source for a fan, with three sections through the fan at the locations shown by the arrows.

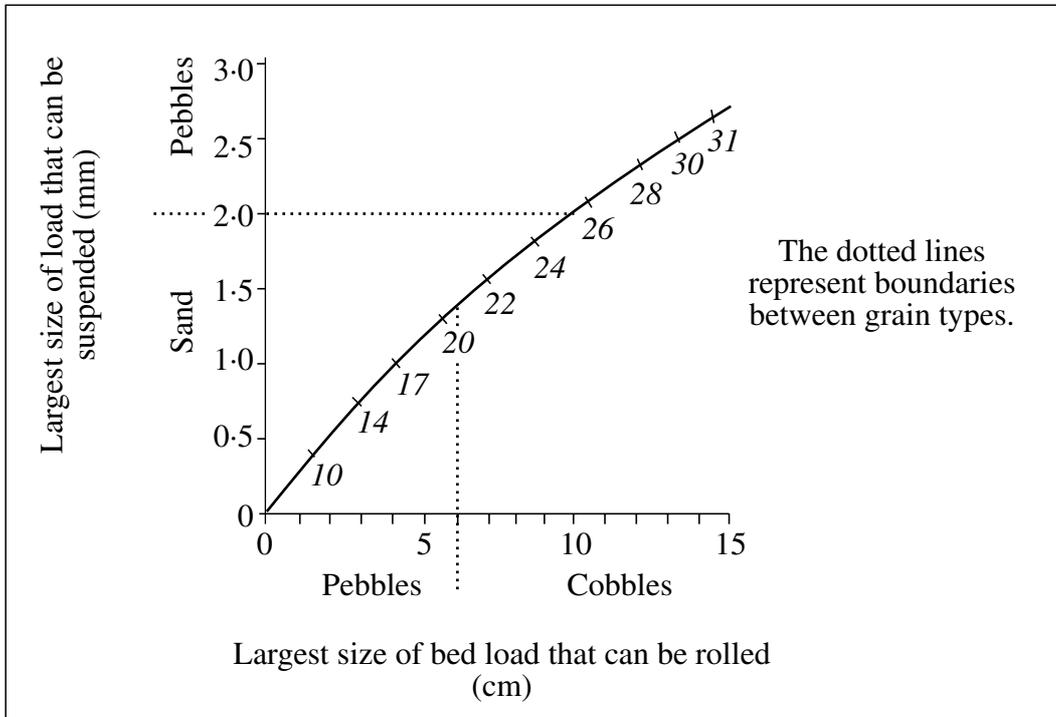


Question 32 continues on page 31

QUESTION 32 (Continued)

Marks

Graph 2 shows the relationship between the size of bed load that can be rolled along the bottom of a channel, and the size of load that can be suspended. The numbers in italics immediately below the curve in Graph 2 show the velocity, in cm/s, of the water carrying the sediment.



GRAPH 2

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- (i) What happens to the grain size of the suspended load if the
 - 1 velocity decreases?
 - 2 gradient of the fan increases?
- (ii)
 - 1 What is the grain size of the suspended load when the maximum rolling-bed load is 12 cm?
 - 2 What velocity is needed to transport a maximum rolling-bed load of 12 cm?
- (iii) What is the maximum size of gravel deposited in the mid fan at the location shown by the arrow on Graph 1?
- (iv) Account for the differences in the grain sizes in the section shown for the lower fan.

End of question

QUESTION 33 Igneous Rocks**Marks**

(a) The table shows chemical analyses for three igneous rocks.

7

<i>Oxides</i>	<i>Rock (wt %)</i>		
	<i>A</i>	<i>B</i>	<i>C</i>
SiO ₂	60.86	72.08	50.78
TiO ₂	1.50	0.37	1.13
Al ₂ O ₃	15.40	13.86	15.68
Fe ₂ O ₃	2.73	0.86	2.26
FeO	4.97	1.67	7.41
MnO	0.18	0.06	0.18
MgO	3.12	0.52	8.35
CaO	5.40	1.33	10.85
Na ₂ O	3.36	3.08	2.14
K ₂ O	1.33	5.46	0.56
H ₂ O	0.80	0.53	0.48
P ₂ O ₅	0.35	0.18	0.18

*ORE DEPOSITS
by Park and
MacDiarmid ©
1964, 1970, 1975
by W H Freeman
and Company*

