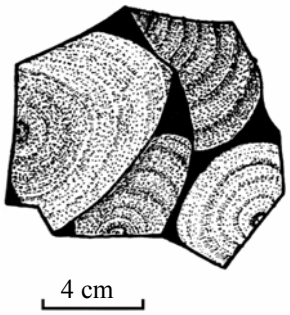
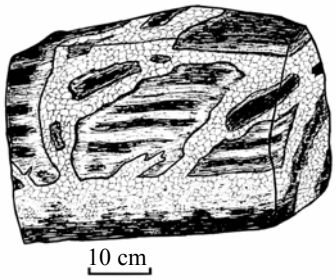
2010 Geology

Intermediate 2

Finalised Marking Instructions

Marks

1. **(a)** Complete the table below.

Drawing of rock	*What the rock is made up of (minerals or other materals)*	*How the rock was formed*	*Name of rock*
	rock fragments	rapid erosion and deposition of rock fragments	conglomerate
	**glass**	extremely rapid cooling of granitic magma	obsidian
	patches of quartz and feldspar in darker matrix	partial melting of gneiss	**migmatite**

1 mark each **3**

Marks

(b) Complete the table below by stating a property of each mineral that would help to distinguish between the pairs of minerals.

Minerals	*Distinguishing properties*	
quartz and gypsum	Property of quartz: Property of gypsum:	**harder (7)/steel blade cannot scratch it/ denser/conchoidal fracture/non fibrous** **less hard (2)/finger nail can scratch it/ less dense/fibrous structure/good cleavage on one plane**
galena and pyrite	Property of galena: Property of pyrite:	**metallic grey colour/higher density (7.5 g cm^{-3})** **brassy yellow colour/lower density (5.0)/ no cleavage**
malachite and olivine	Property of malachite: Property of olivine:	**reacts with HCℓ/green flame test/3.5 – 4 hardness/density 4.0** **no reaction with HCℓ/no colour with flame test/6.5 – 7 hardness/density 3.8**

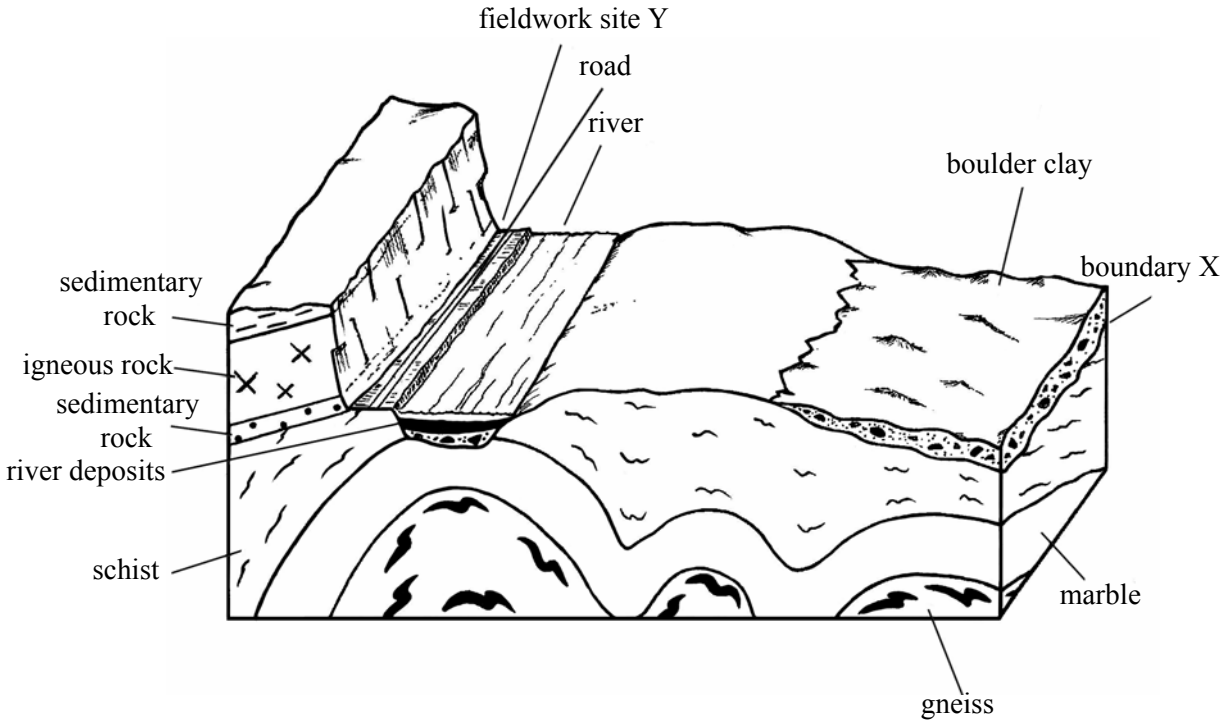
3

As long as the candidate indicates which is the hardest and softest Mohs' the numbers are not necessary. Also if the candidate indicates which is the more or least dense then the actual density values are not necessary.

1 mark per comparison

Marks

2. Study the sketch below. It shows a river valley and its geology.



(a) Which **two** of the following statements are correct?

A Marble is formed by the metamorphism of siltstone.

B Boulder clay is the youngest deposit.

C Schist is a higher grade metamorphic rock than gneiss.

D The river deposits are the youngest deposits.

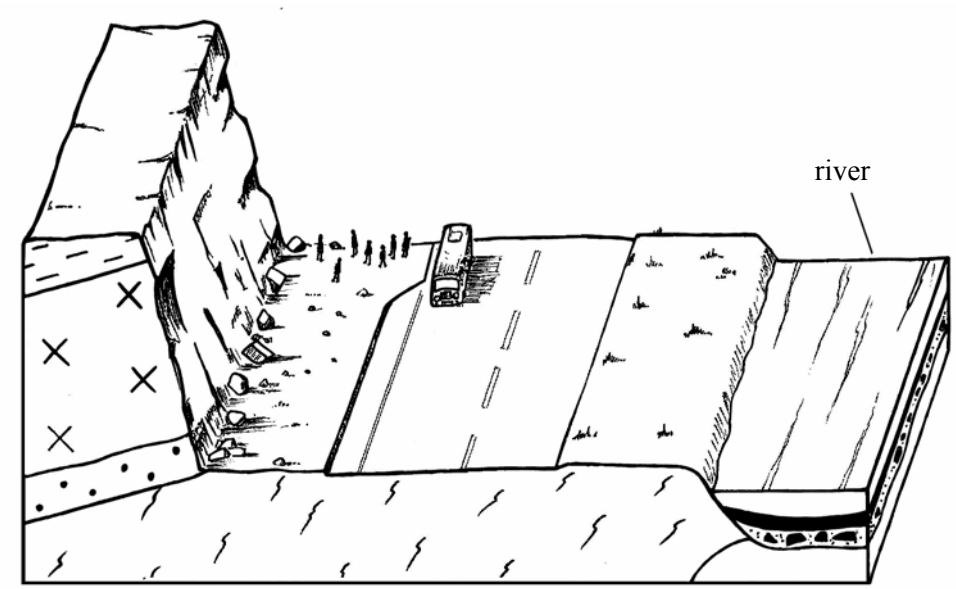
E X is a thrust fault.

F X is an unconformity.

Give only the letters: **D** and **F** **2**

Marks

(b) The diagram below shows fieldwork site Y in more detail.



Describe **four** safety precautions that should be taken whilst studying the rocks at this site.

