

Monday 16 May 2022 – Morning

AS Level Geology

H014/01 Geology

Time allowed: 2 hours 30 minutes



You must have:

- a ruler (cm/mm)
- a protractor

You can use:

- a scientific or graphical calculator
- an HB pencil



Please write clearly in black ink. **Do not write in the barcodes.**

Centre number

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Candidate number

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First name(s)

Last name

INSTRUCTIONS

- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided. If you need extra space use the lined pages at the end of this booklet. The question numbers must be clearly shown.
- Answer **all** the questions.
- Where appropriate, your answer should be supported with working. Marks might be given for using a correct method, even if your answer is wrong.

INFORMATION

- The total mark for this paper is **120**.
- The marks for each question are shown in brackets [].
- Quality of extended response will be assessed in questions marked with an asterisk (*).
- This document has **36** pages.

ADVICE

- Read each question carefully before you start your answer.

Section A

You should spend a maximum of 30 minutes on this section.

Write your answer to each question in the box provided.

Answer **all** the questions.

- 1 A transparent mineral cannot be scratched by a fingernail but can be scratched by a copper coin.

What is its mineral hardness on Mohs' scale?

- A 1
- B 3
- C 5
- D 7

Your answer

[1]

- 2 Which option has three minerals in the correct order of **increasing** hardness?

- A apatite, fluorite, calcite
- B gypsum, calcite, talc
- C quartz, topaz, corundum
- D topaz, apatite, diamond

Your answer

[1]

- 3 Which of the options are framework silicates?

- A feldspar and micas
- B feldspar and quartz
- C olivine and pyroxene
- D quartz and garnet

Your answer

[1]

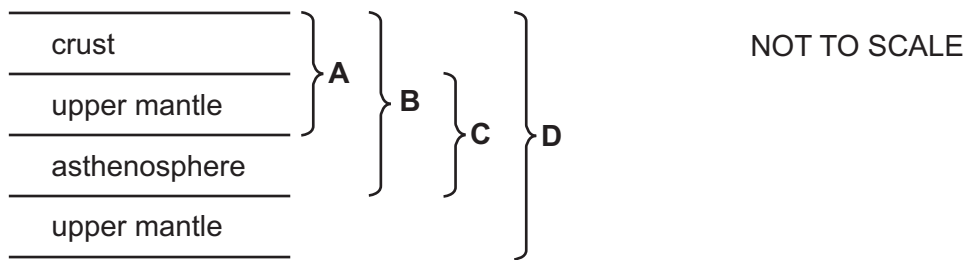
4 Which of the criteria is **not** always true when defining a mineral in geology?

- A It must be an inorganic compound
- B It must be naturally occurring
- C It must have a crystalline structure
- D It must have a known chemical formula

Your answer

[1]

5 Which combination of layers make up the lithosphere?



Your answer

[1]

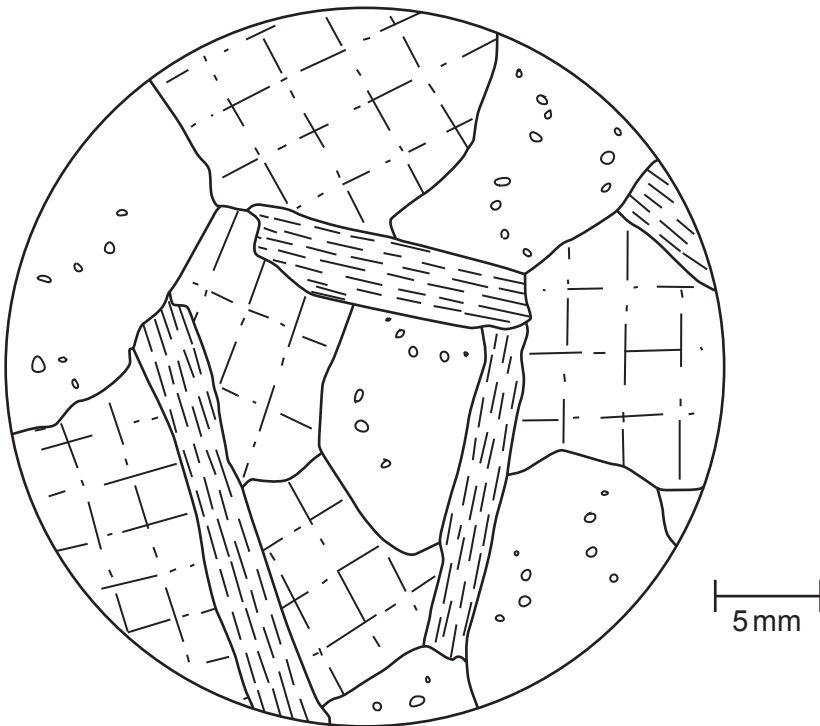
6 Which units should be used for measuring rock density?