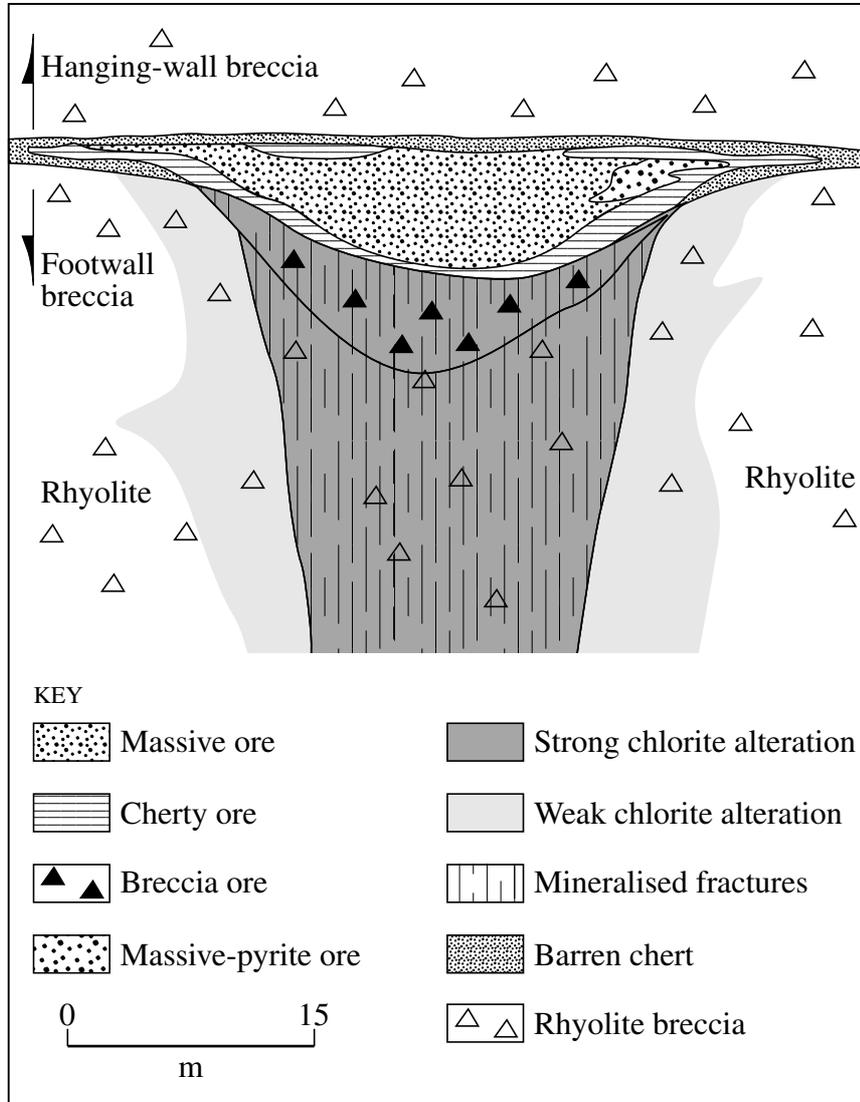
- (i) Select the chemical analysis (*A*, *B* or *C*) that represents a mafic rock and write the corresponding letter.
- (ii) Give **THREE** reasons why this is an analysis of a mafic rock.
- (iii) If this rock was formed at a mid-ocean ridge, describe the source of the magma and the mode of the magma formation.
- (iv) Name **ONE** other tectonic setting in which mafic rocks are the dominant composition erupted.
- (v) Name **ONE** extrusive and **ONE** intrusive mafic rock.
- (vi) Name **TWO** minerals found in **ALL** mafic rocks.

Question 33 continues on page 33

QUESTION 33 (Continued)

Marks

- (b) The diagram shows a section through an ore body formed in association with felsic and intermediate submarine volcanic rocks. The extensive zones of alteration shown in the diagram are typical of this ore type. 7



- (i) Name TWO minerals you would expect to find in the unaltered rhyolite.
- (ii) Describe TWO textures likely to be found in the rhyolite.
- (iii) Briefly describe the plate tectonic setting in which the ore types shown in the diagram are most likely to occur.
- (iv) Briefly outline how the ore body shown in the diagram could have formed. Account for the alteration in your answer.
- (v) Name THREE metals you would expect to find in economic quantities in this type of ore body.

QUESTION 33 (Continued)

Marks

- (c) Andesite is a rock found in abundance in the Pacific *Ring of Fire*. 4
- (i) In your Elective Answer Book, draw a circle with an approximate diameter of seven centimetres. Assume that this circle represents the view through a microscope. Draw a diagram of the andesite, showing TWO essential minerals, plagioclase and hornblende. For each mineral, show TWO diagnostic features, including crystal shape. Indicate the texture of the rock on your diagram.
- (ii) Draw a fully-labelled diagram to show the structure of a typical andesitic volcano. Include a scale in your diagram.