1 **Wear hat in case of rock falls/sturdy footwear to cross boulder area**

2 **An indication of awareness of road dangers eg park off the road**

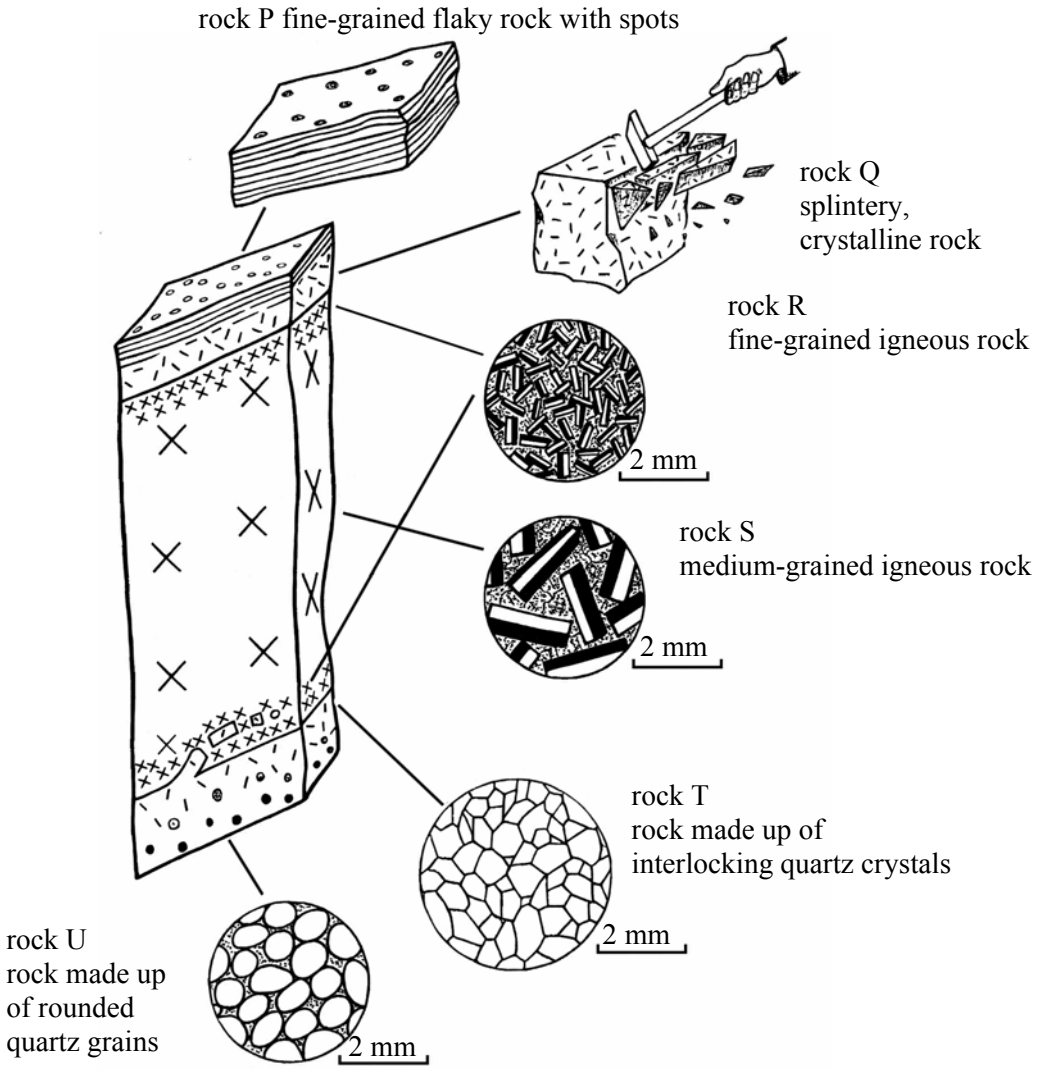
3 **An awareness of dangers posed by the river eg keep away from river**

4 **Have a first aid kit**

Or any other reasonable precaution **2**

4 = 2 marks
3 = 1 mark
1 or 2 = 0 marks

		Marks
(c)	Following fieldwork at site Y, a student recorded these annotated diagrams in his notebook.	



Give **two** pieces of evidence that indicate that the igneous rock layer is a sill and not a lava flow.

Any two of the following:

- **The rocks on either side have been baked/metamorphosed**.
- **There is evidence of a chilled margin indicating contact with cooler older rocks on both sides**.
- **There is no sign of a fossil soil forming on the upper area of the igneous rock therefore no exposure to the atmosphere**.
- **Transgression which indicates that it is a sill**. **2**

Marks

(d) Complete the table below.

Rock type on diagram	*Name of rock*	*How rock was formed*
P	**spotted rock**	**low grade thermal metamorphism of shale**
Q	**hornfels**	**high grade thermal metamorphism of shale**
T	**metaquartzite/ quartzite**	**thermal metamorphism of sandstone**
U	Sandstone	Deposition of quartz grains followed by burial, compaction and cementation to make this sedimentary rock

3

1 mark for the three rocks named correctly
1 mark for the three rock formations named correctly

Any three parts correct gains 1 mark
Any 5 parts gains 2 marks
All 6 parts correct gains 3 marks

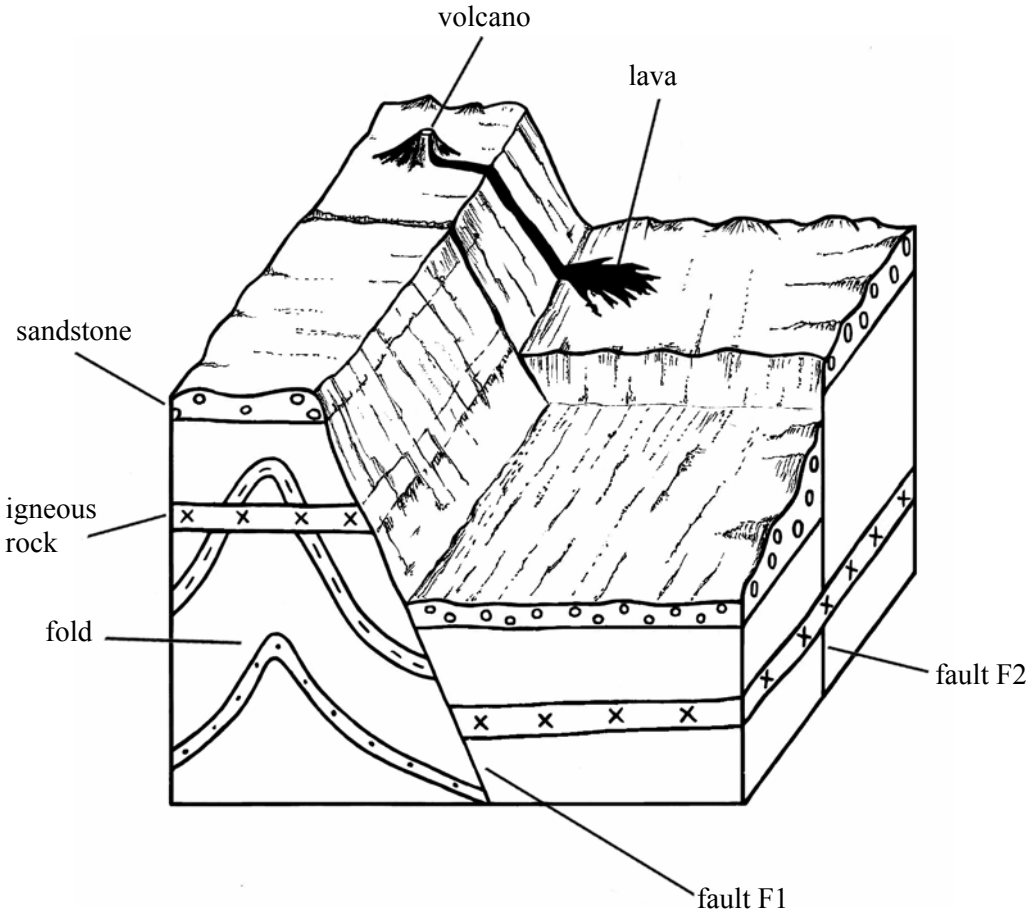
(e) Explain why rock R is finer-grained than rock S.

- **small crystals indicate rapid cooling/large crystals indicate slow cooling**
- **R cooled faster because of contact with cold (country) rock**
- **S cooled slowly because it was in the middle of the intrusion**
- **R lies on the chilled margin**

1

	Marks

3. Study the block diagram.



(a) **(i)** What type of fold is shown on the diagram?

- **anticline** **1**

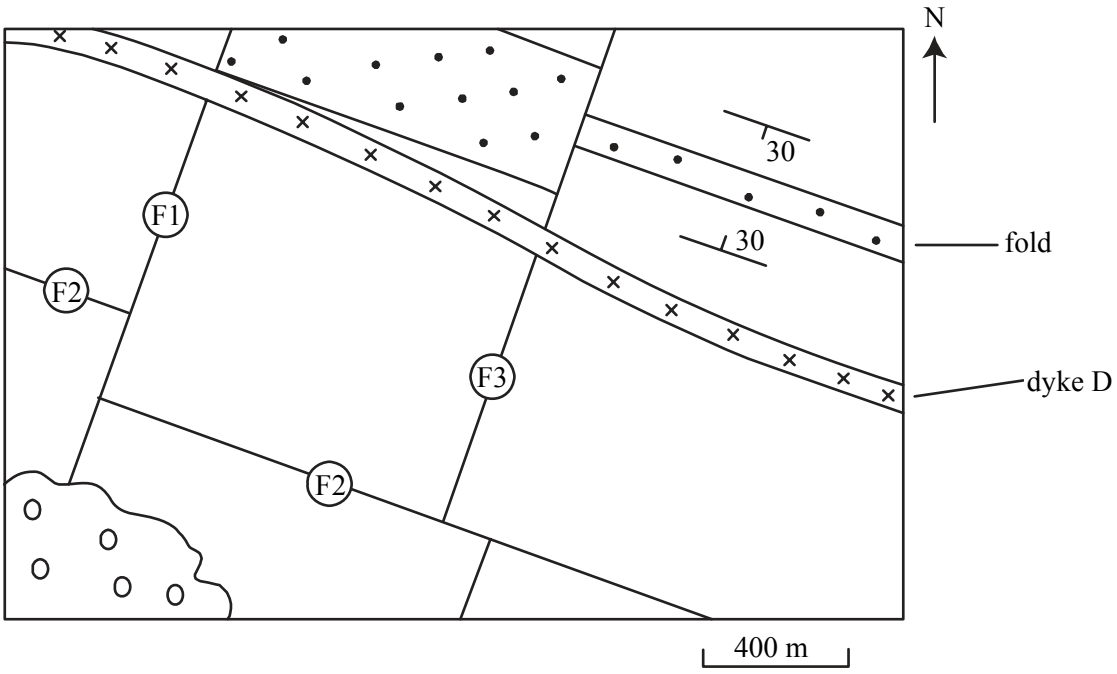
(ii) What type of fault is F1?