- A g cm^{-3}
- B kg^3m
- C kg m^{-2}
- D t m^{-2}

Your answer

[1]

The diagram below shows a thin-section of an igneous rock. It only shows the margins of mineral crystals, cleavage and inclusions. Questions 7 and 8 refer to this diagram.



7 What is the rock type shown? Use your knowledge of mineral properties and the mineralogy of igneous rocks.

- A Basalt
- B Dolerite
- C Granite
- D Rhyolite

Your answer

[1]

8 Which term best describes the igneous texture shown in the thin-section diagram?

- A Amygdaloidal
- B Equicrystalline
- C Porphyritic
- D Vesicular

Your answer

[1]

9 Which property would be the most useful to distinguish between hand specimens of quartz, olivine and pyroxene?

- A Colour
- B Lustre
- C Reaction with acid
- D Streak

Your answer

[1]

10 Under the Goldschmidt classification, which element would be considered 'chalcophile'?

- A Iron
- B Lead
- C Magnesium
- D Uranium

Your answer

[1]

11 Concentration factors can be used to determine the relative concentrations of some elements.

If the average crustal abundance of Nickel is 0.0075%, what concentration factor is required to produce an ore body with 0.5% metal?

- A 0.015
- B 6.7
- C 15
- D 67

Your answer

[1]

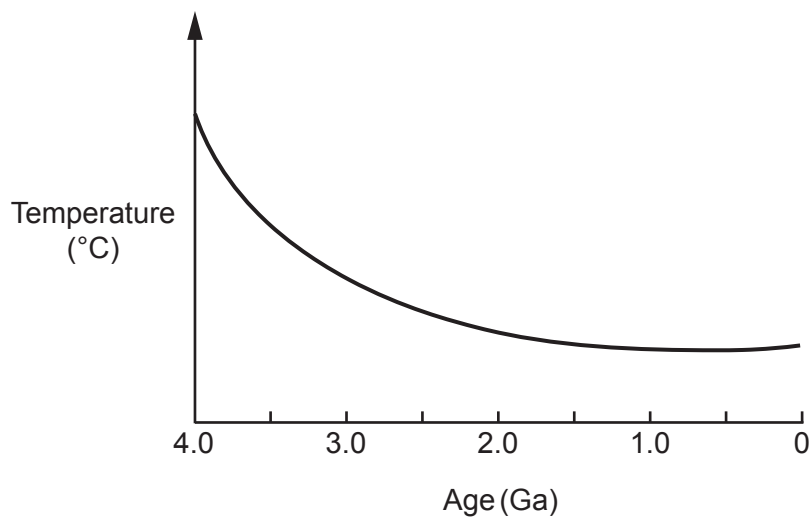
12 Which discontinuity option marks a **distinct** compositional change in the layered Earth?

- A Gutenberg and Lehmann
- B Lehmann and Moho
- C Moho and Gutenberg
- D Moho only

Your answer

[1]

13 The cooling curve of the Earth looks similar to the graph below.



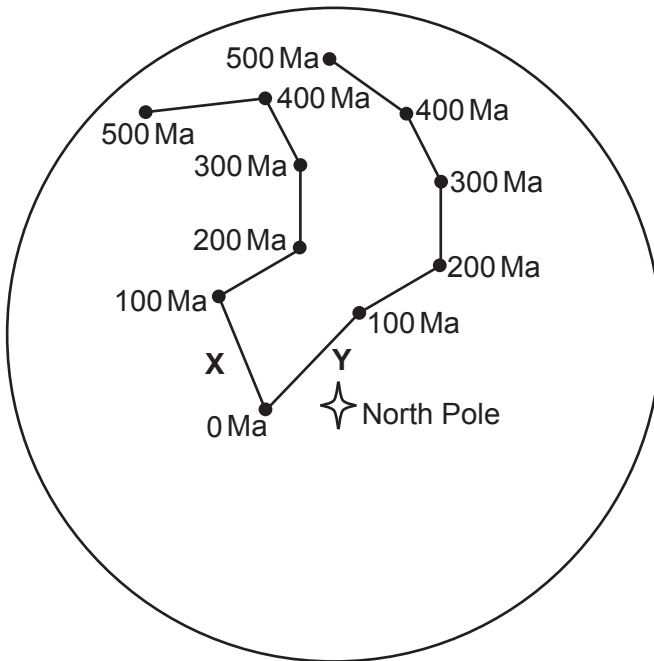
At what age does radioactive decay become significant?

