



HIGHER SCHOOL CERTIFICATE EXAMINATION

1997
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.
Mark your answers 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 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.

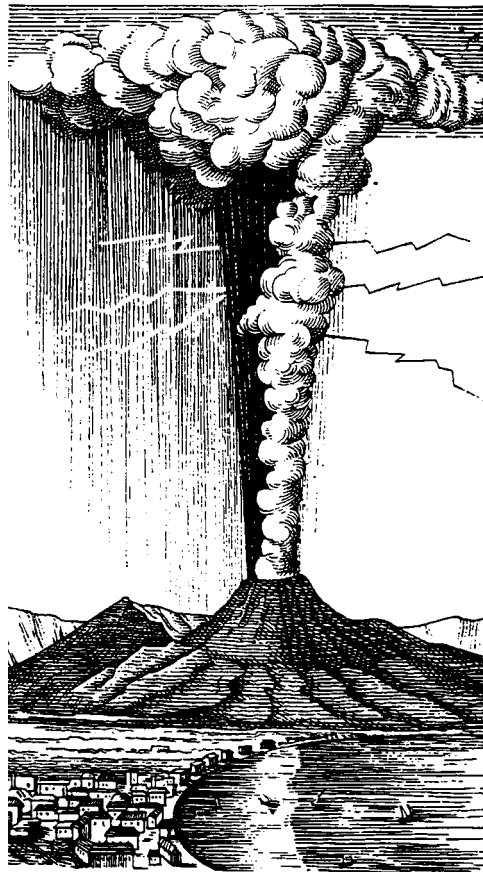
PART A

Questions 1–15 are worth 1 mark each.

Mark your answers in pencil on the Answer Sheet provided.

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

1. The diagram below is a drawing of an eruption that occurred in 1822. The eruption produced lava and substantial amounts of ash.

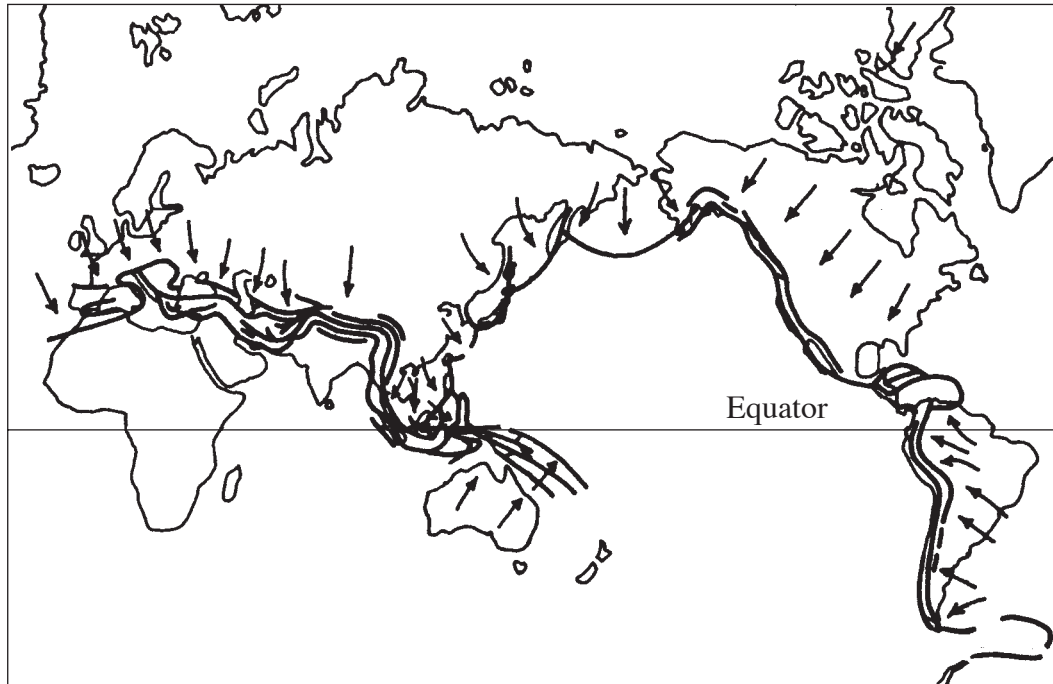


'The World of Geology', R Lauterbach, Regent Books 1984, p16.

The style of eruption described and illustrated above is characteristic of a

- (A) composite volcano at a divergent plate boundary.
- (B) composite volcano at a convergent plate boundary.
- (C) shield volcano at a hot spot.
- (D) shield volcano at a collision zone.

2. The map below shows some Tertiary mountain ranges. The arrows show the general direction of plate movement.



KEY



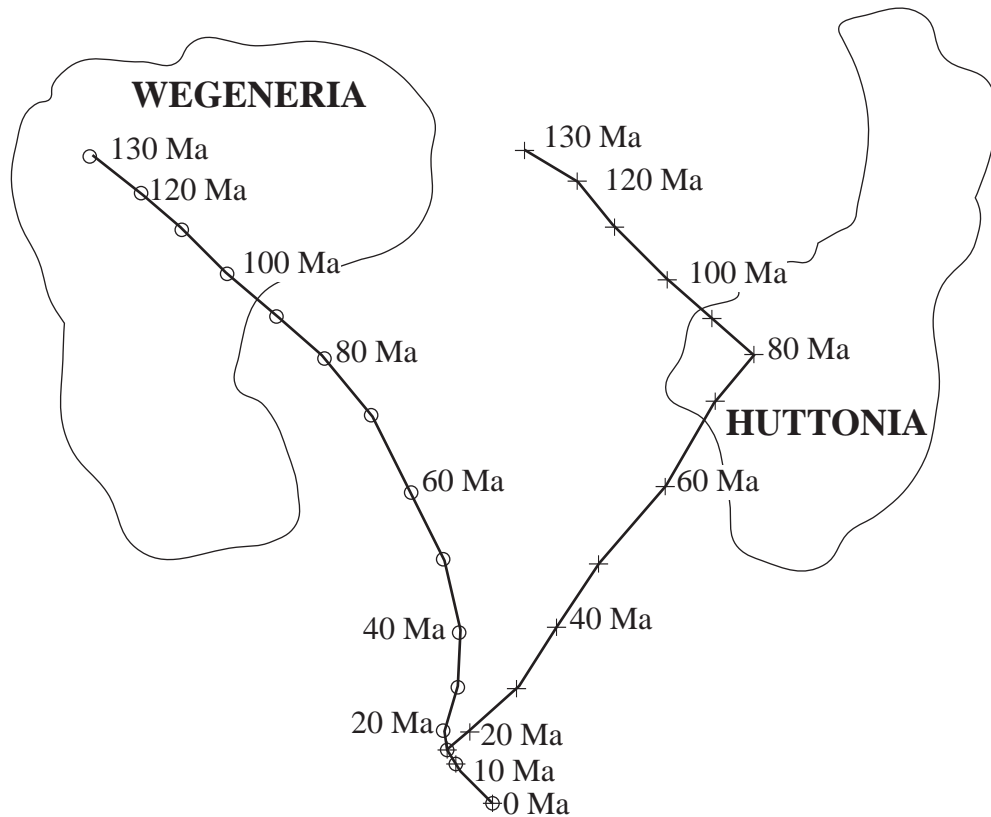
Tertiary mountain range

'Debate about the earth', H Takeuchi et al, Freeman Cooper & Co 1970 p62 fig 2.4.

The most common type of volcano associated with the mountain ranges shown on the map would be a

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

3. The diagram below shows apparent polar wandering curves for two imaginary continents, Wegeneria and Huttonia.



KEY

- 40 Ma + Apparent pole position relative to Wegeneria at the time (in millions of years before present)
- 40 Ma ○ Apparent pole position relative to Huttonia at the time (in millions of years before present)

Apparent polar wandering curves are evidence

- (A) that the poles change position over geological time.
 (B) of magnetic anomalies in basalt.
 (C) that the Earth's magnetic field has frequently reversed.
 (D) of continental movement.

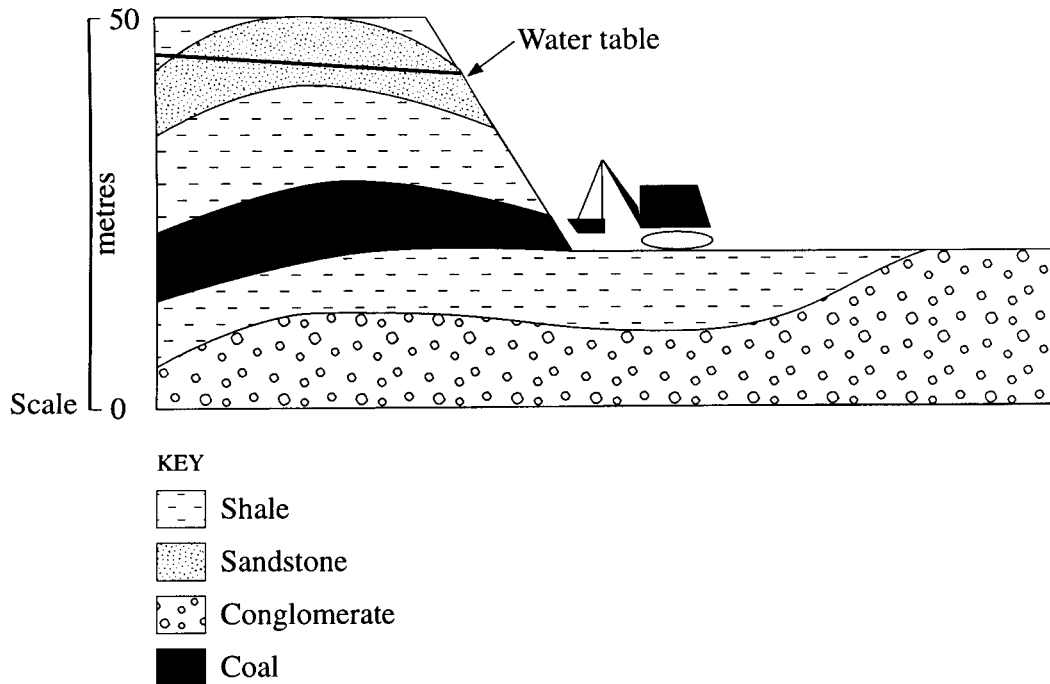
4. The photograph below shows part of a mountain range.

**DUE TO COPYRIGHT RESTRICTIONS THIS
IMAGE COULD NOT BE REPRODUCED.**

This photograph was most likely taken in a

- (A) range of block mountains.
- (B) region characterised by normal faulting and basaltic volcanism.
- (C) range of fold mountains.
- (D) tectonically active shield area.