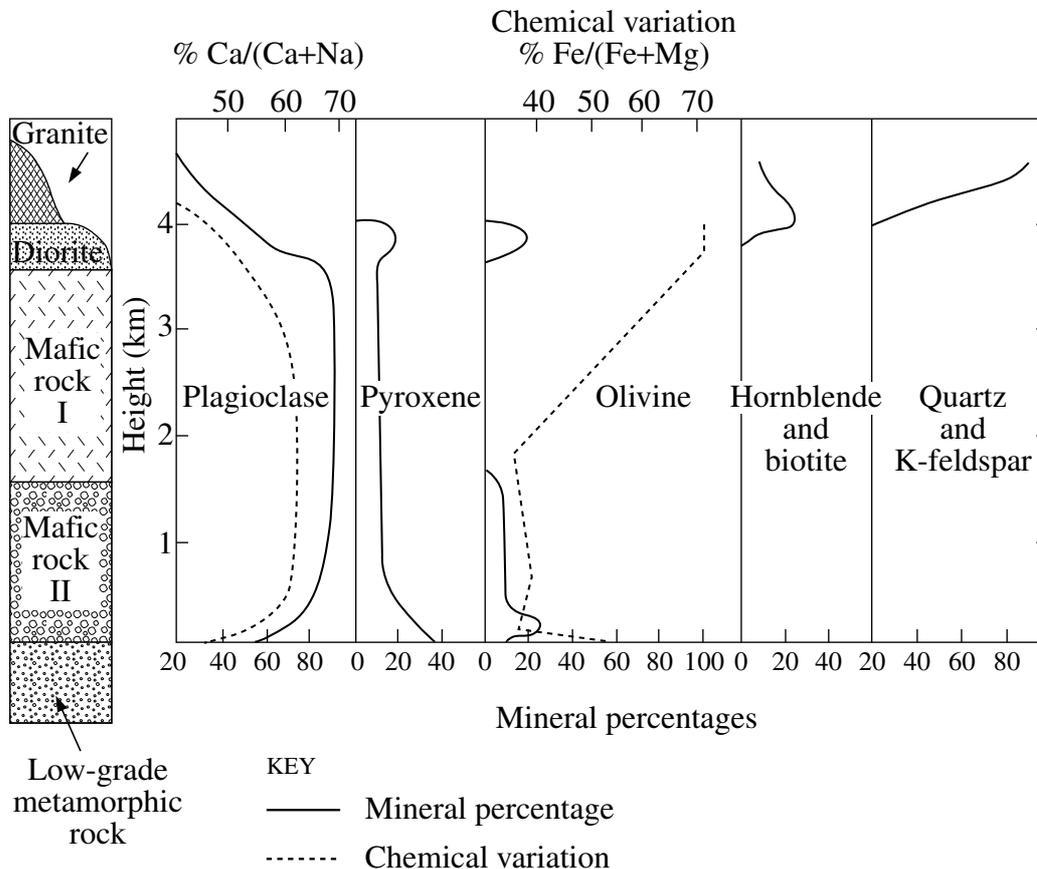
Question 33 continues on page 35

QUESTION 33 (Continued)

Marks

- (d) The diagram shows a layered intrusion in low-grade metamorphic rocks, the percentage of seven minerals in the rocks, and the chemical variation in two of these minerals. The intrusion has been eroded.

7



PETROLOGY: IGNEOUS, SEDIMENTARY, AND METAMORPHIC by Ehlers and Blatt© 1982 by W H Freeman and Company.

- Name the minerals found only in the granite.
 - Describe the mechanism that controls the percentage of these minerals in the granite.
- Explain why the curves for the percentage of plagioclase and the percentage of Ca/(Ca+Na) content of the plagioclase are a similar shape.
- Describe how the percentage of olivine and Fe/(Fe+Mg) content of olivine changes from the base to the top of the section.
- Describe the texture and mode of formation of the rock type that you would normally expect to find in the intrusion at the lower contact.
- Using information from the graph, name the rock described in part (d) (iv) above.

End of question

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QUESTION 34 Economic Geology**Marks**

In this elective you will 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.

(a) For an economic deposit you have studied, answer the following questions. **6**

- (i) Name the economic deposit.
- (ii) Name ONE metal or material that is, or could be, obtained from the deposit.
- (iii) Briefly describe how the metal or material was concentrated.
- (iv) Briefly describe how the metal or material is, or could be, extracted.
- (v) 1 What is ONE use of the metal or material?
2 What properties of the metal or material influence this use?
- (vi) Briefly describe how the geology of the economic deposit has influenced or could have influenced, the grade of the ore or the quality of the material.

(b) For EITHER a second economic deposit OR an engineering project you have studied: **7**

- (i) Name the economic deposit or engineering project.
- (ii) During the exploitation of a mineral deposit, or the setting up and operation of an engineering project, there is usually an impact on the local area and economy.