- A 4.0 Ga
- B 3.0 Ga
- C 2.0 Ga
- D 1.0 Ga

Your answer

[1]

- 14 The diagram represents the apparent polar wandering curves of two continents X and Y. They are viewed from above the North Pole.



Which interpretation of the curves is correct?

- A X and Y split apart 500 Ma ago
- B X and Y were joined at 0 Ma and split apart by 100 Ma ago
- C X and Y were joined between 400 and 100 Ma ago
- D X and Y were the same distance apart between 100 and 400 Ma ago

Your answer

[1]

- 15 Salt pseudomorphs are found in a mudstone.

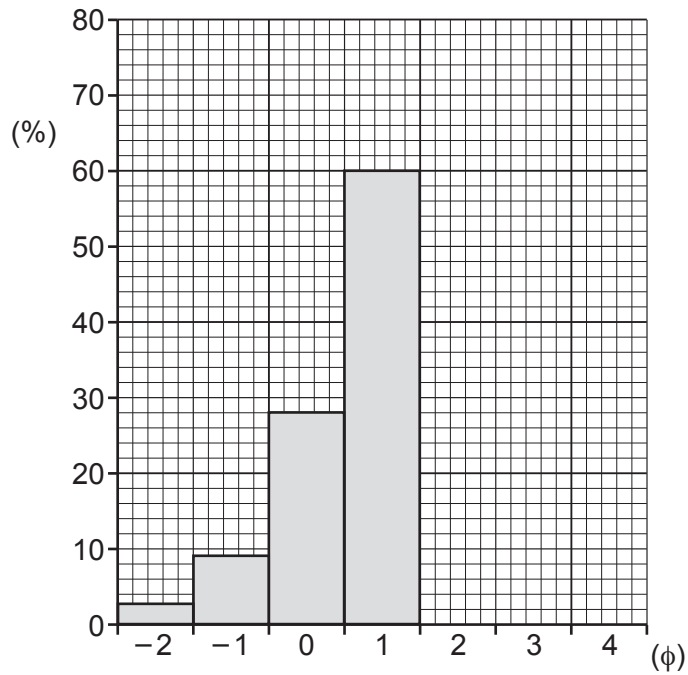
What is the most likely environment of deposition?

- A Desert environments
- B Fluvial environments
- C Shallow carbonate seas
- D Shallow siliclastic seas

Your answer

[1]

- 16 A sample of dune sand was sieved to analyse its grain size distribution. The results were plotted in the graph below which identified an anomalous result.



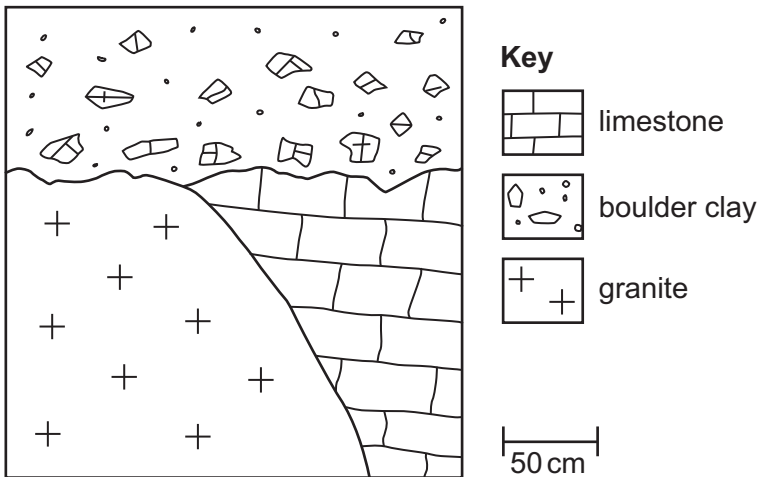
Which of the experimental errors caused the anomaly?