5. Examine the cross-section of the open-cut coal mine below.



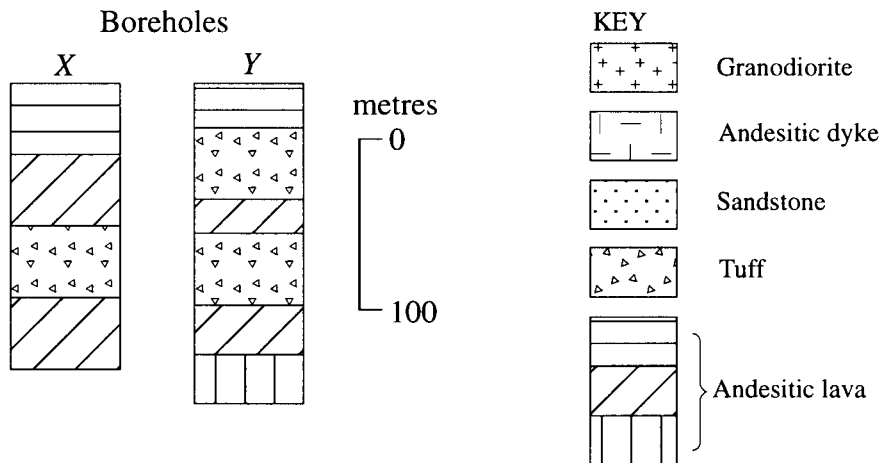
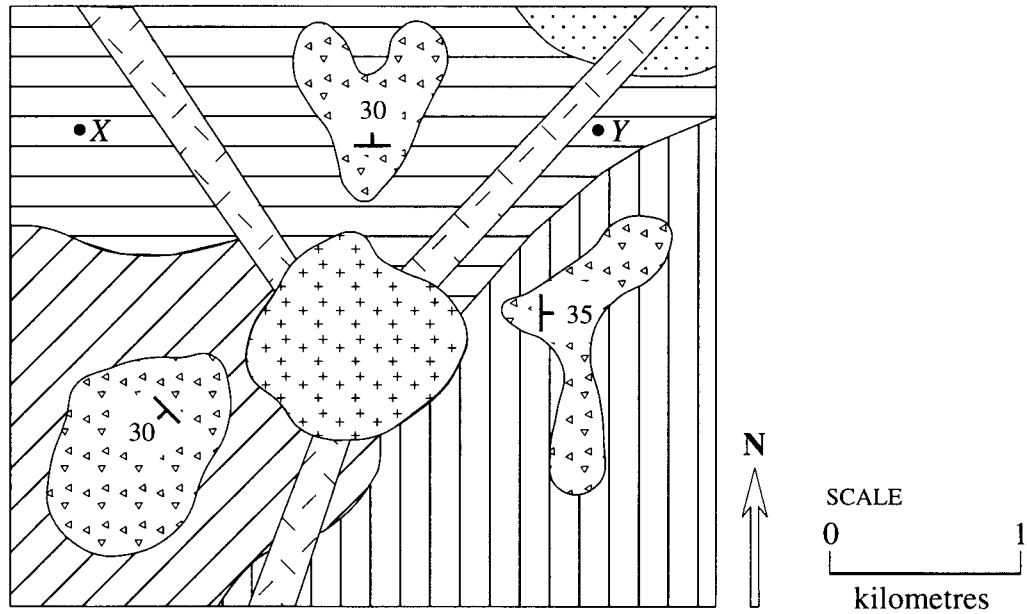
The coal is being extracted using open-cut techniques because

- (A) the water table is too high for other techniques.
 - (B) an underground mine would flood.
 - (C) the coal seam is relatively shallow.
 - (D) open-cut mines are environmentally better than other techniques.
6. Balleny Island is a large active volcano rising nearly 7 kilometres above the floor of the Southern Ocean. It has a basal diameter of approximately 100 kilometres. The volcano has been built up, over time, with a series of extensive lava flows. A line of extinct but similar volcanoes extends north from Balleny Island for a distance of several thousand kilometres.

Balleny Island is most likely

- (A) part of an island arc.
- (B) formed by a hot spot.
- (C) a place where the mid-ocean ridge rises above sea level.
- (D) formed as a result of partial melting at a plate boundary.

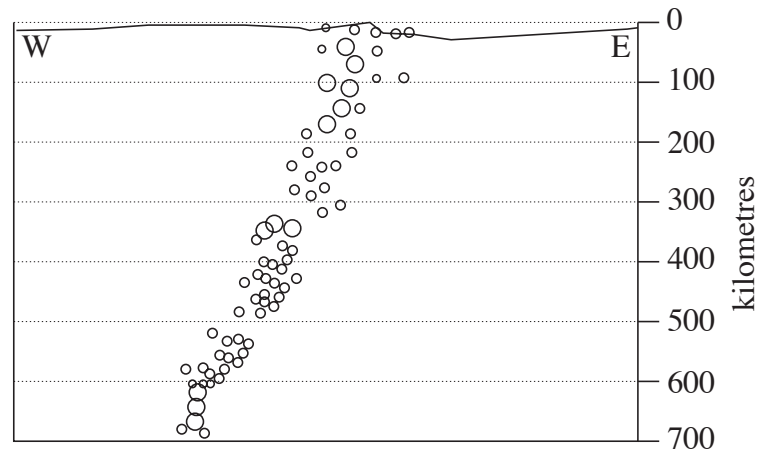
7. The map below shows a region of volcanic, plutonic, and sedimentary rocks. Two vertical boreholes were drilled at sites X and Y as shown on the map.



The type of volcano that most likely produced these features would have

- (A) steep sides and violent eruptions.
- (B) lateral elongated fissures from which mafic lava flows.
- (C) gently sloping sides and silica rich lava.
- (D) effusive eruptions producing felsic lava.

8. The diagram below is a cross-section of part of the Earth, showing the foci of earthquakes.



KEY

Richter magnitude of earthquakes

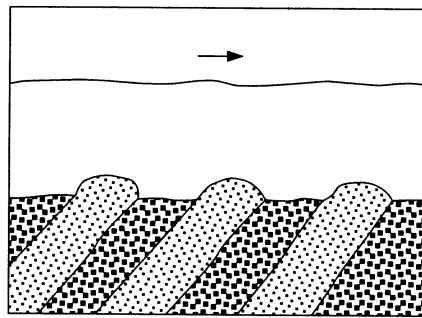
- 3–5
- 5–7
- 7 or greater

'Perspectives of the Earth', Clark & Cook, Australian Academy of Science, p419, fig 16.17

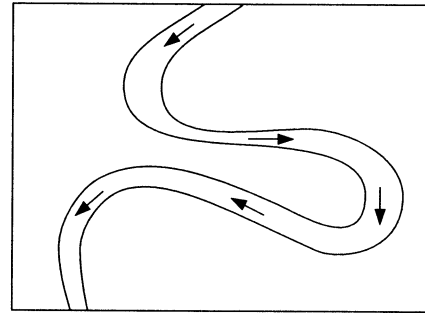
Earthquake foci much deeper than 700 km are not detected because

- (A) the descending plate has been assimilated into the core.
 - (B) the Earth is liquid below a depth of 700 km.
 - (C) the descending plate has been assimilated into the mantle.
 - (D) seismographs are not sensitive enough.
9. The lithosphere is the section of the Earth that
- (A) extends from the outer core to the surface.
 - (B) includes the crust and the asthenosphere.
 - (C) extends from the Moho to the surface.
 - (D) includes the crust and the top part of the mantle.

10. The diagrams below show two situations in which placer deposits can form in rivers.



Cross-section



Map

KEY



Direction of stream flow

'The Blue Planet', BJ Skinner & SC Porter, John Wiley, 1995 p455 fig 17.9.

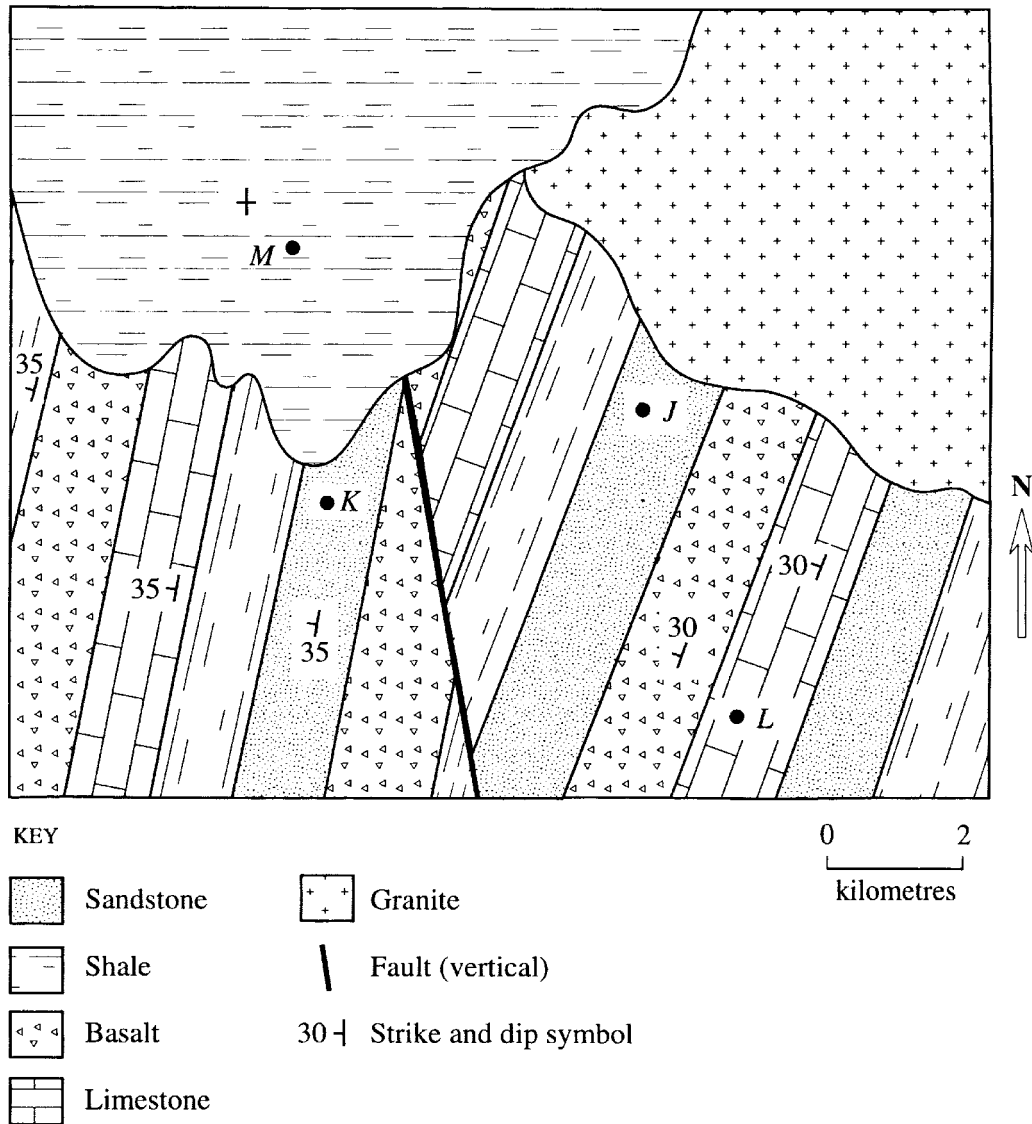
Minerals that characterise placer deposits accumulate in these locations because they

- (A) have a hardness greater than 6.
- (B) are more dense than other minerals.
- (C) are chemically reactive.
- (D) have crystal shapes that do not float very well.