- **normal fault** **1**

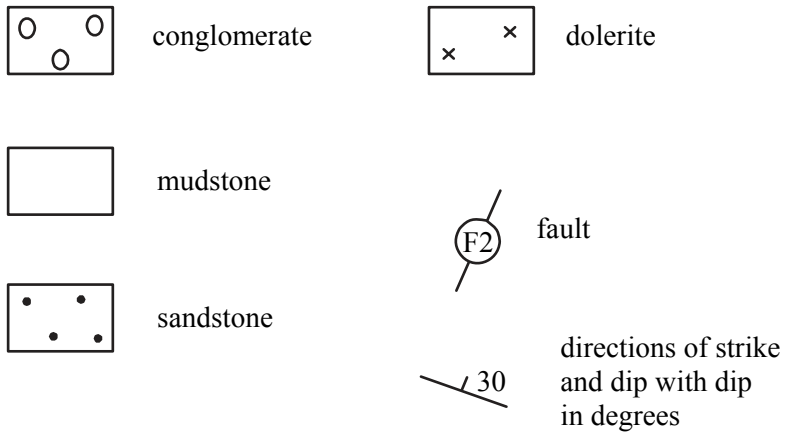
		Marks
(b)	Place the following events in the correct order from oldest to youngest.	
	A Movement on fault F1	
	B Movement on fault F2	
	C Folding of rocks	
	D Intrusion of igneous rock	
	E Eruption of volcano	
	F Deposition of sandstone	
	Give only the letters: **C → F → B → D → A → E** (oldest … youngest)	**3**
	6 in correct order = 3 marks **4 or 5 in correct order = 2 marks** **2 or 3 in correct order = 1 mark** **1 or less in order = 0 marks**	

Marks

4. Study the geological map.



Key (rocks not in order of age)



(a) What type of fold is shown on the map?

- **syncline** **1**

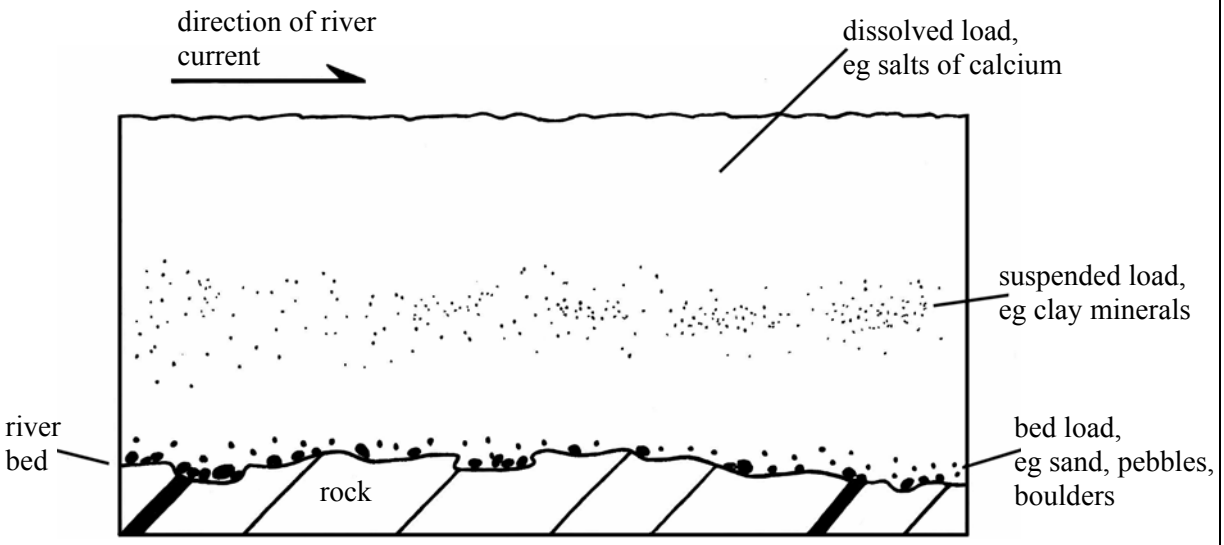
(b) How can you tell that the rocks on the south-east of fault F3 have been moved up relative to the rocks on the north-west side?

- **The sandstone outcrop is narrower indicating greater erosion due to uplift on the SE side/older mudstone comes in contact with younger sandstone to the NW of the fault indicating uplift to the SE has taken place**. **1**

		Marks
(c)	Explain why you cannot tell if the conglomerate is older or younger than dyke D.	
	• **The conglomerate was deposited over fault F1. F1 came after F2 because it displaced it. F2 followed F3. F1 was the last fault and both the dyke and the conglomerate came after it but made no contact with any other common feature**. • **No cross cutting relationship to allow relative age to be established.**	**1**
(d)	Place the following events in the correct order from oldest to youngest.	
	A Movement on Fault F2	
	B Deposition of mudstone	
	C Movement on fault F3	
	D Intrusion of dyke D	
	E Deposition of sandstone	
	F Movement on fault F1	
	Give only the letters: **B → E → C → A → F → D** oldest youngest	**3**
	6 in correct order = 3 marks **4 or 5 in correct order = 2 marks** **2 or 3 in correct order = 1 mark** **1 or less in order = 0 marks**	

Marks

5 The diagram shows how material is transported by a river.



(a) From the diagram, give **one** piece of evidence for each of the following.

Chemical weathering has taken place in the area drained by the river.

- **Rain water (a weak acid)/acid rain has reacted with material in the river giving calcium salts in solution or clay minerals produced** **1**

Erosion is taking place or has taken place.

- **A variety of rock fragments are present in the river/clay, sand, pebbles and boulders are present/river bed is uneven** **1**

	Marks

(b) The table shows current speeds at which clay, sand and pebbles are eroded and deposited.

Particle	*Minimum current speed of water needed to cause erosion* (cm/second)	*Current speed of water below which particles are deposited* (cm/second)
Clay	100·00	0·01
Sand	20·00	10·00
Pebbles	70·00	30·00

(i) Between which current speeds will sand be transported but not eroded?

- **>10 and <20 cm/second** **1**

(ii) Explain why it takes a faster current to erode clay than to erode sand?

- **The moving water cannot easily push into the very small pore spaces between the clay/the clay particles are attracted to one another and do not easily part/the clay particles are sticky/clay is stronger than sand** **1**

(iii) Explain why pebbles are deposited at faster current speeds than sand.

- **The pebbles are heavier and require faster currents to move them than sand particles**.
- **Pebbles are heavier so settle from faster currents.** **1**

(c) In the Earth's crust:

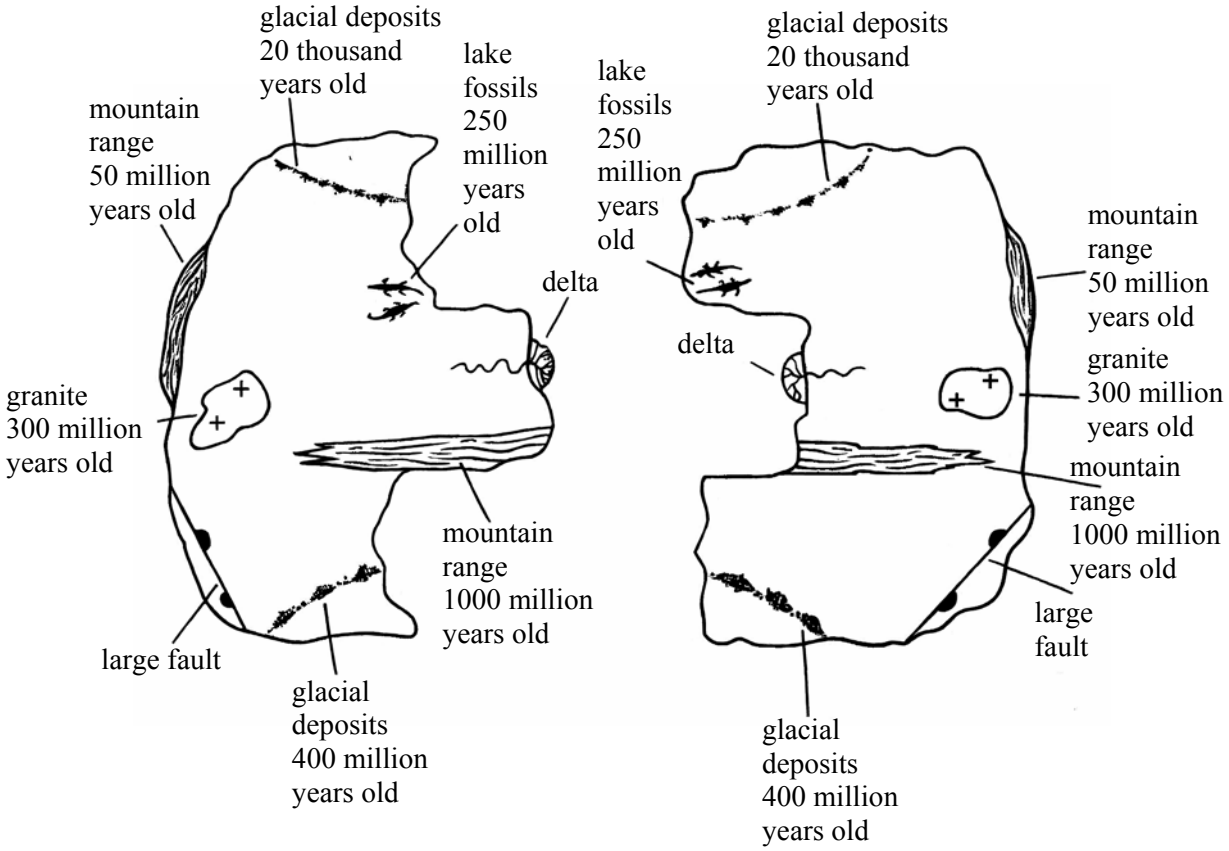
- 45% of all sedimentary rock is mudstone
- 32% is sandstone
- 22% is limestone.