- A Balance inaccurate
- B Sand lost during weighing
- C Sieves not emptied before experiment
- D Sieves not in the correct order

Your answer

[1]

The diagram below is a geological cross-section. Questions 17 and 18 refer to this diagram.



17 Which process in the rock cycle would **not** be found in the rocks represented in the cross-section?

- A Deposition
- B Extrusion
- C Metamorphism
- D Uplift

Your answer

[1]

18 What transported the clasts to create the sediment in the uppermost bed of the cross-section?

- A Ice
- B Rivers
- C Waves
- D Wind

Your answer

[1]

19 What process could best explain the formation of chert?

- A Deposition of microfossils below the carbonate compensation depth (CCD)
- B Diagenesis of carbonate ooze on the sea bed
- C Precipitation from black smokers on ocean ridges
- D Reduction of fine muds on the deep sea bed

Your answer

[1]

20 Which option lists the events involved in the creation of the Solar System in the correct order?

- A Collapse of nebula, increased rate of rotation, formation of a star, formation of planetesimals
- B Formation of a protoplanetary disc, increased rate of rotation, formation of protoplanets, formation of a star
- C Formation of a star, increased rate of rotation, formation of protoplanets, formation of planetesimals
- D Supernova shockwave, formation of a star, collapse of nebula, formation of protoplanets

Your answer

[1]