11. Shield areas are

- (A) large accumulations of basaltic lavas.
- (B) tectonically stable continental blocks of low relief.
- (C) regions undergoing isostatic adjustment.
- (D) associated with fold mountain belts, Mesozoic granites, and gneisses.

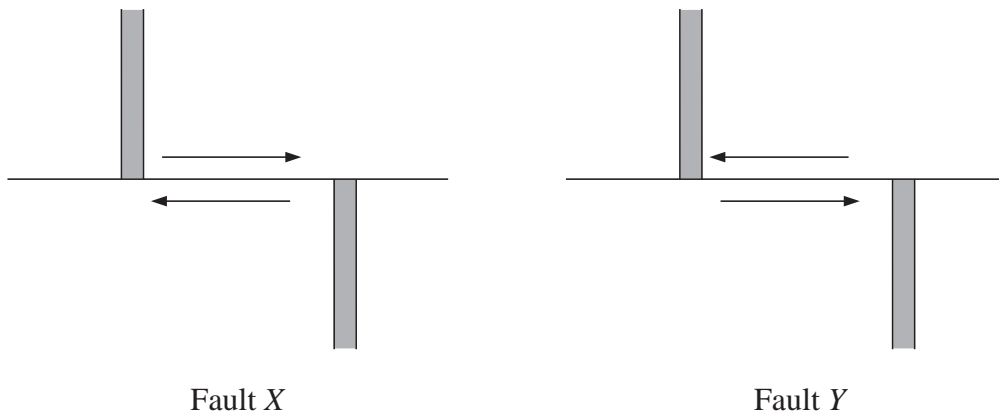
12. The Clampett Oil Company has been granted the right to explore for oil in the Greasetrap Hills area. A junior geologist drew the map below during a field season but unfortunately took another job before completing the project.



At which location on the map (*J*, *K*, *L*, or *M*) should the company drill to have the best chance of striking oil?

- (A) *J*
 (B) *K*
 (C) *L*
 (D) *M*

13. The diagrams below show movement along two strike-slip faults.

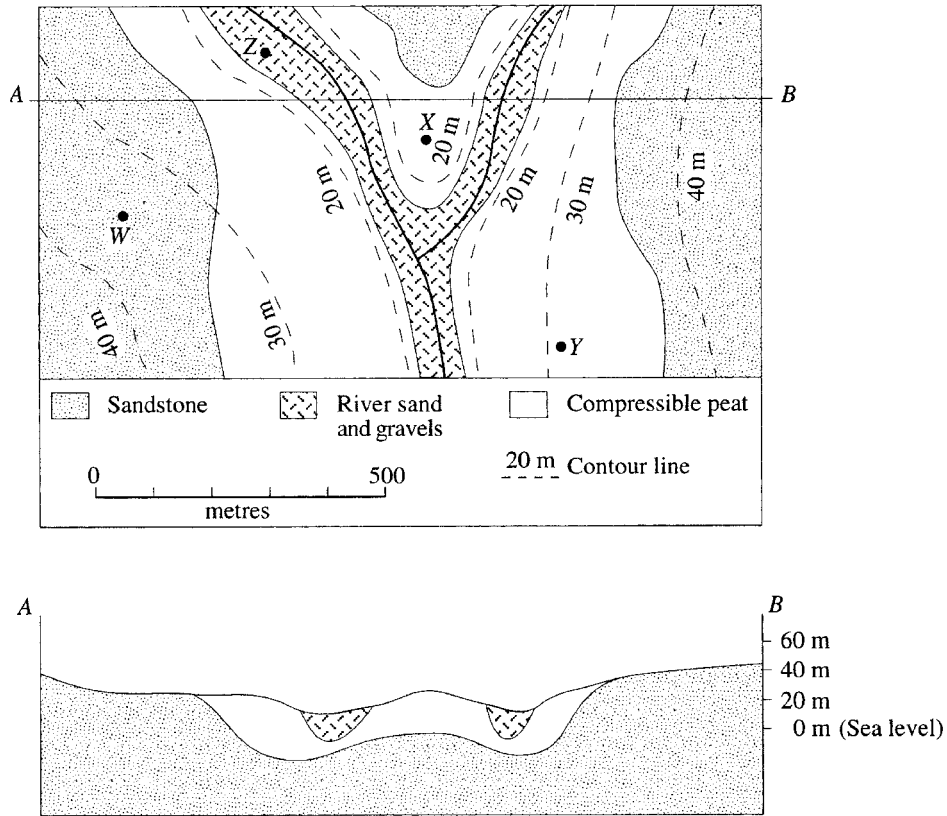


Select the statement below that is the most accurate.

- (A) X and Y are both transform faults.
 - (B) Y is a transform fault; X is a transcurrent fault.
 - (C) Y is characteristic of mid-ocean ridges.
 - (D) X is characteristic of mid-ocean ridges.
14. The Great Dismal Swamp of Virginia and North Carolina, USA, is a modern example of a coal-forming environment. The swamp is located on a low-lying coastal plain. The peat now forming in this area is most likely to be preserved if
- (A) sea level falls and the swamp drains.
 - (B) a volcanic ash fall from a distant volcano covers the area.
 - (C) sea level rises and layers of sediment cover the swamp.
 - (D) the geothermal gradient rises due to deep igneous intrusions.

15. Examine the map and cross-section given below.

NOTE. The area is subject to flooding.
 10-year flood height—22 m above sea level
 100-year flood height—30 m above sea level



The best location for a new medium density housing development would be

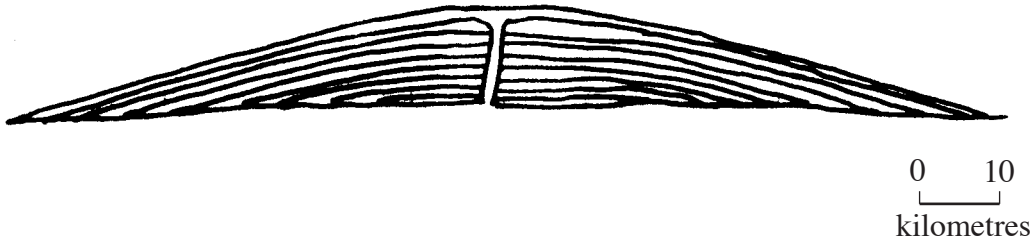
- (A) W
- (B) X
- (C) Y
- (D) Z

PART B

Questions 16–25 are worth 3 marks each.

Answer this Part in the Part B Answer Book.

16. The diagrams below show a volcano and a sketch from a photomicrograph of rock A which was found on this type of volcano.



ROCK A



0 1
millimetres

'Petrology of igneous rocks', 12th ed, Hatch, Wells & Wells, Allen & Unwin 1961.
Courtesy International Thomson Publishing Services Ltd.

Rock A contains crystals of olivine, plagioclase, and pyroxene.

- (a) (i) Give a suitable name for rock A.
(ii) Name the plutonic equivalent of rock A.
- (b) What is the likely source of the magma that formed rock A?
- (c) On which type of plate boundary would this type of volcano be most likely to occur?

17. The general community now expects mine sites to be appropriately rehabilitated.

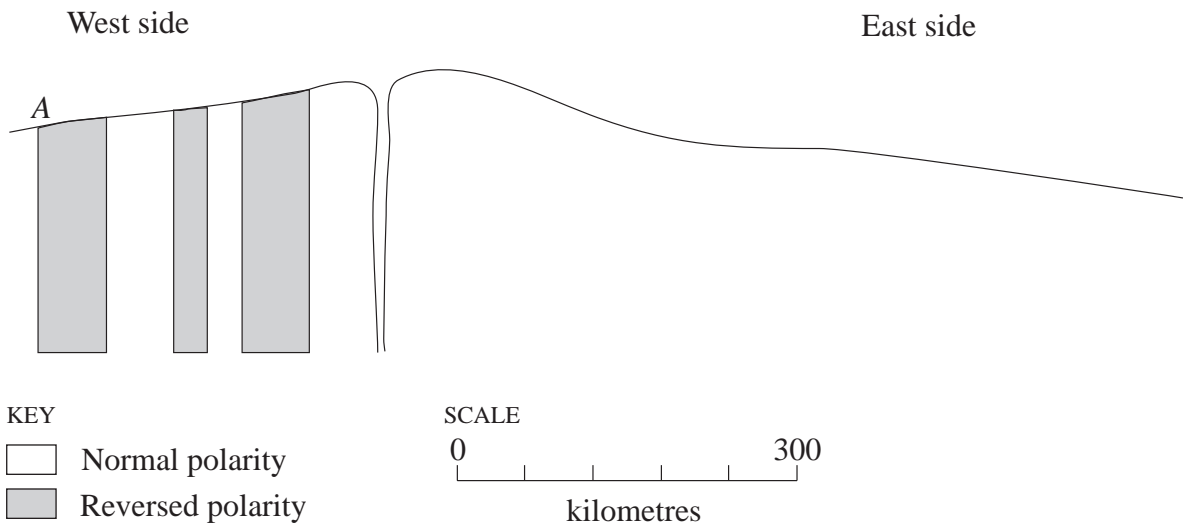
Describe THREE ways a mining company should examine and document a site, prior to commencing mining operations, to aid in its rehabilitation.

18. Geothermal power stations have been built in Iceland and New Zealand.

- What is the source of the steam that turns the turbines in these power stations?
- What is a major advantage of using geothermal power rather than fossil fuels?
- Describe a natural risk to geothermal power stations.