Using FOUR different examples, discuss the impact, EITHER now OR in the future, of developing the project or deposit on:

- 1 the area adjacent to the deposit or project;
 - 2 the nearest town or population centre;
 - 3 the availability of money to the local economy;
 - 4 local plant and animal life.
- (iii) For EITHER the economic deposit OR the engineering project you studied, briefly describe the local geology.
 - (iv) Briefly discuss how the geology of the local area has influenced, or could influence, mine development or construction of the project.

QUESTION 34 (Continued)

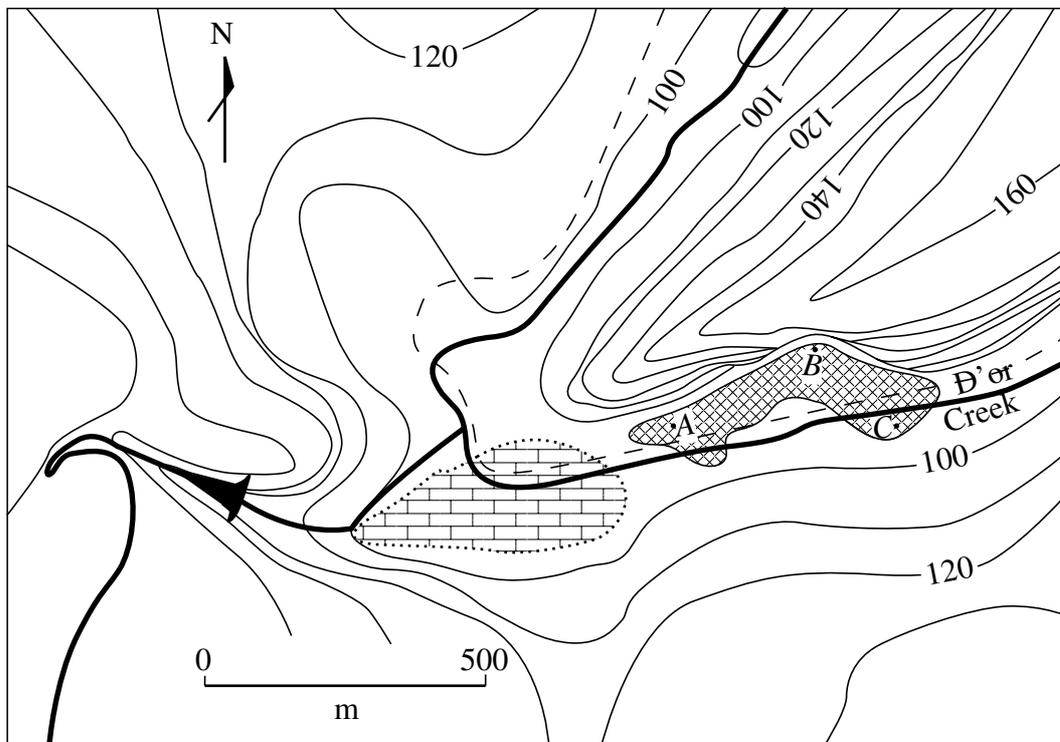
Marks

(v) If new reserves for the economic deposit are sought, or an extension to the engineering project is required, briefly describe:

- 1 ONE method you would use to obtain geological data about the area;
- 2 the type of data the method would provide;
- 3 how you would interpret the data.

(c) A radiometric survey of the area covered by the map below led to the discovery of a metalliferous deposit. Three holes were drilled in the deposit. The results of the drilling are shown in the table on page 37.

7



KEY

Contour interval = 10 m

— River or stream

- - - Railway

Town water supply

• A Drill hole

Golden Valley township

Inferred ore body

Question 34 continues on page 39

QUESTION 34 (Continued)

Marks

<i>Hole</i>	<i>Depth to top of ore body (m)</i>	<i>Thickness of ore body (m)</i>	<i>Gold (ppm)</i>	<i>Silver (g/tonne)</i>
<i>A</i>	25	38	8	10
<i>B</i>	38	45	3	8
<i>C</i>	25	75	1	18