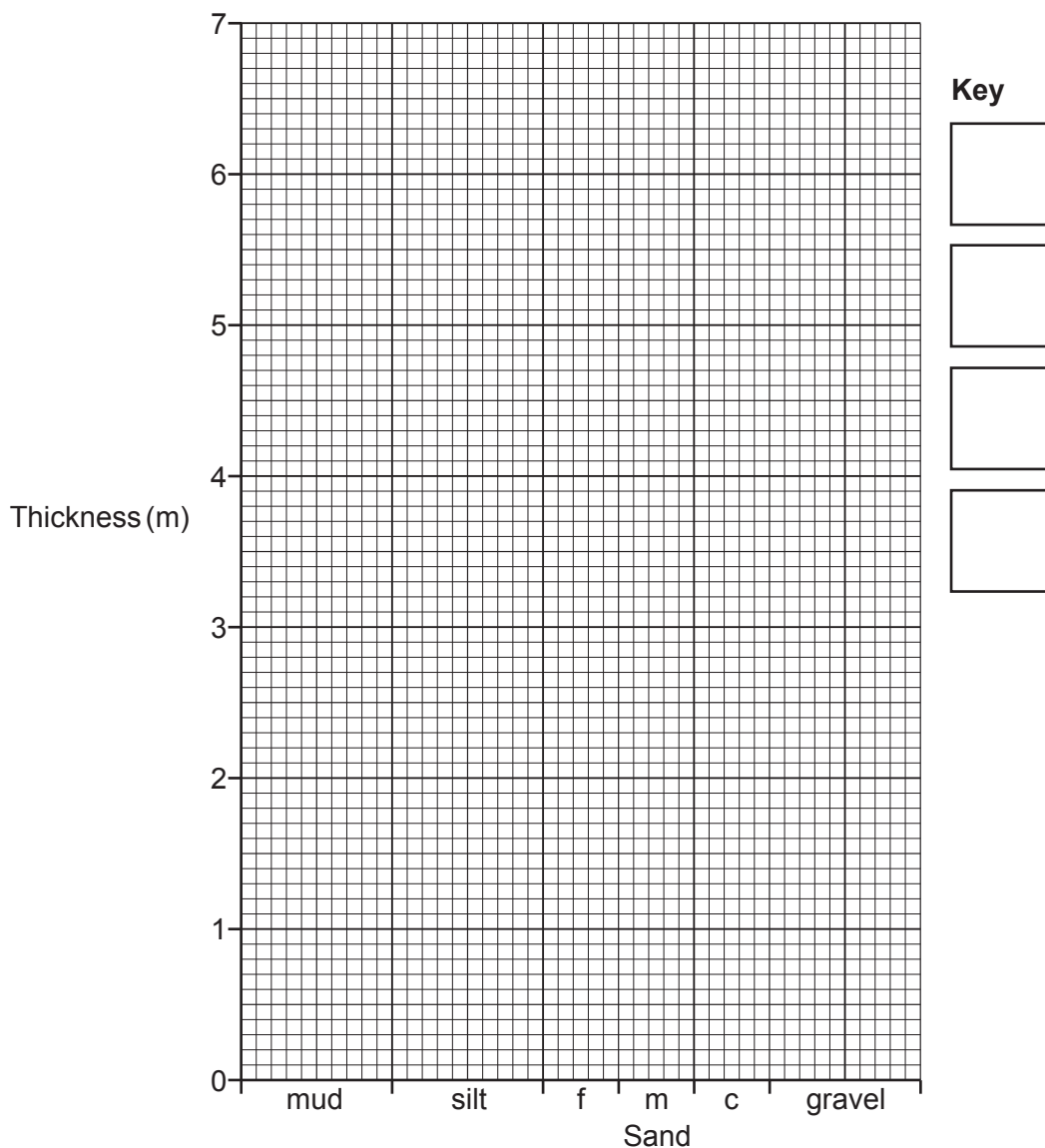
Section B

Answer **all** the questions.

- 21 A student measured the bed thickness and grain sizes of a sedimentary sequence and made observations, starting at the base of the sequence and working upwards. Their findings are recorded in the table.

	Thickness (m)	Observation
Base	0.5	Grains too small to measure, feels like clay. Upper surface eroded
	0.2	A mixture of smooth pebbles, cobbles and granules. Many clasts blade-shaped
	3.6	A fining-upwards bed of coarse to fine sands showing large-scale cross bedding
	1.8	A fining-upwards bed of silt showing small-scale cross bedding
Top	0.6	Grains too small to measure, rootlets seen at the top of the bed

- (a) (i) Using the information in the table, construct a graphic log of the sequence on the graph below. [4]



- (ii) Complete the log **and** key with appropriate symbols to represent the structures and observations. [2]

- (b) (i) Identify the environment in which the sequence was deposited. Explain your answer. [3]

Environment

Explanation

.....

.....

.....

.....

Additional answer space if required.

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Question 22(b) begins on page 17

16
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(b) Fig. 22.2 represents the logs of three boreholes taken from rocks which were part of a shallow siliclastic sea.

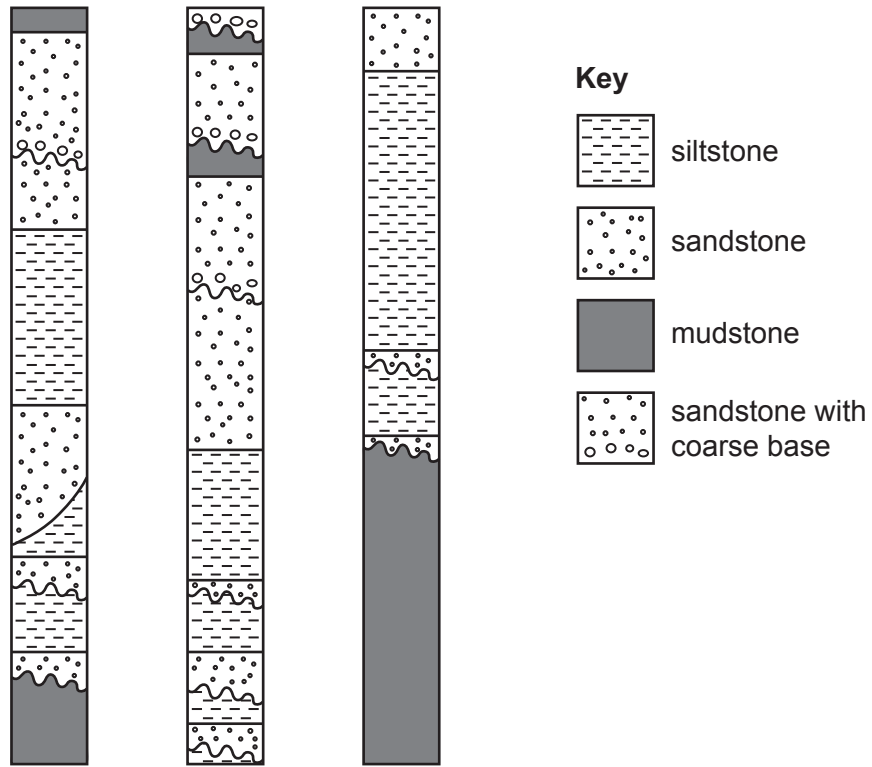


Fig. 22.2

(i) Draw lines on Fig. 22.2 correlating two bedding planes between the three logs. [2]

(ii) Many correlations depend on matching sequences of relative bed thickness.