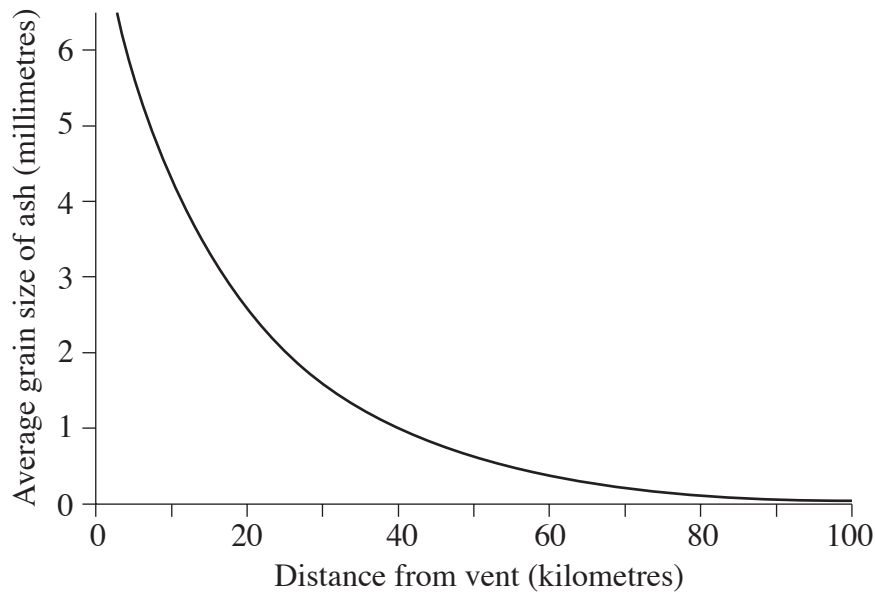
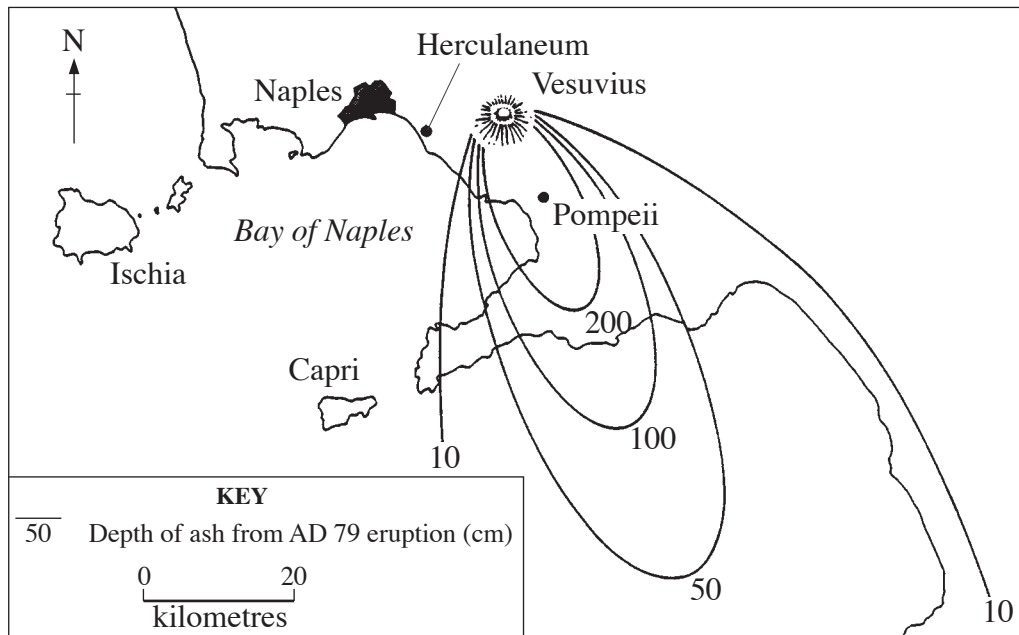
19. The diagram below shows a cross-section through a mid-ocean ridge. Magnetic anomaly patterns are shown on one side of the ridge.

A particular index fossil has been found at point A on the ocean floor.



- On the diagram in your Answer Book, draw the anomaly pattern on the eastern side of the ridge.
- The fossil found at point A is 15 million years old. Calculate the spreading rate of the western side of the ridge. Express your answer in centimetres per year.
- Why is a mid-ocean ridge a topographic high?

20. The map shows the thickness of the ash deposit following the AD 79 eruption of Mt Vesuvius. The graph shows the relationship between grain size of the ash and the distance from the vent for the same eruption.



'Tectonic processes', D Weyman, Allen & Unwin 1981.

Prior to the eruption, Pompeii was a busy seaport. Following the eruption, Pompeii was buried until 1763, when it was rediscovered and excavated by archaeologists.

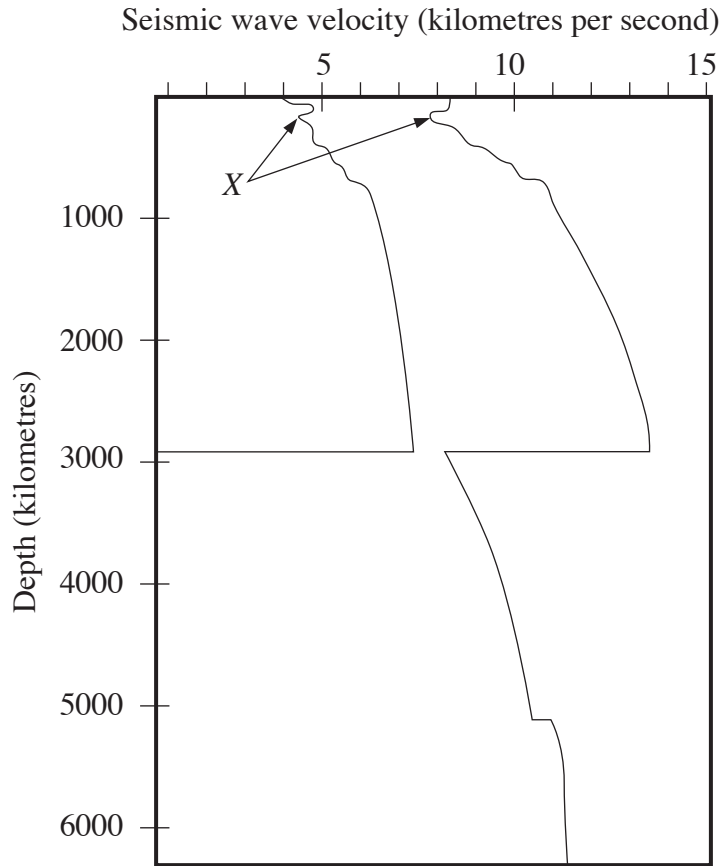
- Give an explanation for the present coastline being 4 km from Pompeii.
- What was the average grain size of the ash that fell on Pompeii?
- If Mt Vesuvius were to erupt in the near future, the city of Naples could be seriously threatened. Describe one volcanic hazard apart from ash fall that could affect the citizens of Naples.

21. The 'Lucky Strike' gold deposit has the following characteristics.

<i>Lucky Strike gold deposit</i>	<i>Characteristics</i>
Location	Remote, mountainous, and at the source of a river
Rainfall	Extremely high (2 to 4 m per year); flash floods are common
Waste disposal requirements	Large volumes of overburden; hazardous chemical residues
Landforms	Steep slopes; deeply weathered soils

- (a) Select TWO of the characteristics in the table above, and describe how *each* could affect the daily operation of a mine at this site.
- (b) List TWO factors that could affect the economic viability of establishing a mine at this site.
22. (a) Using TWO labelled diagrams, show how the Himalayan mountain range was formed.
- (b) The rate of erosion of the Himalayan mountain range is about 4 mm per year, yet the altitude of these mountains is not being reduced at this rate.
- Give ONE possible reason for this apparent contradiction.

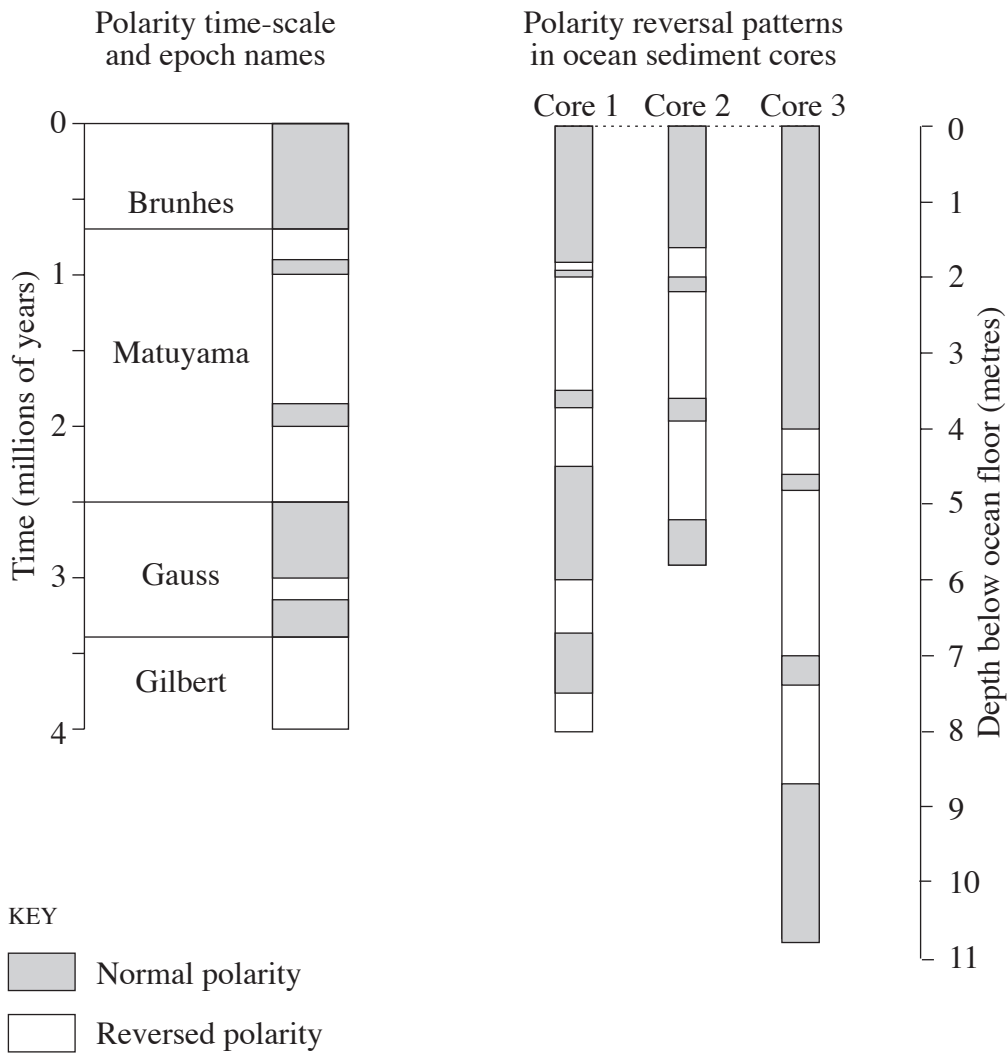
23. The graph below shows the variation in velocity of P and S waves with depth.



'Properties of the earth', Clark & Cook, Australian Academy of Science, 1983.