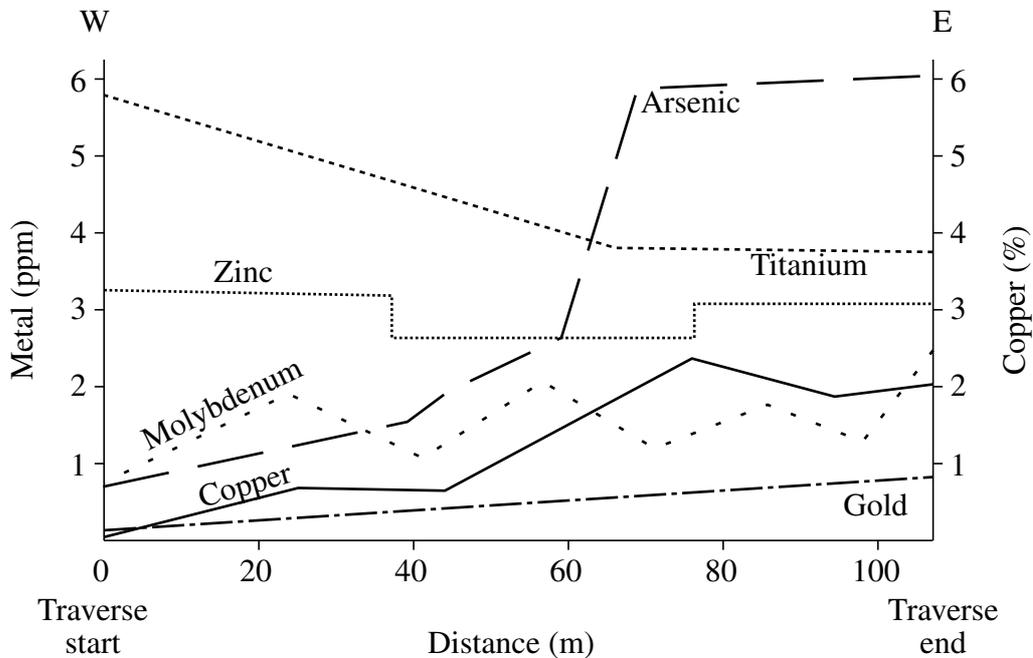
- (i) Based on the data shown on the map, and the data in the table, classify the reserves as inferred, indicated or proved. Explain your answer.
- (ii) Describe ONE method you would use to determine the actual size of the ore body.
- (iii) If a decision to mine is made, would you recommend underground or surface mining? Justify your answer.
- (iv) If mining takes place, briefly describe ONE environmental problem that may be encountered.

Question 34 continues on page 40

QUESTION 34 (Continued)

Marks

- (d) The diagram shows the abundance of six metals along a west to east traverse. The traverse goes from basaltic country rock to an ore body that contains mineable grades of copper and gold. The concentration of copper is shown as a percentage and all other elements are in parts per million (ppm). 5



- (i) At current world prices the cut-off grade for the ore body is 1.5% copper. Determine the distance from the start of the traverse to the boundary of the mineable ore of this ore body.
- (ii) What is the concentration of gold at the boundary identified in part (i)?
- (iii) Name the element that shows a significant change in concentration at the boundary of the ore body.
- (iv) If the world price of copper doubles, will the amount of mineable ore in this deposit change? Explain your answer.

End of question

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 studied.

- (a) Draw a labelled sketch map of an appropriate size that shows the location and name of each of the items in parts (i) to (v) below that occurs either within or adjoining your study region. **4**

You will be required to answer further questions (parts (b) to (f) below) about each of the items (i) to (v) that you choose to indicate on your map. Choose these items carefully as you cannot use the same item twice.

The items you should show are:

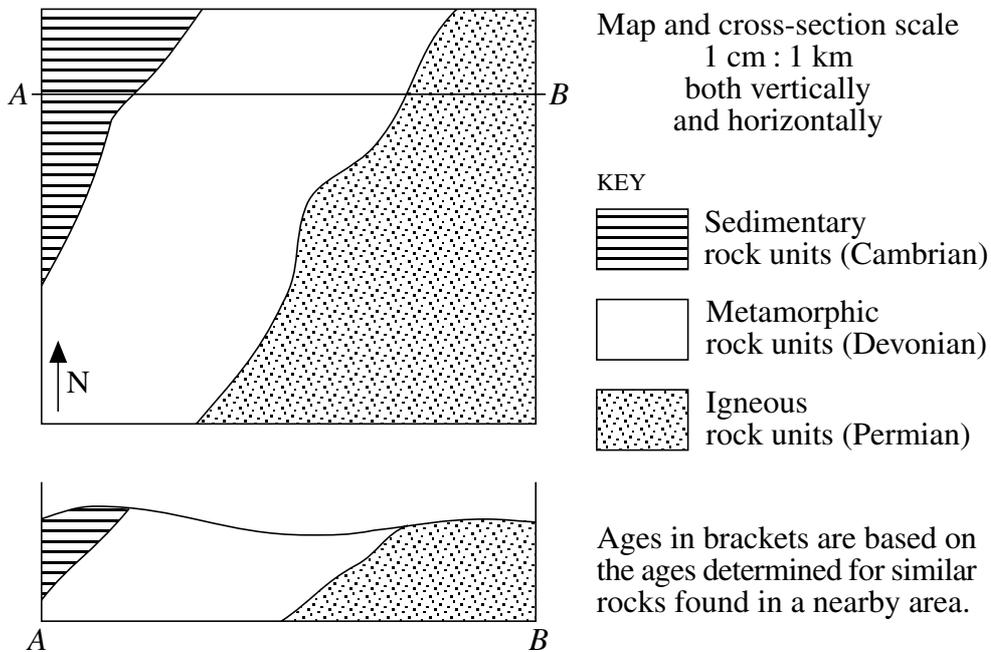
- (i) one major structural feature;
 - (ii) one mineral deposit or one economically useful geologic material;
 - (iii) a single feature of special geological interest such as a spectacular scenic site; or a large-scale civil engineering site; or a palaeontological or archaeological site; or artesian system, etc;
 - (iv) one igneous rock unit;
 - (v) one adjoining geological area.
- (b) For the structural feature you indicated on the map in part (a) (i), briefly describe the type of feature, how the feature formed, and when the feature is thought to have formed. **3**
- (c) Explain why the mineral deposit or economically useful geologic material you indicated in part (a) (ii) is exploited. Indicate the importance of that mineral deposit or geologic material to the local or regional economy. **3**