What is the percentage occurrence of all other types of sedimentary rock (salt deposits, coal, etc)?

- **1%** **1**

Marks

6. Study the maps of the continents.



(a) Give **four** pieces of evidence which suggest that the continents were once joined.

1 **The continents would fit together like a jigsaw (ignoring the recent deltas)**

2 **Ancient 1000 million year old mountain ranges match up**

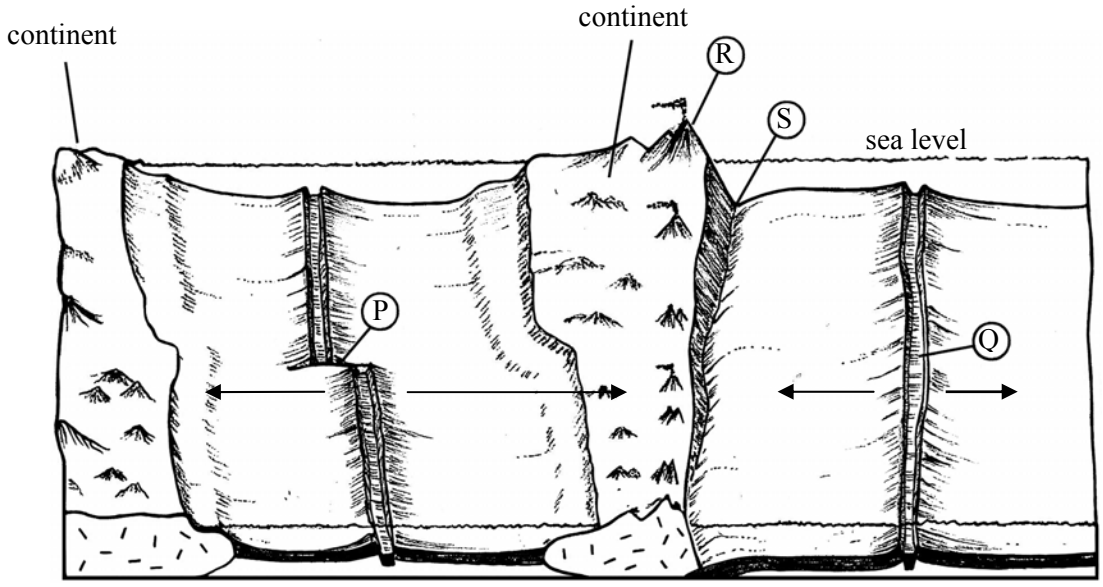
3 **Matching 250 million year old lake fossils**

4 **Matching 400 million year old glacial deposits** **3**

4 correct = 3 marks
3 correct = 2 marks
2 correct = 1 mark
1 correct = 0 marks

	Marks

(b) The diagram shows lithospheric plates.



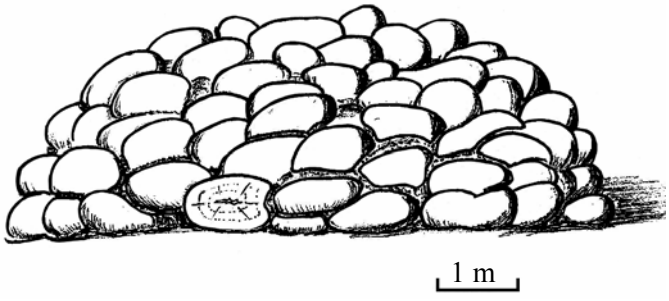
(i) How many plates are shown on the diagram?

- **4 plates** — **1**

(ii) On each plate draw an arrow to show the direction of plate movement. — **2**

4 correct = 2 marks
3 or 2 correct = 1 mark
1 correct = 0 marks

(c) The diagram shows a type of lava.



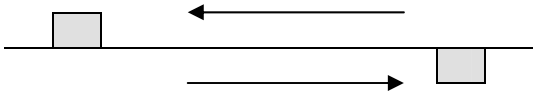
At which position on the map (P, Q, R or S) would this type of lava be found?

Position: **Q** — **1**

			Marks
(d)	**(i)**	Which position on the diagram (P, Q, R or S) shows a transform fault? Position: **P**	**1**
	(ii)	How does movement on a tear fault differ from movement on a transform fault? **Two** diagrams must be used in your answer.	

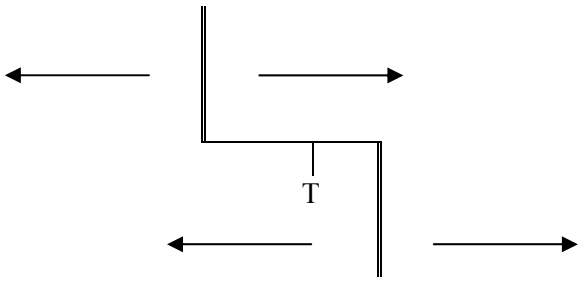
Tear fault diagram

It occurs within a plate



Transform fault diagram

It occurs along a plate edge where plates are sliding past each other.



2

Marks

(e) The table shows how ocean depth changes with age away from an oceanic ridge.

Age of oceanic crust (million years)	*Depth of ocean* (m)	*Change in depth over the previous 50 million years* (m)	*Temperature of crustal rocks*
0	2300		High
50	5000	2700	
100	5900	**900**	
150	6100	**200**	
200	6150	**50**	Low

(i) Complete the table to show the change in depth over the remaining 50 million year intervals. **1**

(ii) Describe the relationship between age and depth of the oceanic crust as shown in the table.

- **As age increases the depth increases** **1**
- **The rate of deepening is faster to begin with then slows down** **1**

(iii) Using information given in the table, give a reason to explain why the depth of the ocean changes.

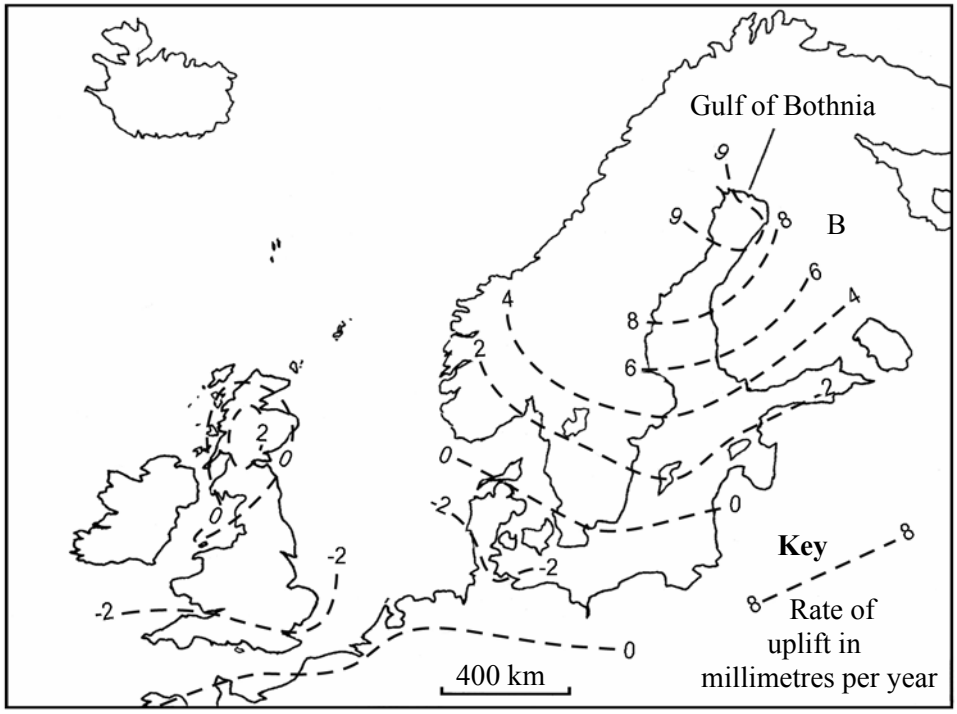
- **The oceanic crust has contracted on cooling as it moves away from the oceanic ridge/the oceanic crust near the ridge is hot and thus has a larger volume (giving a shallower sea).** **1**

(iv) Predict a possible depth for oceanic crust that is 250 million years old.