- (a) Name zone X .
- (b) Seismic wave velocities decrease in zone X . State TWO other characteristics of this zone.
- (c) What is the role of zone X in isostatic adjustment?

24. The diagram below shows the magnetic polarity time-scale for the past four million years, together with the names given to each magnetic epoch (time unit). The diagram also shows the magnetic reversal patterns found in three ocean sediment cores.



'A revolution in the earth sciences', A Hallam, Clarendon Press, 1973, p63.
Reprinted by permission of Oxford University Press.

- Which core was taken from the location where the rate of deposition was greatest? Justify your answer.
- How old are the sediments in core 3 at a depth of 7 metres below the ocean floor?
- Describe in detail how these sediment layers could be dated using a method other than correlation with the polarity time-scale.

25. The diagrams below show the magnetic anomaly patterns across the East Pacific Rise along two different traverses drawn to the same scale.

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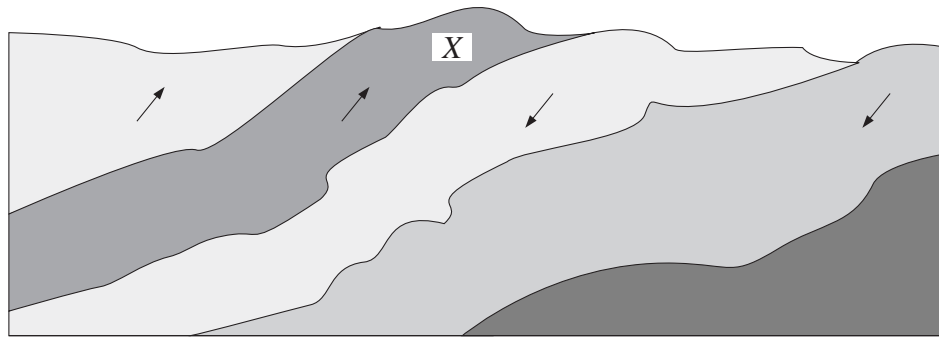
- (a) On the diagram in your Answer Book:
- (i) draw an arrow to indicate the location of the mid-ocean ridge axis on Traverse 1;
 - (ii) draw a line extending from the peak beneath \times on Traverse 1 to a point of the same age on Traverse 2.
- (b) Is the ridge at Traverse 1 spreading at the same rate as the ridge at Traverse 2? Give reasons to support your answer.

PART C

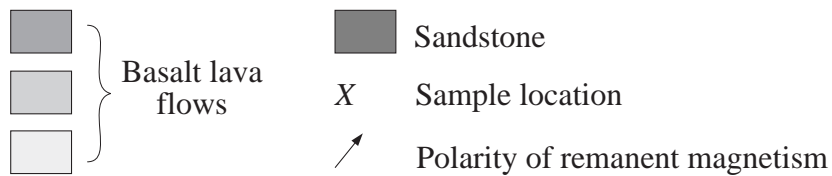
Questions 26–31 are worth 5 marks each.

Answer this Part in the Part C Answer Book.

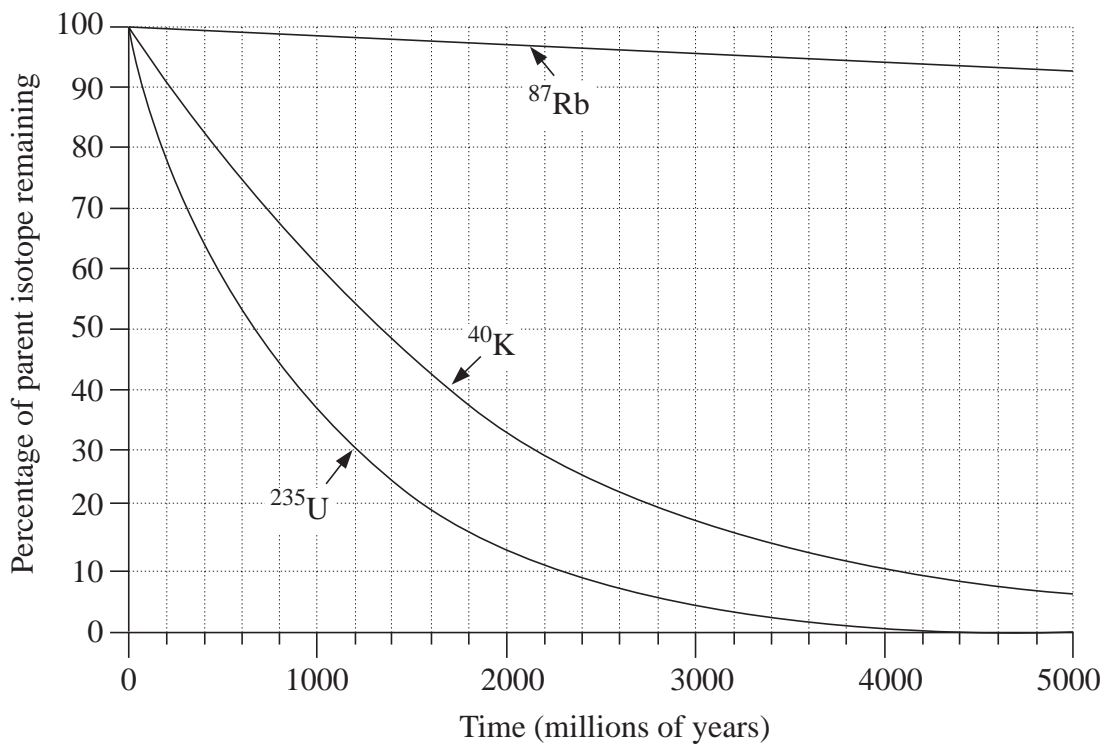
26. The diagram below shows a series of lava flows, and the direction of polarity of the remanent magnetism in each flow. A sample of basalt was taken from location X.



KEY



The graph below shows the decay curves for three radioactive isotopes.



QUESTION 26. (Continued)

- (a) Describe the process by which these rocks acquired remanent magnetism.
- (b) The sample of basalt from location X was dated using the potassium–argon method, by measuring the percentage of potassium-40 (^{40}K) remaining in the rock.

The rock was assessed as being 200 million years old. What percentage of the original potassium-40 remains?

- (c) Give TWO reasons why the potassium-argon method would be suitable for dating this sample of basalt.

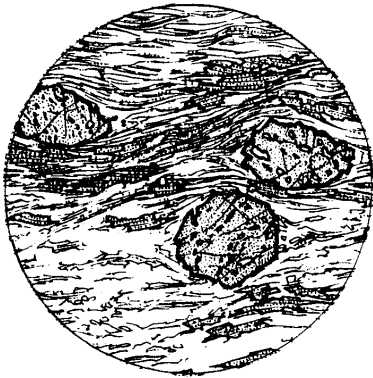
27. The basic infrastructure cost of setting up a sediment-dredging operation at Mopoke Island is estimated to be \$3 000 000. The table below gives the value of the materials present in the sediment and the additional costs of extracting them.

<i>Material</i>	<i>Value</i>	<i>Additional cost</i>
Sand	\$2 500 000	\$5 000 000
Gravel	\$2 500 000	\$500 000
Cassiterite	\$4 000 000	\$550 000

- (a) Which of the materials would be economic to extract? Give reasons for your answer.
- (b) List TWO items that were probably included in *infrastructure costs*.
- (c) List TWO items that could be included in *additional costs*.
- (d) List TWO environmental factors which could affect a sediment-dredging operation.

28. The diagram below shows a cross-section through a mountain range, and sketches from photomicrographs of four rocks.

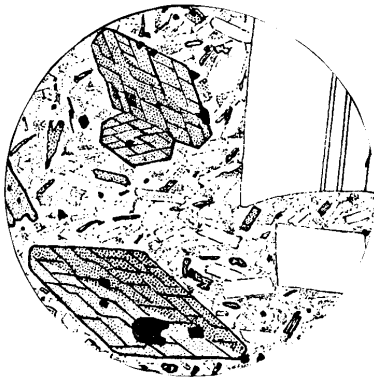
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Rock A

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Rock B



Rock C

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Rock D

SCALE
0 1
millimetres

Rock A & Rock C: 'Microtextures des Roches Magmatiques et Metamorphiques', JP Bard, Masson, Paris 1980. © Masson Paris.

QUESTION 28. (Continued)

- (a) Using the numbers on the cross-section, indicate the most likely locations for *each* of rock *A* and rock *C*.
- (b) Describe what is happening at location 1 on the diagram.
- (c) Draw a clearly labelled diagram of a fault that would be commonly associated with location 5 on the diagram.
- (d) Give an appropriate name for rocks *B* and *D*.
- (e) Describe the processes that would have to occur for the rock formed at location 4 to be exposed at the surface.

29. Porphyry copper deposits are generally low-grade large-tonnage deposits, mined for copper and associated metals.

The diagram below shows a porphyry copper system.



- (a) Describe how copper minerals become concentrated in this type of deposit.
- (b) Describe a process that could have produced the alteration zones.

QUESTION 29. (Continued)

The diagram below is a photomicrograph of a rock found at A.



0 2
└───┘
millimetres

- (c) Describe in detail the texture of the rock found at A.
- (d) Name TWO metals, other than copper, which occur in economic concentrations as a result of igneous activity.

30. This question refers to the photograph below. The photograph shows part of the Red Sea that is an example of a plate boundary.



NASA

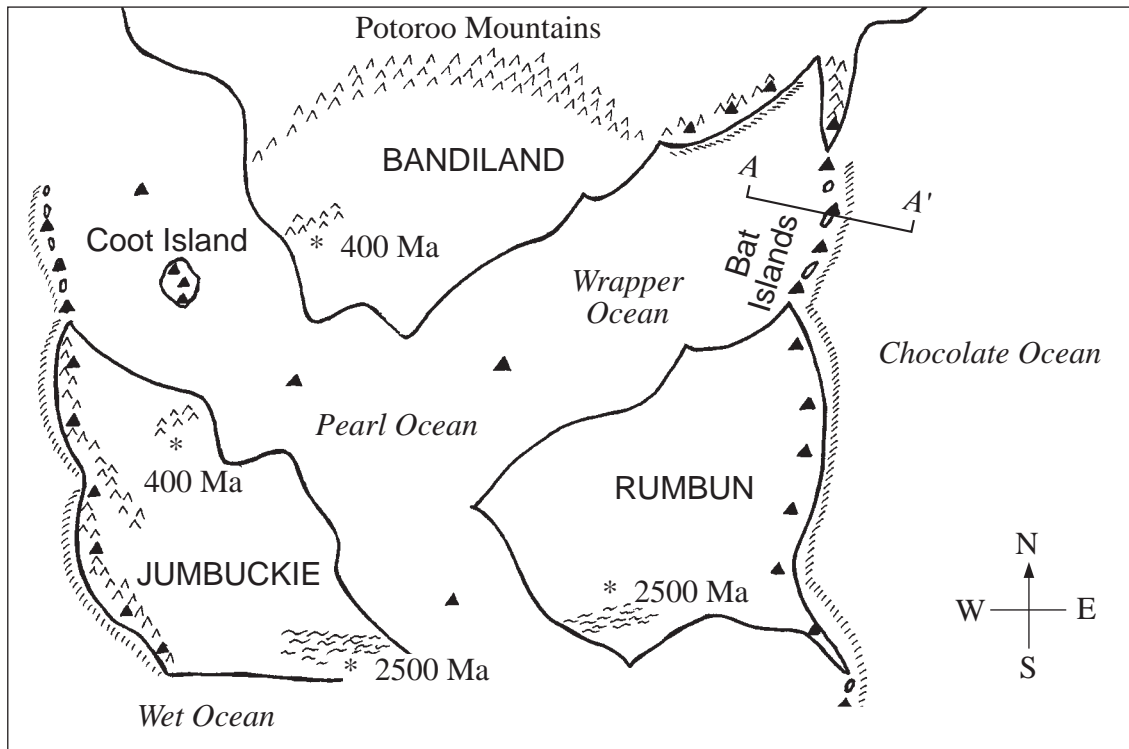
- (a) Name this type of plate boundary.
- (b) In the space provided in your Answer Book, draw a series of THREE diagrams showing how this type of plate boundary changes from its beginning to maturity.