Question 35 continues on page 42

QUESTION 35 (Continued)

Marks

- (d) Describe the feature of special geological interest you indicated in part (a) (iii). Describe why it is special, important or interesting. **3**
- (e) Name and describe a common rock type in the igneous rock unit you indicated in part (a) (iv). Briefly describe and illustrate with a series of sketches how the igneous rock body formed. **4**
- (f) Describe and discuss the geological relationship of the region you studied to the adjoining area that you drew for part (a) (v) of this question. **3**
- (g) Examine the map and cross-section below. They are the preliminary findings of a geological survey covering a previously unmapped portion of Antarctica. **5**



The nature of the geological contacts between the three rock units given on the map and cross-section have not yet been determined.

Question 35 continues on page 43

QUESTION 35 (Continued)

Marks

- (i) Examine the contact between the metamorphic rock units and the igneous rock units.
- 1 Name or briefly explain TWO possible types of geological boundaries for the contact between the metamorphic rock units and the igneous rock units.
 - 2 Briefly explain how you would determine which of the two suggested boundaries is correct.
- (ii) Suggest a suitable method that might be used to confirm or disprove the suggested ages for the:
- 1 sedimentary rock units;
 - 2 igneous rock units.

End of question

QUESTION 36 Palaeontology**Marks**

- (a) As trilobites evolved, there was a progressive decrease in the number of thoracic segments, with a corresponding increase in the size of the pygidium. The extremities of the head shield also became less spiny and more blunt and rounded. **6**

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- (i) Use this statement to put each of the trilobites illustrated in order from oldest to youngest. Label the oldest trilobite.
- (ii) Using ONE of the morphological changes described above, suggest how such a morphological change may have helped the trilobites to survive in their environment.
- (iii) Briefly describe ONE morphological change in the trilobites not described above.
- (b) Some people are sceptical about evolution because there are missing links, that is, a lack of fossils of intermediate forms. Others say we should be amazed at the number of fossils of intermediate form that have been found. Explain why missing links occur. **3**
- (c) Most biologists define species in terms of the geographic possibility of breeding and a common gene pool. These data are usually unavailable to palaeontologists. **3**
- (i) Briefly describe how palaeontologists recognise that two organisms belong to the same species.
- (ii) Comment on the reliability of palaeontological methods for defining species.