- **Any answer > 6150 metres and < 6200 metres** **1**

Marks

7. The map shows the rate of isostatic uplift for part of north-west Europe.



(a) Explain why isostatic uplift is taking place around the Gulf of Bothnia.

- **During the last ice age the crust was depressed by an ice mass (1)**
- **Since it has now melted the land is rebounding (1)** **2**

(b) Suggest why the rate of uplift is faster in the Gulf of Bothnia than in Scotland.

- **The region with the greatest accumulation of ice during the Ice Age will rebound the most** **1**

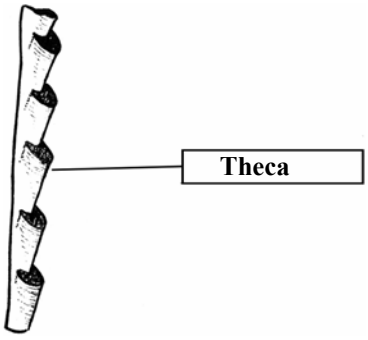
(c) What information on the map indicates that southern England is sinking rather than rising?

- **It has a negative (-2) rate of uplift** **1**

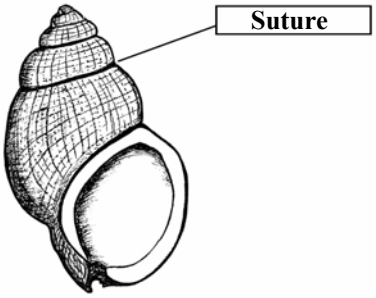
	Marks

8. **(a)** **(i)** Name the parts of the fossils.

Fossil P

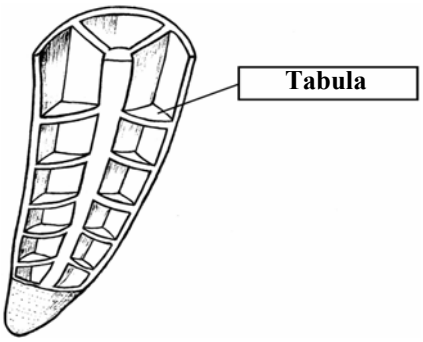


Fossil Q

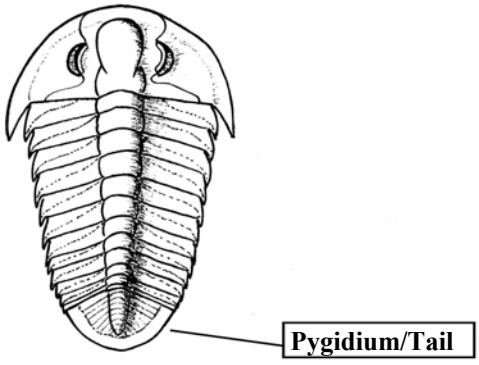


Fossil R

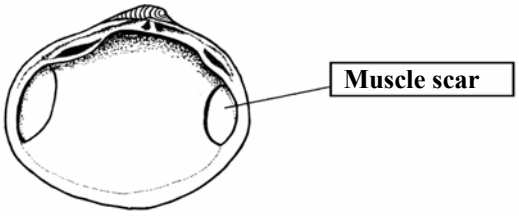
Fossil S



Fossil T



Fossil U



All 6 correct = 3 marks
4 or 5 correct = 2 marks
2 or 3 correct = 1 mark
1 correct = 0 marks — **3**

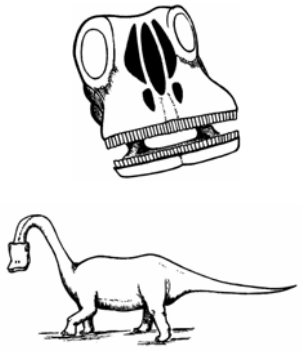
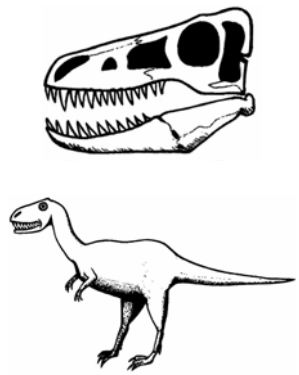
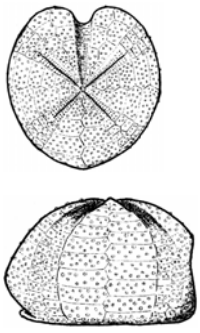
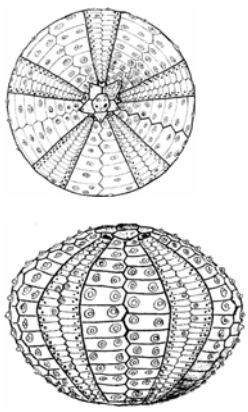
(ii) Name fossils P, Q, R, S, T and U.

Name of fossil P	**graptolite**
Name of fossil Q	**gastropod**
Name of fossil R	**plant**
Name of fossil S	**coral**
Name of fossil T	**trilobite**
Name of fossil U	**bivalve**

All 6 correct = 3 marks
4 or 5 correct = 2 marks
2 or 3 correct = 1 mark
1 correct = 0 marks — **3**

Marks

(b) Complete the table by saying how each animal lived and give a reason for each answer.

Animal	*How the animal lived with reason*
	How animal lived: **Herbivore** Reason: **numerous flattish teeth indicate grazing or browsing/short thick legs indicate slow moving/no weapons for attack/long neck to browse tall plants (1)**
	How animal lived: **Carnivore** Reason: **pointed teeth useful in holding prey/sharp teeth useful in attacking/teeth (probably) adapted for tearing prey/has sharp claws that could be used in attack/long legs indicates it runs fast to catch prey (1)**
	How animal lived: **Burrowing (marine)** Reason: **streamlined shape an adaptation to burrowing/anus towards top and rear/waste sent to back of burrow/mouth towards front and base to allow feeding in newly excavated burrow space (1)**
	How animal lived: **non burrowing (marine)/surface dweller** Reason: **anus centre top allowing water to flow around and take waste away/rounded shape not good for burrowing/mouth at centre of base for grazing the sea floor (1)**

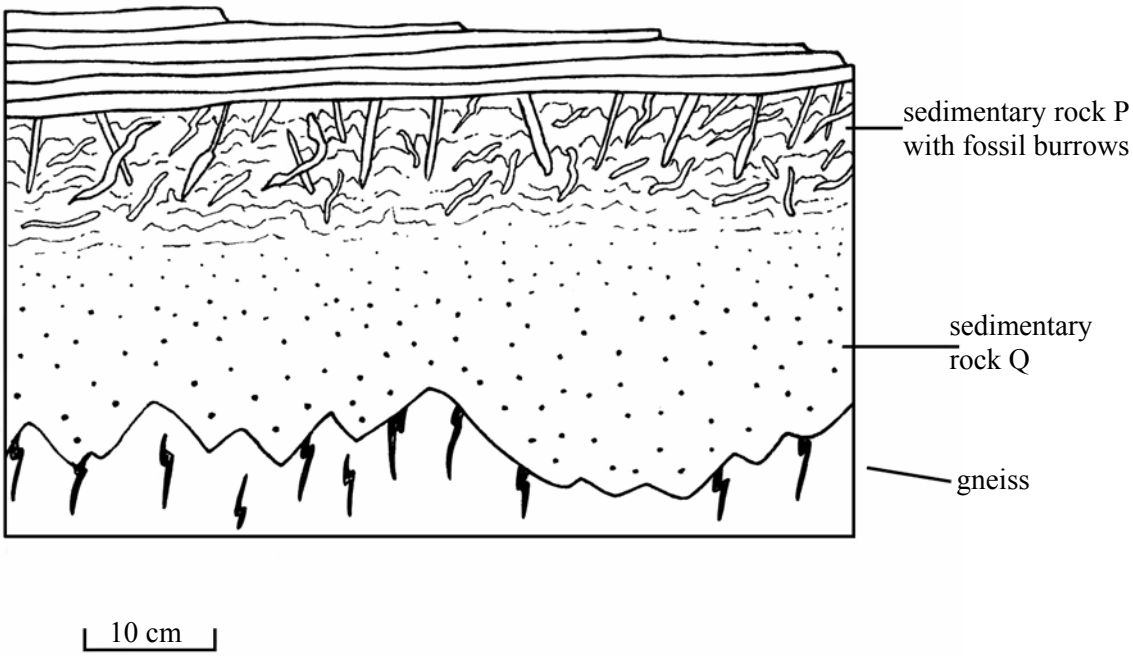
If a candidate states correctly how two animals lived they gain 1 mark even if the reasons are incorrect. If the candidate states correctly how all 4 lived with incorrect reasons they obtain 2 marks.