The stage illustrated in the photograph should be your SECOND diagram.

On the THIRD diagram, label the:

- (i) lithosphere;
- (ii) asthenosphere;
- (iii) continental crust;
- (iv) oceanic crust;
- (v) direction of plate movement.

31. The map below shows the surface of the hypothetical planet Yowie, a planet similar to Earth.



SCALE

1 cm : 2000 km

KEY

				* 120 Ma
Mountains	Deformed rocks	Ocean trench	Active volcano	Age of rock (million years)

The planet Yowie has three large continents: Jumbuckie, Rumbun, and Bandiland, that are separated by oceans. There are some very high mountain ranges, seismic activity, and active volcanoes.

- Give TWO pieces of evidence that support the theory that Jumbuckie and Bandiland were once joined.
- Draw a labelled cross-section through the region indicated by A—A'. Include a vertical scale.
- Assuming that Yowie has a geochemistry similar to Earth, describe the composition of the lava, and the eruptive style of the volcanoes on Coot Island.

SECTION II—ELECTIVES

(25 Marks)

Attempt ONE question.

Answer the question in a *separate* Elective Answer Book.

	Page
QUESTION 32. Contemporary Sedimentary Processes	29
QUESTION 33. Igneous Rocks	32
QUESTION 34. Economic Geology	37
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QUESTION 36. Palaeontology	46

QUESTION 32. Contemporary Sedimentary Processes**Marks**

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

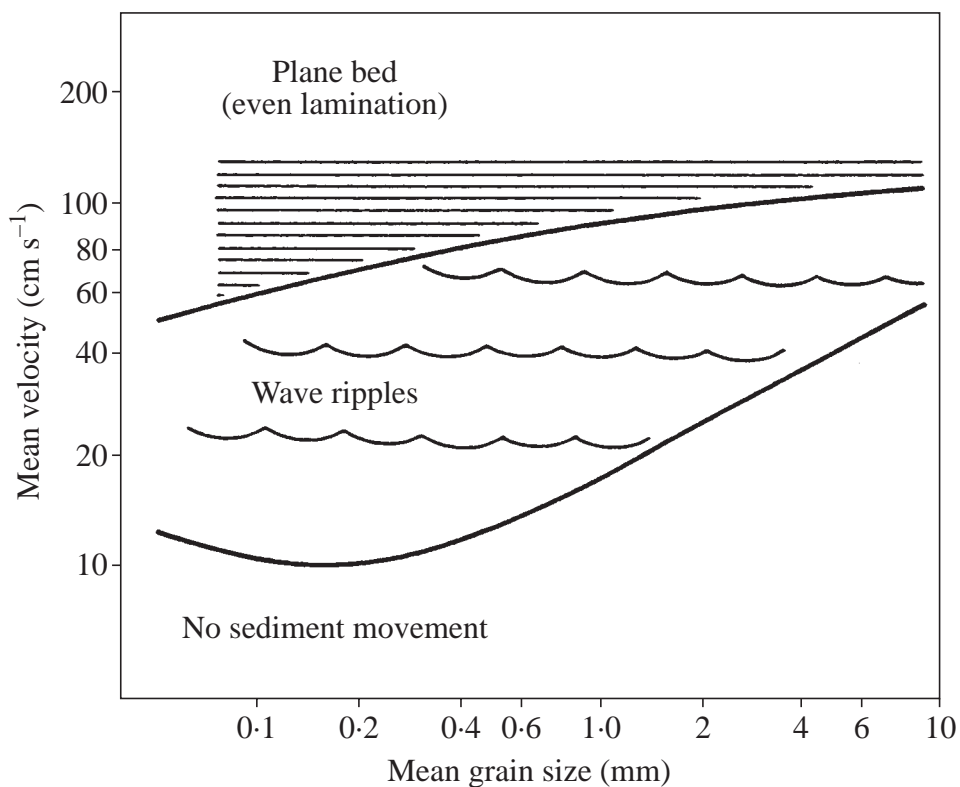
- a river/stream;
- a beach;
- a lagoon/lake;
- a bay/estuary/delta;
- a desert.

- (a) (i) Name the environment you have studied. **6**
- (ii) Draw a labelled sketch map of the area you studied.
- (iii) Name the dominant transporting medium in that environment.
- (iv) Select ONE locality you have studied and mark its location on the sketch map with the letter *A*. Describe the velocity or energy of the transporting medium at this locality.
- (v) Outline the steps you took, or that could be taken, to measure the velocity of the transporting medium at site *A*.
- (vi) Select another locality in which the energy of the transporting medium is different from site *A*. Mark this second locality on your sketch map with the letter *B*.
Describe the differences in velocity or energy between sites *A* and *B*, and give reasons for these differences.
- (vii) On the sketch map, place the letter *C* at one locality where erosion is occurring.
- (viii) Why is erosion occurring at site *C*?
- (b) With reference to the environment you have studied, describe how changes in the velocity or energy of the transporting medium influence: **3**
- (i) grain size of the sediments;
 - (ii) composition of the sediments;
 - (iii) sedimentary structures.
- (c) With reference to the environment you have studied, describe ONE technique or method that could be used to determine variations in the: **4**
- (i) grain size of the sediment;
 - (ii) composition of the sediment.

QUESTION 32. (Continued)

Marks

- (d) For the environment you studied: 4
- (i) describe the major human influence on the depositional patterns;
 - (ii) name ONE plant found in your environment;
 - (iii) describe how the plant named in part (ii) might have influenced the sedimentary processes;
 - (iv) name ONE animal, other than humans, found in your environment;
 - (v) describe how the animal you named in part (iv) might have influenced the sedimentary processes.
- (e) The diagram below shows the fields for various bedforms in a stream. Mean flow velocity is plotted against mean grain size. 3



- (i) For a grain size of 1.0 mm, what is the range of mean flow velocity in which ripples are likely to form?
- (ii) For a grain size of 0.1 mm, what is the lowest mean flow velocity above which sand grains are transported?
- (iii) What will happen if the mean flow velocity of the stream changes from 60 cm s⁻¹ to 100 cm s⁻¹, and the mean grain size remains at 0.6 mm?

QUESTION 32. (Continued)

Marks

- (f) Imagine that an environment similar to the one you have studied has been preserved in a rock sequence. Erosion has occurred and you can now view a cliff face that represents a vertical section (cross-section) through these rocks. No folding or metamorphism has occurred. **5**
- (i) Name TWO sedimentary structures that you would expect to find in the outcrop.
 - (ii) Draw clearly labelled diagrams of these two structures.
 - (iii) Select ONE of these structures, and give a detailed explanation of how it would have formed.
 - (iv) Describe the features that could be present in the cliff face, and would indicate the direction of the transporting medium in this ancient environment.

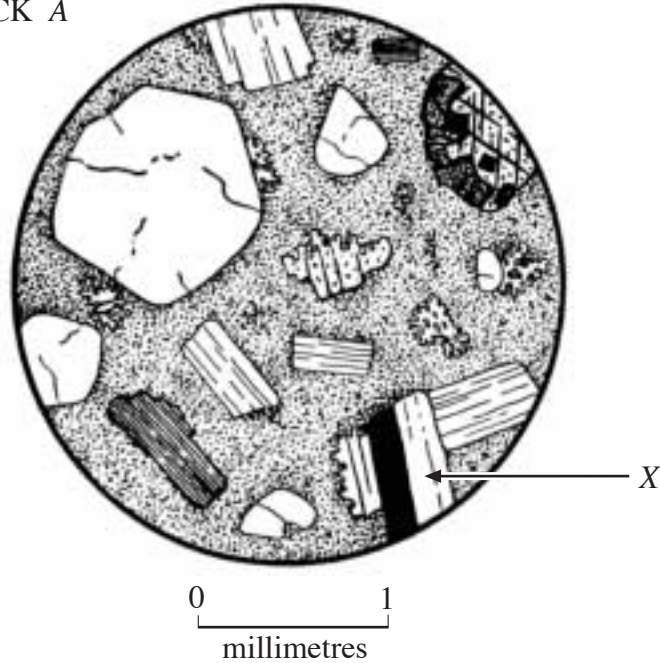
QUESTION 33. Igneous Rocks**Marks**

(a) This question relates to the diagrams and tables below.

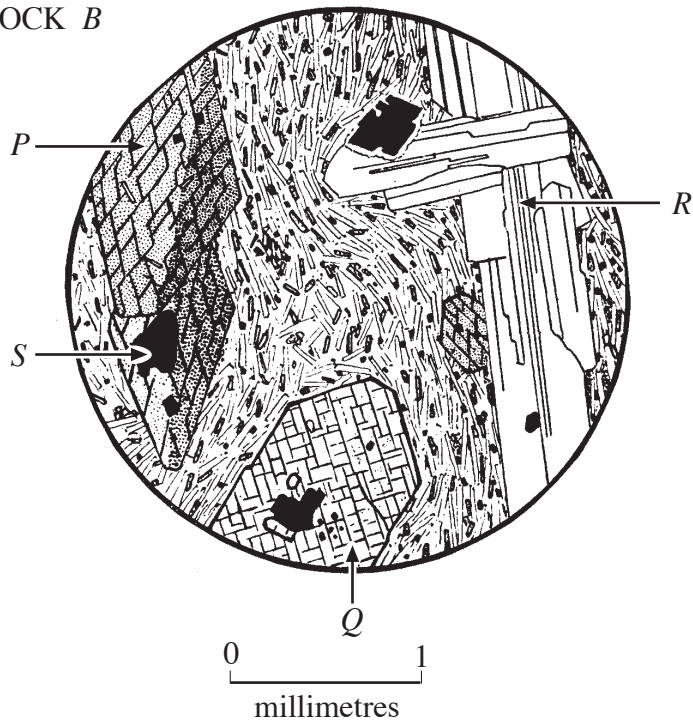
11

The photomicrographs below are of two igneous rocks.