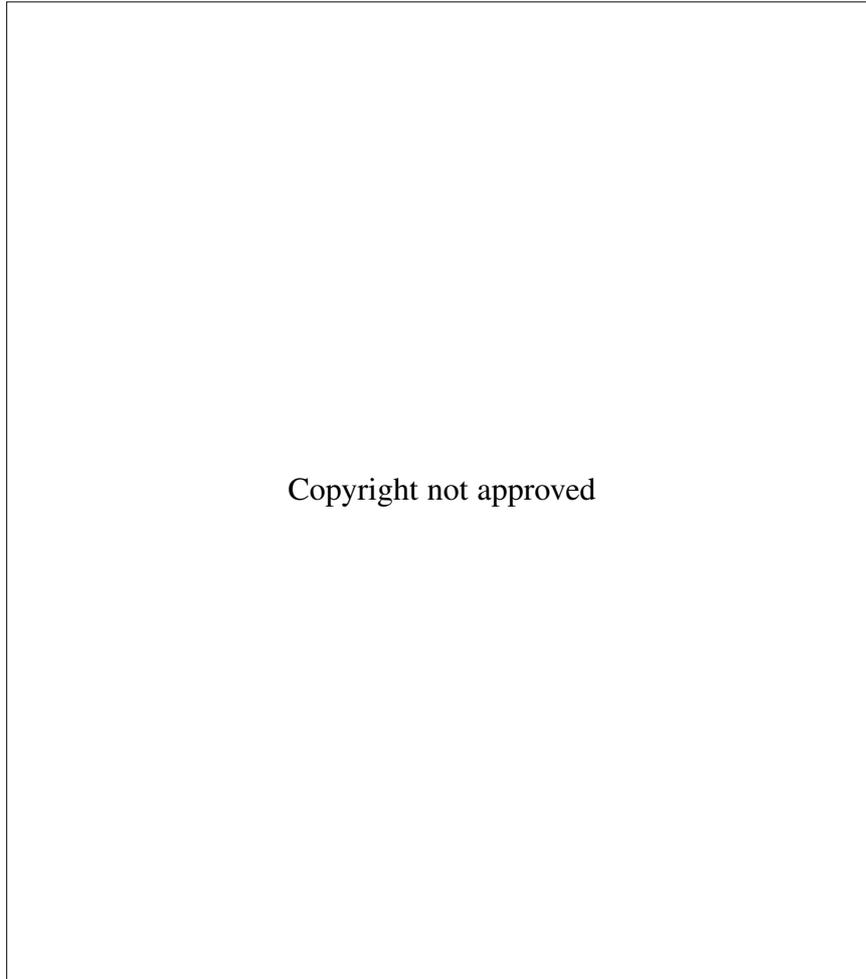
Question 36 continues on page 45

QUESTION 36 (Continued)

Marks

- (d) The graph shows the abundance of ammonite genera from the Devonian period to the Cretaceous period.

4



- (i) State what happened to the number of ammonite genera in the last third of the Triassic.
- (ii) Suggest ONE possible cause for these changes.
- (iii) Ammonites were free-swimming animals found in most oceans of the world. One problem free-swimming organisms have is maintaining buoyancy as the body grows. Using a diagram, show how the ammonites overcame this problem.

Question 36 continues on page 46

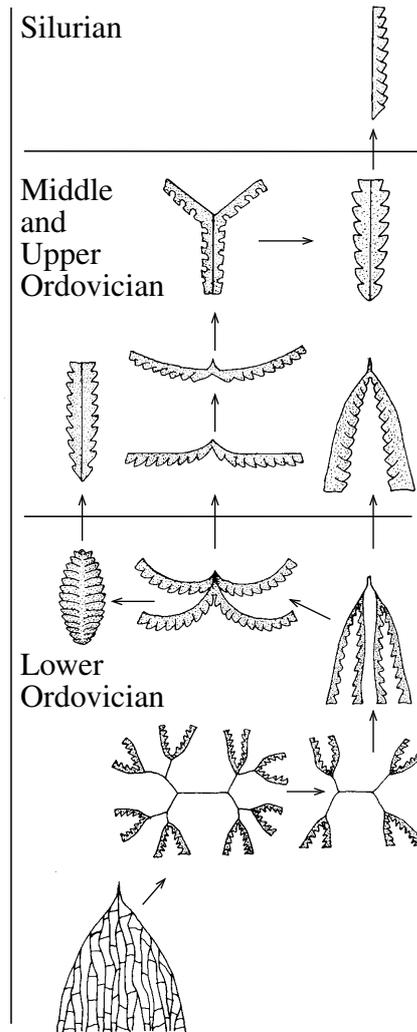
QUESTION 36 (Continued)

Marks

(e) The diagram shows graptolites from different geological ages.

4

- (i) Suggest the environment in which graptolites most probably lived. Give ONE piece of evidence (palaeontological or otherwise) to support your suggestion.



- (ii) Using information from the diagram, describe TWO trends in the structure of graptolites through geological time.
- (iii) Suggest ONE possible change in the environment that may have caused one of the trends illustrated.

Question 36 continues on page 47

QUESTION 36 (Continued)

Marks

(f) Answer EITHER (i) OR (ii) OR (iii).

5

EITHER

- (i) The drawings show members of a group of microscopic organisms commonly used in oil exploration.

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- 1 Name this group of organisms.
- 2 Describe the characteristics of this group of organisms that make it useful in correlation.
- 3 Describe how this group of organisms is used in oil exploration, other than for correlation.