4

		Marks
(c)	Why are zone fossils useful?	
	• **For dating rocks/correlation**	**1**
(d)	Give **two** properties of good zone fossils.	
	1 **Geographically widespread/easily identifiable**	
	2 **Have shown rapid evolution/abundant**	
	3 **Well preserved**	**2**
(e)	Name **two** fossils used in zoning.	
	1 **Ammonites**	
	2 **Graptolites**	
	3 **Trilobites**	
	4 **Plant spores**	
	5 **Fresh water mussels**	
	6 **Micraster**	
	Or any other correct answer	**1**

Marks

9. The diagram shows rocks in a quarry.

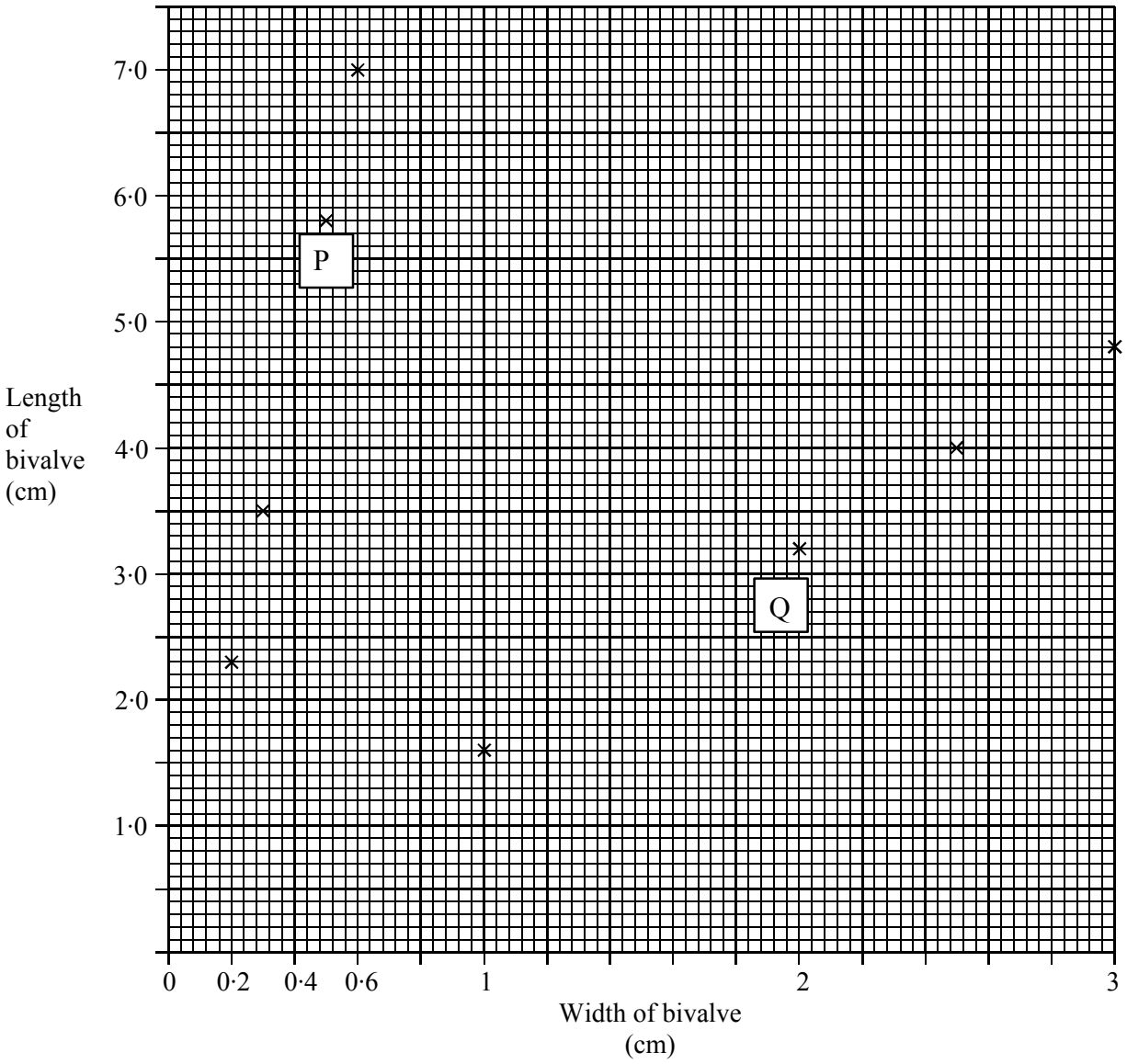


A student on a field trip to the quarry collected four bivalves from rock P and four from rock Q. After the student slipped on a rock, the eight became mixed up. On returning to the lab, the student labelled the bivalves A to H and measured their lengths and their widths.

The lengths and widths of all the bivalves are given in the table.

Label	*Length of bivalve* (cm)	*Width of bivalve* (cm)
A	1·6	1·0
B	3·5	0·3
C	5·8	0·5
D	4·8	3·0
E	7·0	0·6
F	3·2	2·0
G	4·0	2·5
H	2·3	0·2

			Marks
9.	**(a)**	On the graph paper below, plot length against width for each bivalve. The plot for bivalve A has been done for you.	



2

(b) **(i)** The bivalves seem to fall into two groups, one which came from rock P and the other from rock Q.

On the graph label the bivalves belonging to rock P. **1**

See graph above.

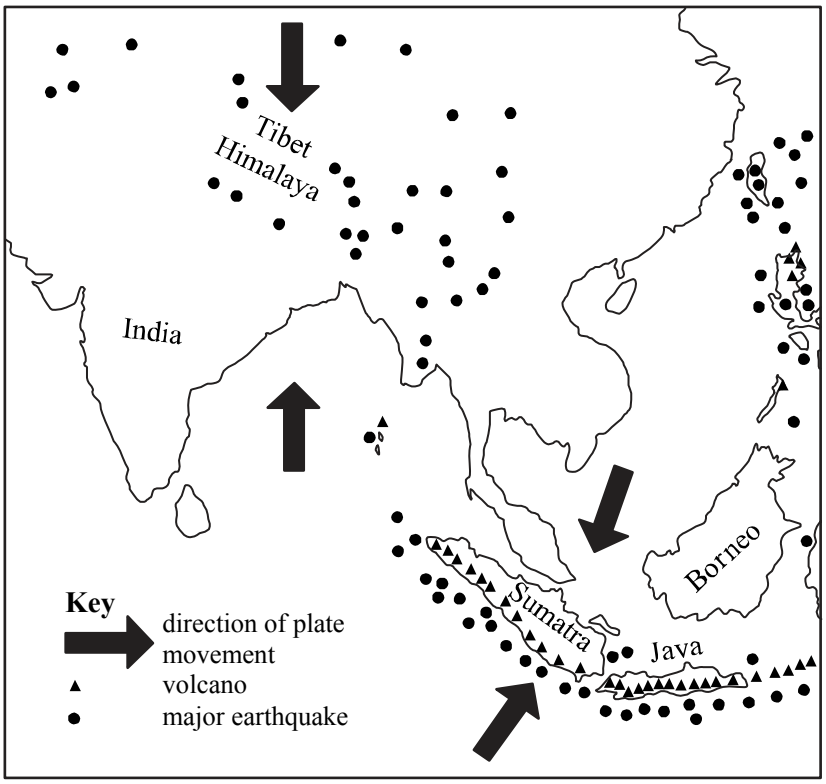
Q is labelled on the graph above but is not necessary.

(ii) Give a reason for your choice.

Reason: **Burrows are seen in rock layer P and a long thin shape is suited to burrowing**. **1**

Marks

10. Study the seismic hazard map of south Asia.



(a) **With the aid of a diagram**, explain why earthquakes **and** volcanoes are common in the Sumatra-Java area shown on the map.

Volcanoes **One plate is subducting underneath another, rocks melt and magma rises to form volcanoes (1)**

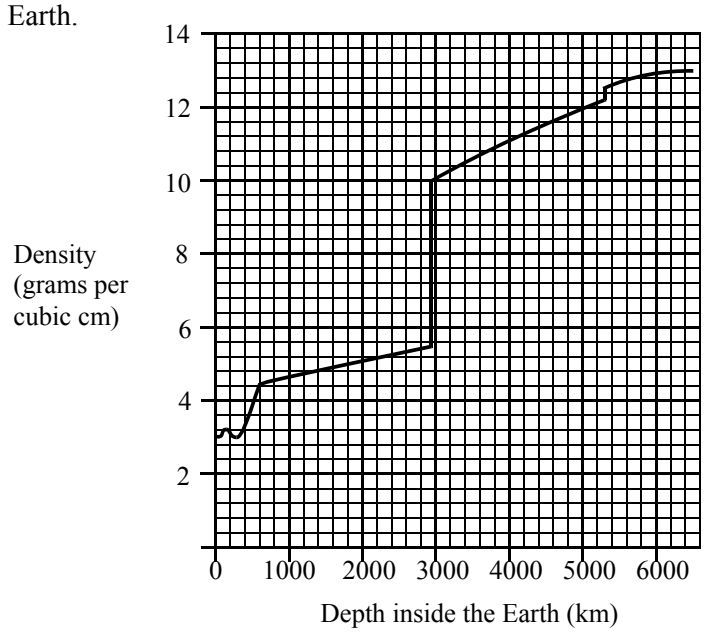
Earthquakes **Rocks are compressed and break (1)**
An annotated diagram would suffice. However, if there is no diagram deduct 1 mark. **2**