ROCK A



ROCK B



Rock B: 'Petrology of igneous rocks', 12th ed, Hatch, Wells & Wells, Allen & Unwin 1961.
 Courtesy International Thomson Publishing Services Ltd.

QUESTION 33. (Continued)

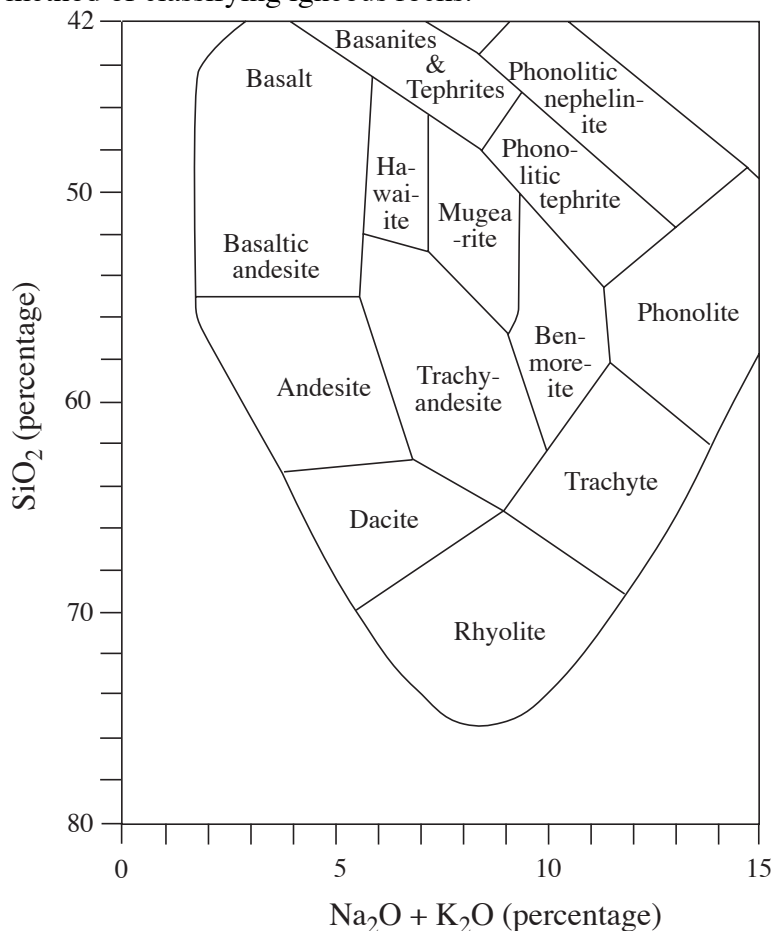
Marks

The table below shows the chemical composition of rock A.

	<i>Weight per cent</i>
SiO ₂	71.4
TiO ₂	0.4
Al ₂ O ₃	14.3
Fe ₂ O ₃	1.5
FeO	0.6
MnO	0.1
MgO	0.8
CaO	1.0
Na ₂ O	3.8
K ₂ O	4.6
P ₂ O ₅	0.2
H ₂ O	1.3

'Magmas and magmatic rocks', EAR Middlemost, Longman NY 1985. Reprinted by permission of Addison Wesley Longman Ltd.

The diagram below is a classification based on the percentage of silica (SiO₂) versus percentage total alkalis (Na₂O + K₂O). This is known as a TAS plot and is one method of classifying igneous rocks.



'Magmas and magmatic rocks', EAR Middlemost, Longman NY 1985. Reprinted by permission of Addison Wesley Longman Ltd.

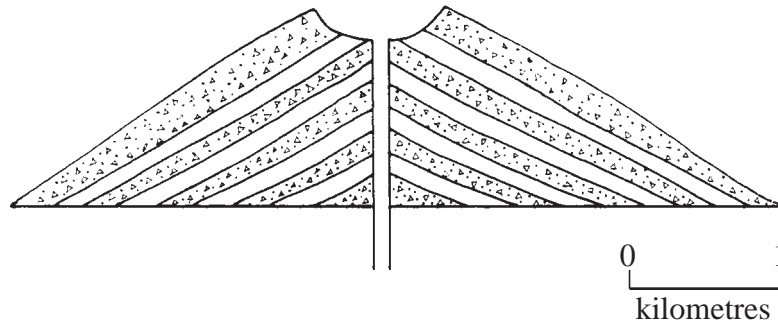
Question 33 continues on page 34

QUESTION 33. (Continued)

Marks

- (i) Using the analysis shown in the table and the TAS plot on page 33, name rock *A*.
- (ii) Name the mineral labelled *X* in rock *A*.
- (iii) Name the texture of rock *A*.
- (iv) With reference to the texture, give a detailed description of the cooling history of rock *A*.
- (v) In what type of igneous rock body would rock *A* be found?
- (vi) Name another rock that could form from a magma of the same composition.

Rock *B* was collected from the volcano shown below.



- (vii) Identify which one of the minerals, *P*, *Q*, *R*, or *S* is most likely to have crystallised first. Justify your choice.
- (viii) Name rock *B*.
- (ix) Using the TAS plot on page 33, state the range of total alkali ($\text{Na}_2\text{O} + \text{K}_2\text{O}$) content possible in a rock of the same type as rock *B*.
- (x) Account for the difference in the silica (SiO_2) content of rock *A* and rock *B*.

QUESTION 33. (Continued)

Marks

- (b) As recently as 6000 years ago, basaltic volcanoes were active in southern Victoria. Geologists studying these volcanoes have been able to interpret the types of eruptions that formed the volcanoes by examining the rock record. A typical eruptive sequence may have proceeded as follows: **8**

Rising magma mixes with groundwater and violent eruptions of volcanic ash and rock begin. The rock and ash are blasted laterally from the vent for several days and the pyroclastic material is deposited around the vent. The formation of a high eruption column follows, from which volcanic ash falls back around the vent to produce a cone. Several days pass with little activity and a lake forms in the vent. Continuous activity returns in the form of violent, lateral blasts, and much of the cone is flattened. A high eruption column returns and ash is deposited in a cone around the vent. After several days lava fountains form and lava covers the pyroclastic material.

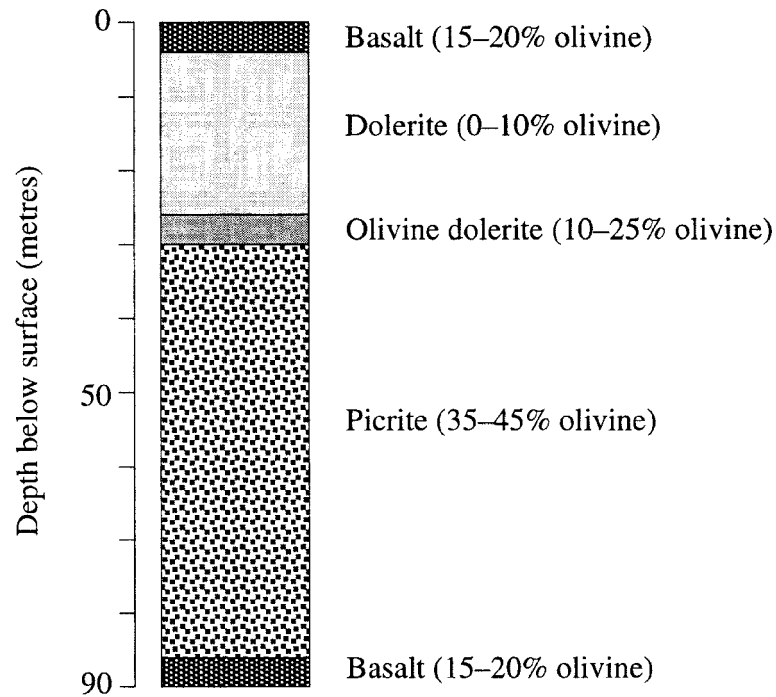
- (i) Using clearly labelled diagrams, describe and draw the major changes in the eruptive characteristics of the Victorian volcano outlined in the passage given above. Your diagrams should clearly show changes in the cross-sectional shape of the volcano.
- (ii) Discuss the reasons for the changes outlined in part (i).
- (iii) Suggest a plate tectonic setting in which these Victorian volcanoes could have formed.
- (iv) Is further volcanism likely to occur in this area? Give reasons for your answer.

QUESTION 33. (Continued)

Marks

- (c) The diagram below shows a vertical section through a sill. The basalt in the sill is very fine-grained and relatively unaltered. All other rock types are altered and contain the mineral saponite that forms by the alteration of olivine. Veins of syenite, a felsic rock, occur within the dolerite, olivine dolerite, and picrite. 6

The rock type changes with depth in the intrusion. The original percentage of olivine in each rock type is indicated.



- (i) Name a process that operated in the magma chamber, during crystallisation of the sill, to produce the layered rock types.
- (ii) Why is basalt at both the upper and lower margins of the sill?
- (iii) Explain how the syenite veins form. Include labelled diagrams in your answer.
- (iv) Name TWO economic resources (metals or minerals) that might be present at a depth of 75–85 m in the sill.
- (v) Describe in detail how these resources could have become concentrated.

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 ONE economic deposit you have studied, answer the following:

8

- (i) name the deposit you have studied;
- (ii) briefly outline the method of formation and/or concentration of the deposit;
- (iii) draw and label a geological sketch map or cross-section of the deposit. With reference to your map or cross-section, describe how the shape of the ore body and its relationship to the host material could influence the choice of methods of extraction;
- (iv) list TWO exploration methods used to find this deposit, or that could be used to find similar deposits. Explain what is involved in *each* method, and why *each* was, or would be used;
- (v) describe how quality variation within the deposit affects extraction/refining techniques.

QUESTION 34. (Continued)

Marks

- (b) Using *EITHER* a deposit you have NOT used in part (a), *OR* an engineering project, answer the following questions. 9

EITHER

- (i) For the deposit you did NOT describe in part (a), answer the following:
1. name the deposit you have studied;
 2. draw a sketch map to show the geographic location of the deposit;
 3. name ONE product of your deposit, and describe its use;
 4. describe how improvements in extraction or refining technology have altered, or could alter, exploitation of this resource;
 5. (a) describe in detail ONE way in which the exploitation of the deposit affects the natural environment;
(b) describe how this impact on the natural environment could be reduced;
(c) list TWO important non-geological factors that had to be considered when setting up this project. Explain why they were important.