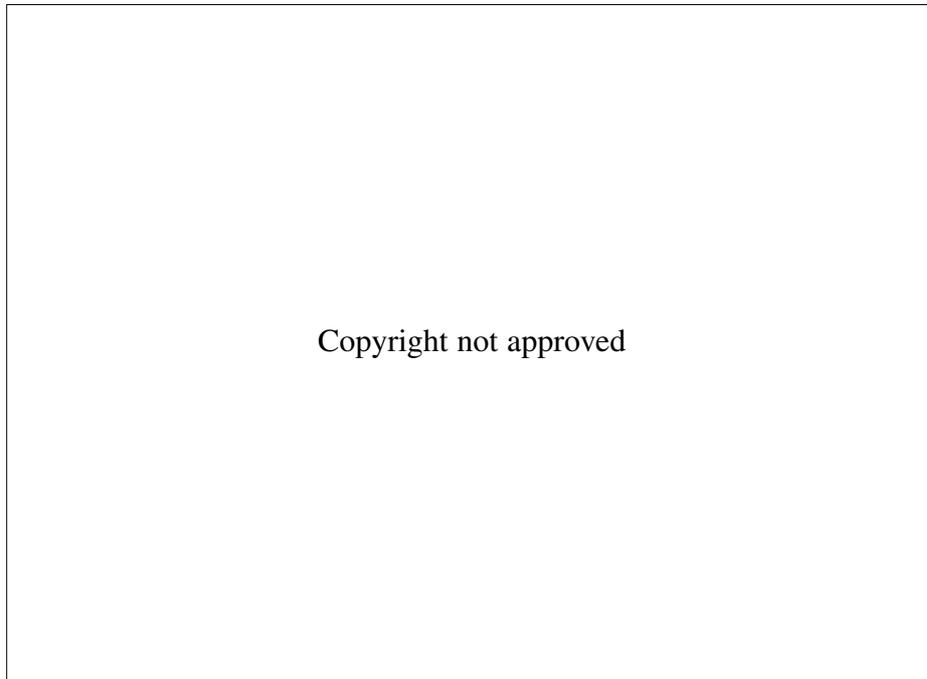
OR

Question 36 continues on page 48

QUESTION 36 (Continued)

Marks

- (ii) The drawing is a reconstruction of life in a Triassic swamp.



- 1 Briefly describe TWO problems facing geologists trying to produce a reconstruction such as this.
- 2 Briefly describe evidence, other than fossil evidence, that geologists might use to interpret past environments.
- 3 State the assumptions that must be made when reconstructing past environments using only our understanding of present-day environments.

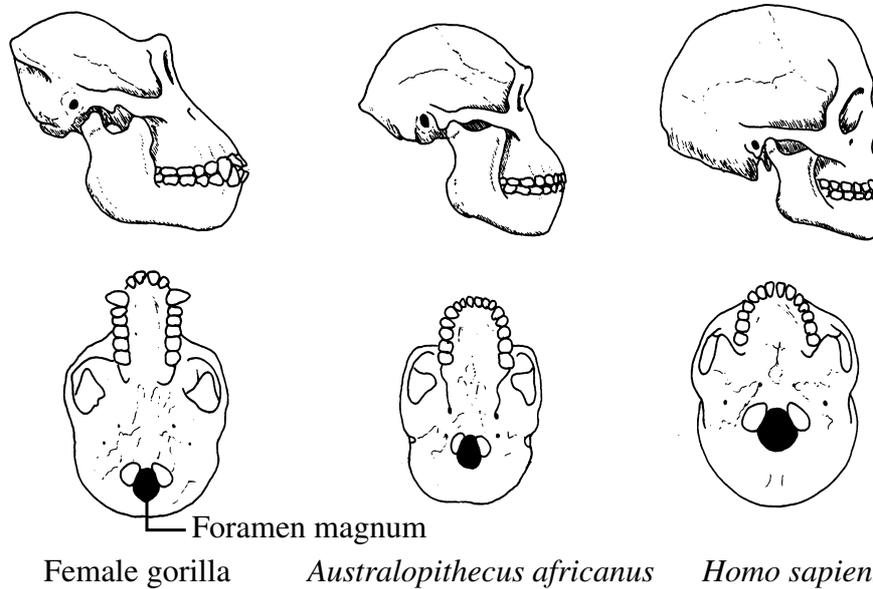
OR

Question 36 continues on page 49

QUESTION 36 (Continued)

Marks

- (iii) The diagram shows a comparison between the skulls of a female gorilla, *Australopithecus africanus* (a possible ancestor to humans), and *Homo sapiens* (a present day human).



Hanson, M, Apes and Ancestors, Longman Paul Ltd, Auckland, 1991

- 1 List THREE characteristics shown in the diagram that suggest that *Homo sapiens* is more closely related to *Australopithecus africanus* than it is to the female gorilla.
- 2 List TWO characteristics shown in the diagram that suggest that *Australopithecus africanus* is more closely related to the female gorilla than it is to *Homo sapiens*.
- 3 Briefly describe how palaeontological principles can be used in the study of ONE of the following types of archaeological remains of Aboriginal Australians: stone tools, cave art or burial sites.

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