Explain why the actual thickness of beds cannot be used in a reliable correlation.

.....
 [1]

(iii) It is often assumed that beds correlated by their lithology have the same age.

Describe and explain an example where this would not be the case.

.....

 [3]

(c) Fig. 22.3 is based on the biozones of ammonites in a stage of the Lower Jurassic. The arrows, labelled **A** to **H**, represent the range in which different species of ammonite are found.

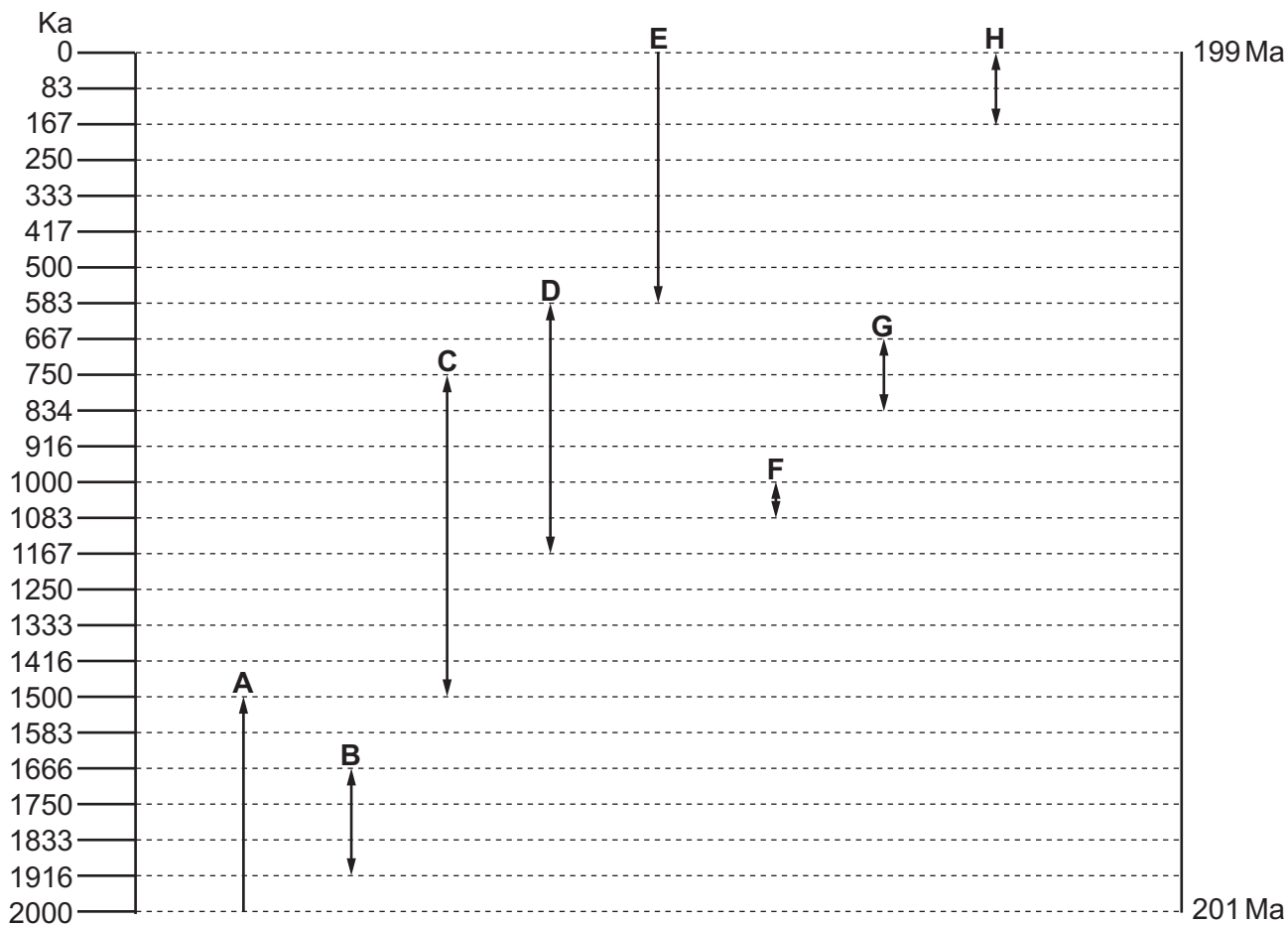


Fig. 22.3

(i) Which of the eight species, **A** to **H**, is the best zone fossil?