OR

- (ii) For an engineering project you have studied:
1. name the project you have studied;
 2. (a) describe a significant geological factor that made this site suitable for the project;
(b) explain how this geological factor influenced design and construction methods.
 3. (a) name TWO rock types found on or near the site of the project;
(b) explain the characteristics of *each* rock type which make it suitable as a construction material, or a foundation layer for the construction.
 4. (a) describe in detail ONE environmental factor that had to be considered during the life of this project;
(b) state what effect this environmental factor had on the operation or maintenance of the project.
 5. describe ONE exploration *or* testing method used in the setting-up of the project.

QUESTION 34. (Continued)

Marks

- (c) You are the mine geologist at a small copper mine in North Queensland. The grade and tonnage of the ore at the mine make it marginal, but under present economic conditions you are operating at a small profit. **6**
- (i) The value of the Australian dollar has risen in comparison to the US dollar. What effect will this have on the value of your copper on the world market? Explain your answer.
 - (ii) On the 7.00 p.m. news one evening, it is reported that a very large overseas copper mine has gone into full production. What effect would this have on the economic viability of your copper mine? Give a reason for your answer.
 - (iii) Several years later you are reading a newspaper at breakfast. You notice that the government of the country in which the very large overseas copper mine is located has been overthrown in a civil war and replaced by a dictator. The mine owner has been arrested and the mine put into state hands. Furthermore, communication and transport have been disrupted by a local volcanic eruption.
 - 1. State ONE outcome that these events may have on world copper prices.
 - 2. How will these events affect the economic viability of the overseas copper mine? Give TWO reasons for your answer.
- (d) Reserves of a resource are often described as indicated, inferred, or proved. **2**
- Give TWO procedures that would be required to change the inferred reserves of a resource into proved resources.

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QUESTION 35. Regional Geology**Marks**

In this elective, you will 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) In studies of this region, you have used a range of investigative methods including fieldwork, library research, laboratory work, and map and aerial photo investigation. **4**

State ONE of the methods you have used, and describe the specific information you gained from this investigation. The information should cover TWO of the following:

- present geomorphology
- soils, vegetation, and land use
- lithologies
- relation to adjacent units.

QUESTION 35. (Continued)

Marks

- (b) Choose ONE sedimentary unit and ONE igneous unit from your region. **10**
- (i) Name the TWO rock units you have chosen.
- (ii) Draw a sketch map of your region, and include a scale.
On this sketch map, shade and label the areas of outcrop of the sedimentary and igneous units. Use a different shading for each rock unit.
- (iii) 1. For the sedimentary unit:
- (a) give the age of the unit;
 - (b) name a common rock type;
 - (c) describe the mineralogy and texture of the rock type;
 - (d) describe the sedimentary environment in which the rock formed.
2. For the igneous unit describe:
- (a) the dominant rock type;
 - (b) an igneous structure present, and how it formed.
- (iv) 1. Name, sketch, and give the age of, ONE fossil found in your region.
2. What does the presence of this fossil indicate about the depositional environment that existed when the rock was formed?

QUESTION 35. (Continued)

Marks

(c) Choose *EITHER* (i) *OR* (ii) below.

3

EITHER

- (i) Choose ONE economically significant geological resource within your region. This could be a mineral deposit or energy resource, a soil unit, a ground water resource, or a particular land use.
1. Name the resource, and explain why it is important to your region.
 2. What is the age of this resource?
 3. Describe how this resource formed, and place its formation in the geological evolution of your area.

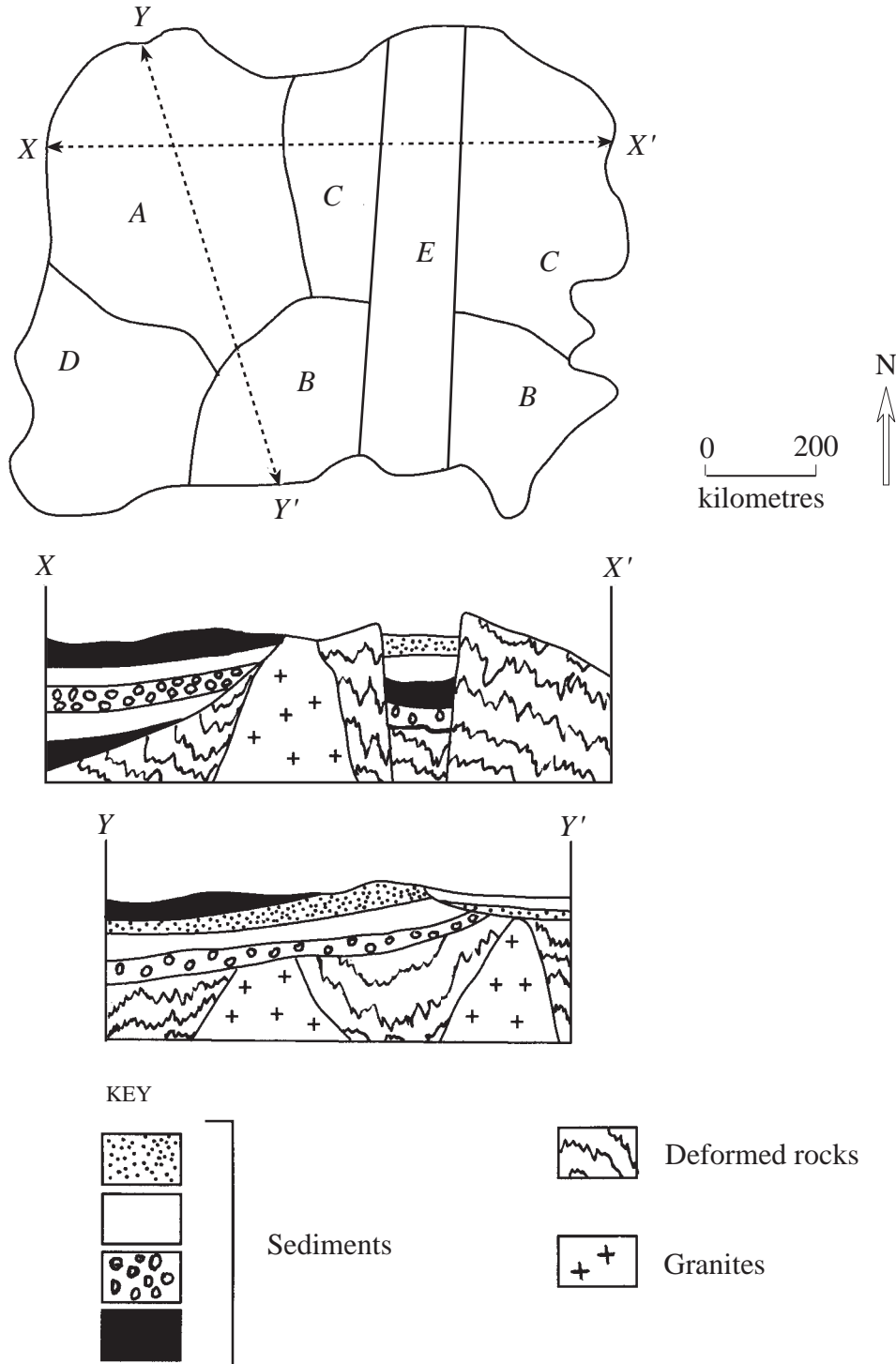
OR

- (ii) Choose ONE feature of special geological interest in your region. It could be a palaeontological or archaeological site, an artesian system, a civil engineering project, or a spectacular scenic feature.
1. Name this feature, and explain why it is of special geological interest.
 2. Describe the geological setting of this feature.
 3. List TWO ways in which you studied this feature.

QUESTION 35. (Continued)

Marks

- (d) Geological regions are separated from one another by their boundaries. The diagram below is a map of an imaginary continent that contains five distinct geological regions, *A*, *B*, *C*, *D*, and *E*. Two cross-sections of the continent, *X—X'* and *Y—Y'*, are also shown. 8



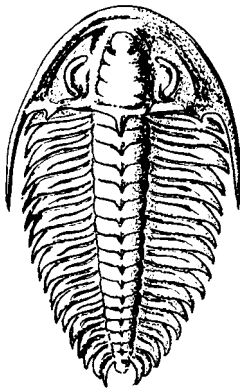
QUESTION 35. (Continued)

Marks

- (i) List regions *A*, *B*, and *C*, in order of increasing relative age. Explain your answer.
- (ii) (a) What is the youngest region shown on the map?
(b) Describe the geological evolution of this region.
- (iii) Choose one of the regions from this hypothetical continent that is similar to the region you have studied in this elective.
 - (a) Describe TWO ways in which this region is similar to the region you have studied.
 - (b) Describe ONE way in which this region is different from the region you have studied.

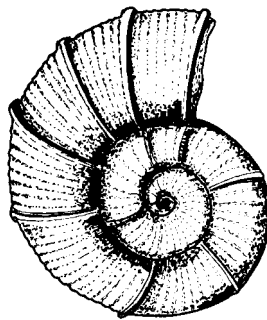
QUESTION 36. Palaeontology**Marks**

- (a) (i) Name a scientist who has made a significant contribution to palaeontology. **3**
- (ii) Describe this scientist's contribution to palaeontology.
- (iii) Explain the significance of this contribution to palaeontology.
- (b) Choose TWO of the fossils illustrated below. **10**



length 15 cm

Fossil P



diameter 11 cm

Fossil Q



length 6 cm

Fossil R

For *each* of the two fossils you have chosen:

- (i) Name the fossil group of which it is a representative.
- (ii) 1. Describe the evolutionary changes in the morphology of the fossil group. Use labelled sketches in your answer.
2. How were the changes described in part 1 above caused by the environment in which the organisms lived?

QUESTION 36. (Continued)

Marks

(c) Field geologists can usually identify fossils to the level of order or suborder. Why is it unusual for a field geologist to identify a fossil to the level of species when the fossil is first found at the field site? **2**

(d) Answer *EITHER* (i) *OR* (ii) *OR* (iii). **4**

EITHER

- (i) 1. Relate the evolution and migration of humans to changes in their environment.
2. Give ONE example of how palaeontologic principles can be used to determine the time hominids or humans arrived at a given place.

OR

- (ii) 1. Give a definition for the term *microfossil*. Give ONE example of a microfossil.
2. Describe the use of index fossils AND microfossils in petroleum exploration, or regional geological studies.

OR

- (iii) Palaeoecology of a sequence of related sedimentary rocks is made easier if there is a wide variety of fossils present.

Explain how fossils are used, together with other evidence, to determine ancient depositional environments for sedimentary rocks.

(e) By the beginning of the Triassic, approximately 80 per cent of species known to be alive at the end of the Permian had died out. **6**

Discuss THREE possible causes for this mass extinction.

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