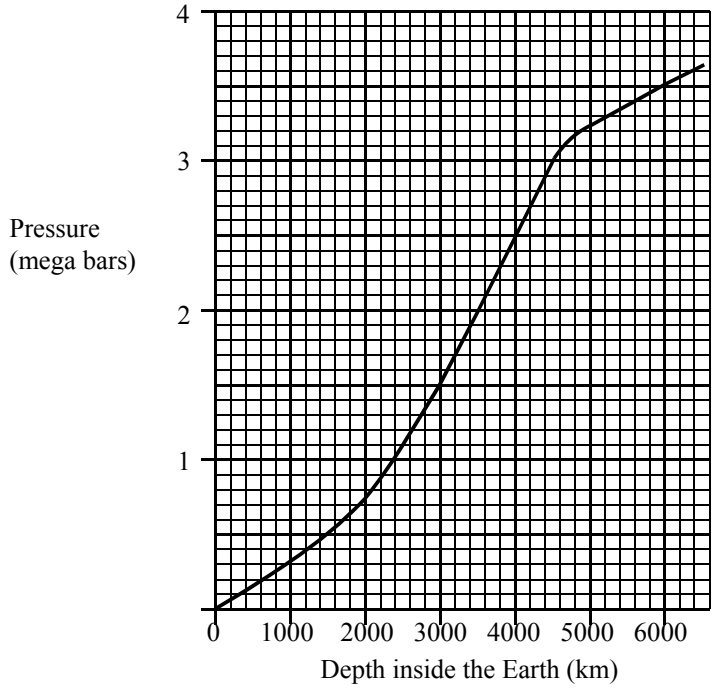
(b) Suggest why there are no active volcanoes in Tibet.

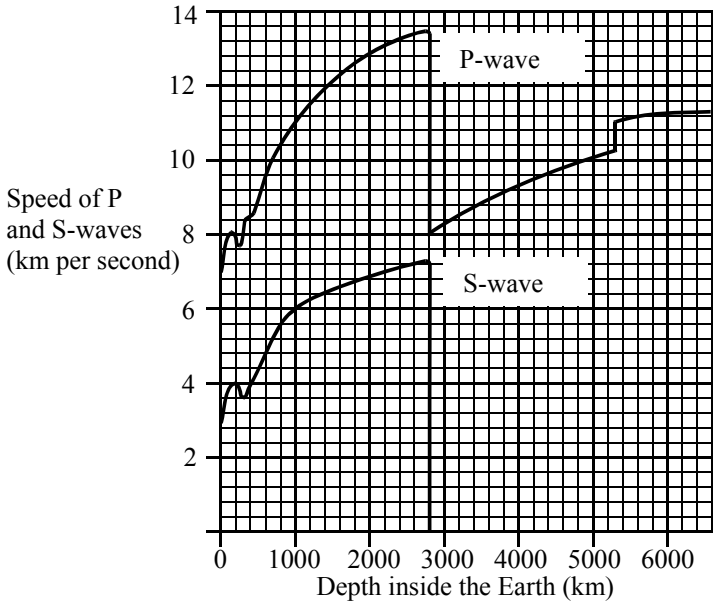
- **There is no subduction**. **1**

	Marks

(c) The graphs give information on earthquake waves and on changing conditions inside the Earth.



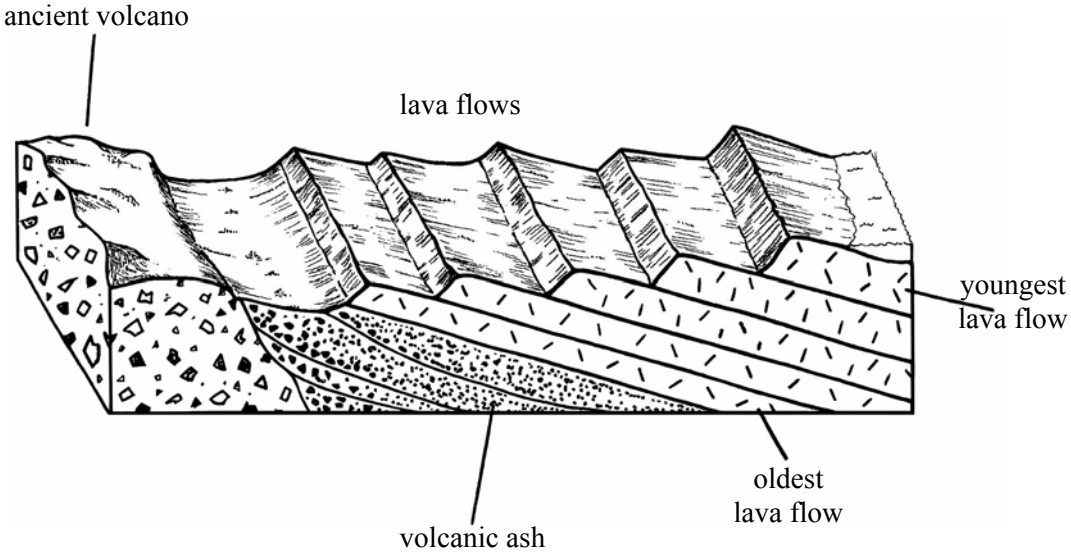




			Marks
(c)	**(i)**	Explain why density changes suddenly at a depth of 2900 km.	
		• **The rock material is different/changes/becomes more dense (due to more iron)/a change from mantle to core/change from peridotite to liquid iron.**	**1**
	(ii)	Explain why S-waves stop at a depth of 2900 km.	
		• **S-waves cannot travel through a liquid**.	**1**
(d)	**(i)**	By how many times does the density of the Earth increase from its surface to the centre?	
		You must show your working.	
		Answer: **approx 4 times (4·3)**	**2**
		• **Obtaining surface and centre densities (approx 3 and 13 g cm^{-3}) (1)** • **Completing calculation (1)**	
	(ii)	From the graphs, which **three** statements are correct?	
		A The speed of P-waves sometimes decreases as depth increases.	
		B To a depth of 2900 km, P-waves travel at about twice the speed of S-waves.	
		C The average density of the Earth is about 13 g/cm^3.	
		D The speed of P-waves increases in the same way that density increases.	
		E Pressure always increases as depth increases.	
		F The change of S-wave speed is caused by pressure change inside the Earth.	
		Give only the letters: **A, B** and **E**	**2**
		All 3 correct = 2 marks **2 correct = 1 mark** **1 correct = 0 marks**	

Marks

11. The diagram below shows the remains of an old volcano and five lava flows.



The table below shows the percentage by volume of the main minerals found in the five different lava flows.

Age of lava (millions of years)	*Percentage (%) by volume of the main minerals*			
	Quartz	*Feldspar*	*Amphibole*	*Pyroxene*
1	35·0	60·0	0·0	0·0
2	31·0	59·0	10·0	0·0
3	25·0	55·0	10·0	10·0
4	6·5	52·0	26·0	13·0
5	0·0	50·0	10·0	35·0