Explain your answer.

Species

Explanation

[2]

(ii) A rock was found to contain an assemblage of fossils **C**, **D** and **G**.

What is the possible age range of the rock?

Range = from to Ma

[2]

(iii) A bed contains only fossil **A**. The bed immediately above it contains **D** and **E**.

How could the plane between the two beds be described?

..... [1]

(iv) Give **three** reasons why ammonites are such useful zone fossils for the Jurassic.

1

.....

2

.....

3

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[3]

- 23** Xenoliths are fragments of the country rock incorporated into, and preserved in, the magma of a major intrusion.

A group of students assumed that the proportion of xenoliths would increase towards the margins of the intrusion. They completed some fieldwork by using a quadrat, sampling the percentage area of xenoliths in a granite where the contacts were not exposed.

The quadrat was placed at regular intervals along a W-E transect provided by a road cutting. The percentage area of the xenoliths was counted at each sampling point. The results are shown in the table.

Distance (m)	Xenolith area (%)
0	70
25	10
50	0
75	0
100	0
125	0
150	0
175	0
200	0
225	0
250	5
275	50
300	75
325	80
350	75
375	70
400	50
425	30
450	20
475	15
500	20
525	50

(b) The students used a systematic sampling technique.

Give **one** reason why this might **not** have been appropriate and suggest an alternative technique.

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..... [2]

(c) It was assumed that xenoliths would be more common closer to the margins of the intrusion.

Explain what **other** factors could affect changes in their distribution.

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..... [2]

(d) The students estimated the area covered by xenoliths rather than count the squares on the quadrat.

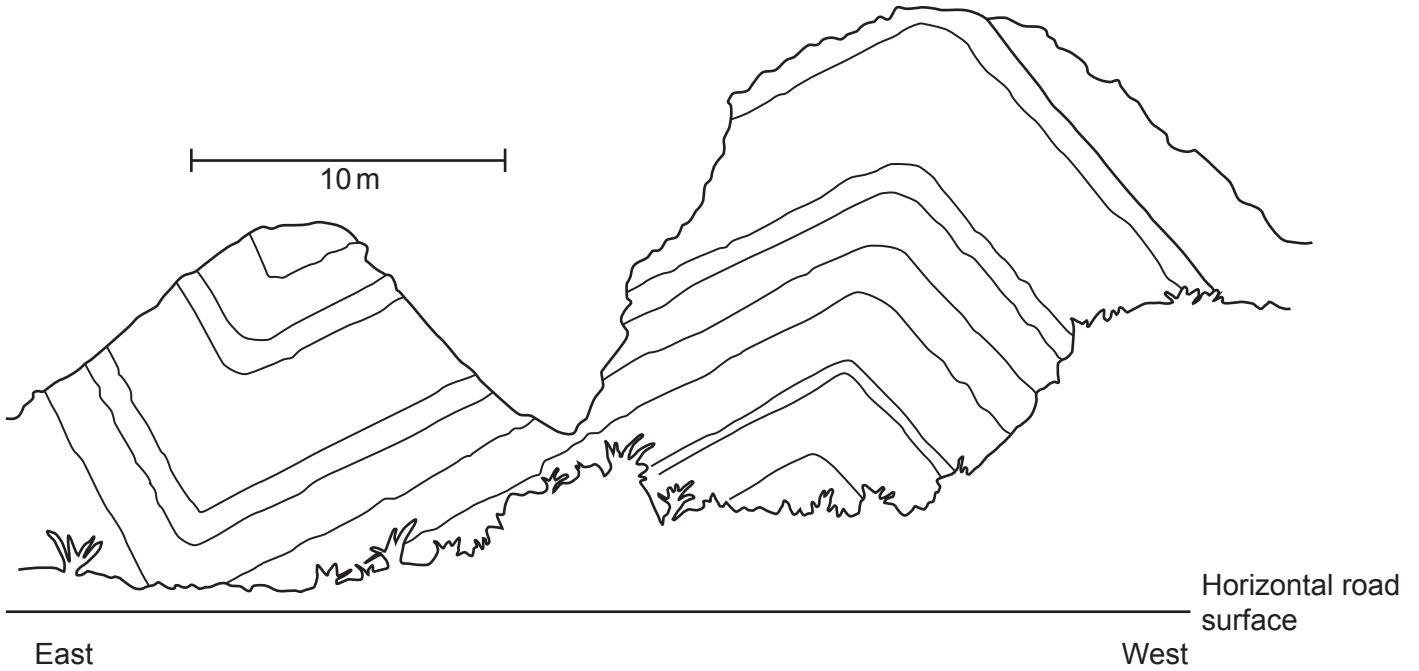
Suggest a piece of evidence that supports this conclusion.

.....
..... [1]

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Turn over for the next question

(b) The diagram represents a folded outcrop alongside a level road.



(i) Draw and label dotted lines representing the axial planes of the folds **on the diagram**. [1]

(ii) Measure the apparent dips of both limbs on the **western** fold.

Apparent dips = and [2]

(iii) Explain why only apparent dips can be measured in this instance.

.....
..... [1]

(iv) Describe the type of fold you have measured.

.....
.....
..... [2]

(v) Calculate the percentage by which the rocks have been shortened by the folding.

Percentage = % [2]

(c) A nearby outcrop of older slate has a definite cleavage. Measurements using the compass-clinometer of the dip of the cleavage from various parts of the slate outcrop are shown in the table. The table shows the dips of the cleavage measured and the frequency that result was found.

Dip (<i>x</i> degrees)	Frequency (<i>f</i>)	<i>x</i> × <i>f</i>	<i>x</i> − \bar{x}	$(x - \bar{x})^2$	<i>f</i> (<i>x</i> − \bar{x}) ²
67	0	0	−5	25	0
68	1	68	−4	16	16
69	2	138	−3	9	18
70	4	280	−2	4	16
71	5	355	−1	1	5
72	7	504	0	0	0
73	4	292	1	1	4
74	3	222			
75	1				
76	0				
77	2				
Total	29				
	Mean			Standard deviation	

(i) Calculate the mean dip of the cleavage.

Mean = degrees [2]

(ii) Compare the mean cleavage dip and the folding in part (b). Explain how they could be related.

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..... [2]

(iii) Calculate the standard deviation of the dip data.

Use the formula: $s = \sqrt{\frac{\sum(x - \bar{x})^2}{n - 1}}$

You can use the table to help.

Standard deviation = [3]

(iv) What does the standard deviation suggest about the data and how does its value compare to the errors involved in using a clinometer whose scale is graduated in 2° intervals?

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..... [2]

(b) Explain how the nature of the geomagnetic field provides indirect evidence for the properties of the core.

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..... [2]

(ii) How can the age of the magnetic anomalies be determined?

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..... [2]

(iii) Once mapped, these isochrons represent the position of the spreading ridge in the past.

Use the map to find the distance between St Johns, Newfoundland (**SJ**) and London, England (**L**), 60 Ma ago.

Distance = km [2]

(iv) Use the map to find the rate of spreading between 20 and 80 Ma in the North Atlantic. Measure this on a line between **SJ** and **L**.

Give your answer in cm a^{-1} .

Rate = cm a^{-1} [2]

(v) Compare the rate of spreading for the last 80 Ma to the east and west of the Mid-Atlantic Ridge.

.....
..... [1]

(vi) Explain why the rate of spreading would be less if measured further north.

.....
..... [1]

(b) The discovery of identical fossils of animals in both South America and South Africa in rocks of the same age has been used as one of the lines of evidence for continental drift.

(i) Suggest **one** explanation for the presence of these fossils in different continents **before** continental drift theory was accepted.

.....
..... [1]

(ii) Fossils of fresh-water animals such as *Mesosaurus* can be found in 270 Ma old rocks in two separate continents.

Explain how this evidence supports the idea of continental drift.

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..... [2]

(c) Using examples, explain how palaeoenvironments have been used to reconstruct historical plate movement.

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..... [4]

END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).

A large area of lined paper for writing, consisting of 25 horizontal dotted lines. A solid vertical line runs down the left side of the page, creating a margin. The rest of the page is open for writing.

A large area of the page is reserved for writing, featuring a vertical solid line on the left side and horizontal dotted lines extending across the page.



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