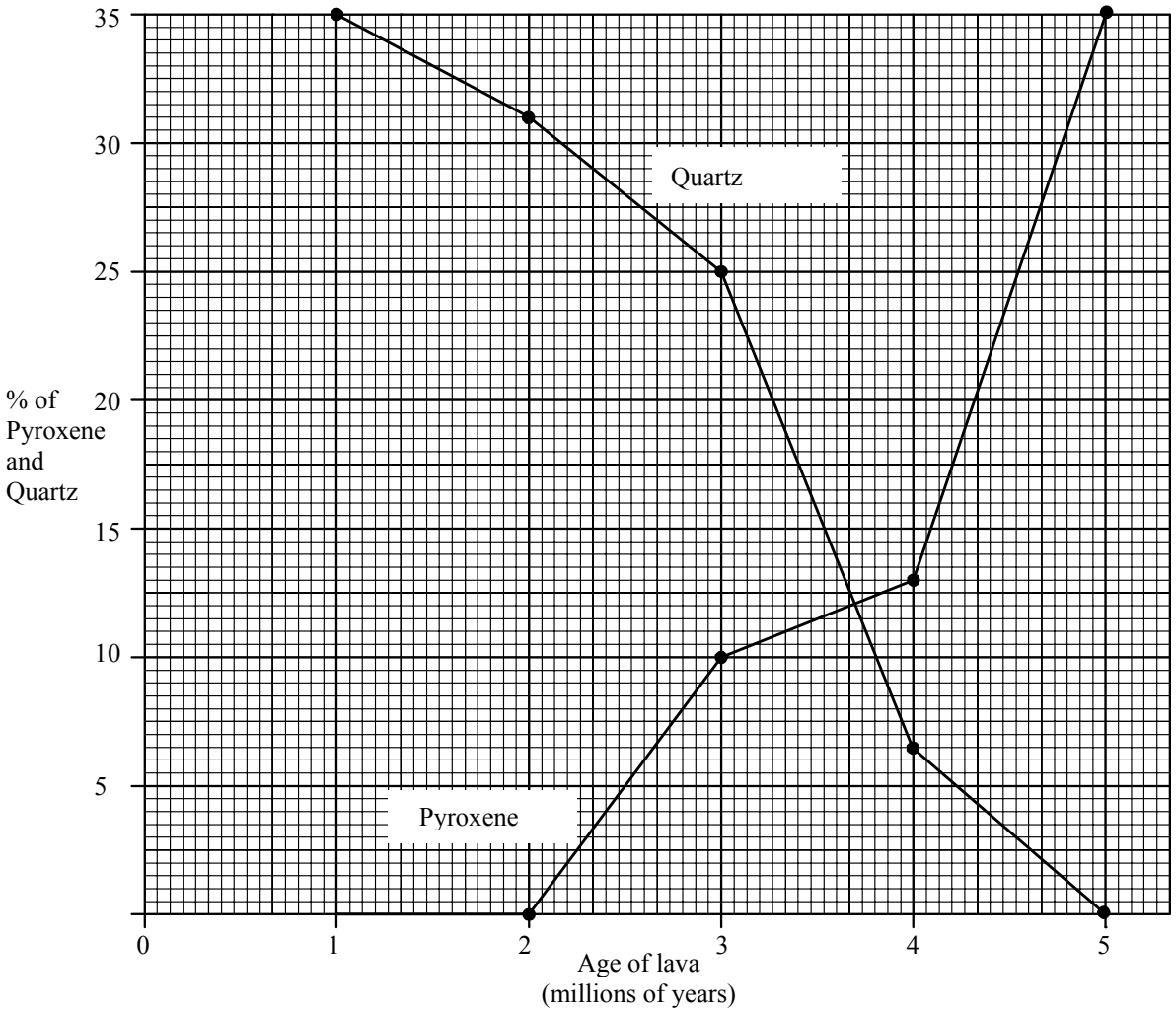
(a) What is the ratio of the four main minerals in the 4 million year old lava?
Quartz has been given the value of 1.

Quartz 1 : Feldspar **8** : Amphibole **4** : Pyroxene **2** **1**

(b) Is the 4 million year old lava acidic, intermediate or basic?

- **Intermediate** **1**

	Marks
(c) On the graph paper below: • draw a line graph to show how the percentage of quartz in the lava changes with the age of the lavas. **Label this line quartz**. • on the same graph paper, draw a second line to show how the percentage of pyroxene in the lavas changes with the age of the lavas. **Label this line pyroxene**.	**3**



Age could be in reverse order on the graph

1 mark for suitable scales (over half graph paper) and for labelling axes
2 marks for plotting points and joining and labelling lines

Points can be joined with a ruler or freehand but must pass through points

			Marks
(d)	**(i)**	Describe the relationship shown on the graph between the age of the lavas and their quartz content.	
		• **"As age increases the percentage quartz decreases**. **Or vice versa As age decreases...".**	**1**
	(ii)	Describe the relationship shown on the graph between the age of the lavas and their pyroxene content.	
		• **"As age increases the percentage pyroxene increases. Or vice versa As age decreases..."**	**1**
(e)		Circle the correct alternative in the sentences below. Give a reason for each of your answers.	
		One million year old lava is **darker/(lighter)** in colour than 5 million year old lava.	
		Reason: **The high quartz and feldspar content makes it lighter because quartz and feldspar are light in colour**.	
		Accept either quartz or feldspar or both	**1**
		One million year old lava is **more dense/(less dense)** than 5 million year old lava.	
		Reason: **Quartz is less dense than pyroxene and amphibole and 5 million year old lava has more pyroxene and amphibole.**	
		Accept either pyroxene or amphibole or both	**1**
(f)		One indicator of a lava's viscosity is its aspect index.	
		Aspect index = $\frac{\text{Thickness of flow (metres)}}{\text{Area covered (km}^2\text{)}}$	
	(i)	By using the formula above, complete the table below for the youngest and oldest lavas from this volcano.	

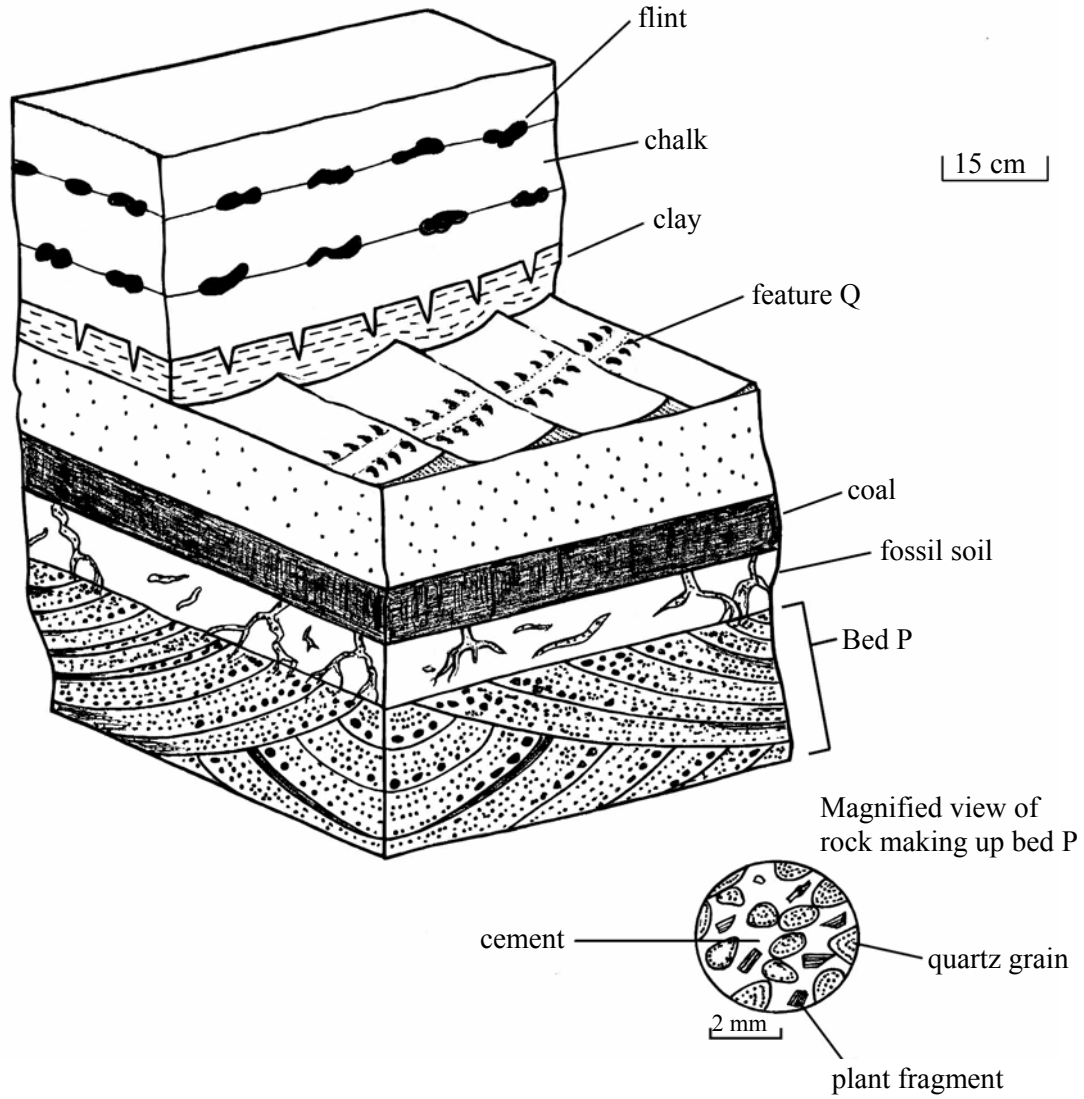
Age of lava flow (millions of years)	*Thickness* (m)	*Area* (km^2)	*Aspect index*
1	8·0	10·0	**0·8**
5	**5·0**	10·0	0·5

2

	(ii)	Explain why the 1 million year old lava and the 5 million year old lava have different viscosities.	
		• **The 1 million year old lava has more quartz and thus high SiO_2 levels and this makes it sticky**.	**1**

	Marks

12. Study the diagram below which shows part of a cliff face.



(a) How has feature Q been formed?

- **An ancient animal left its footprints in the sand/substrate. These have been preserved as a trace fossil**. **1**

(b) What feature suggests that the flints were formed after the chalk?

- **Cross cutting (relationship)/grown across the bedding planes**. **1**

		Marks
(c)	Give **two** pieces of evidence that suggest that bed P was deposited in a delta and not in a desert environment.	
	1 **Plant fragments come from vegetation that grew on the delta mud/fossil soil on top plus roots**.	
	2 **The grains are not perfectly rounded**.	
	3 **Overlain by soil and coal which indicates wet conditions with abundant plant growth.**	**2**

[END OF MARKING INSTRUCTIONS]