2009 Geology

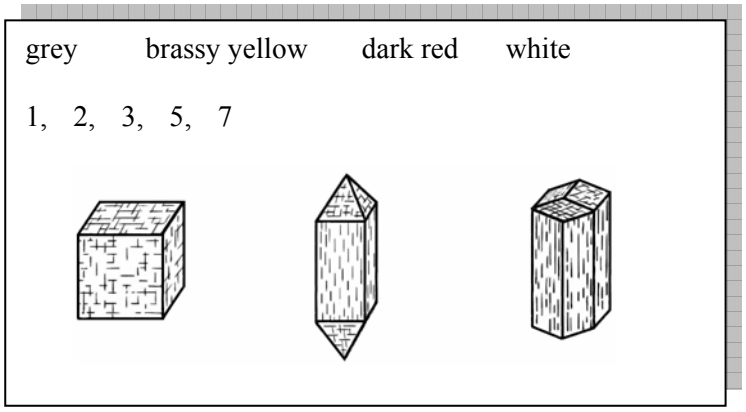
Intermediate 2

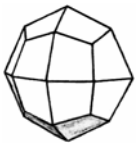
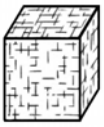
Finalised Marking Instructions

Marks

1. (a) Use **eight** of the following from the box to complete the table below.

Word Box



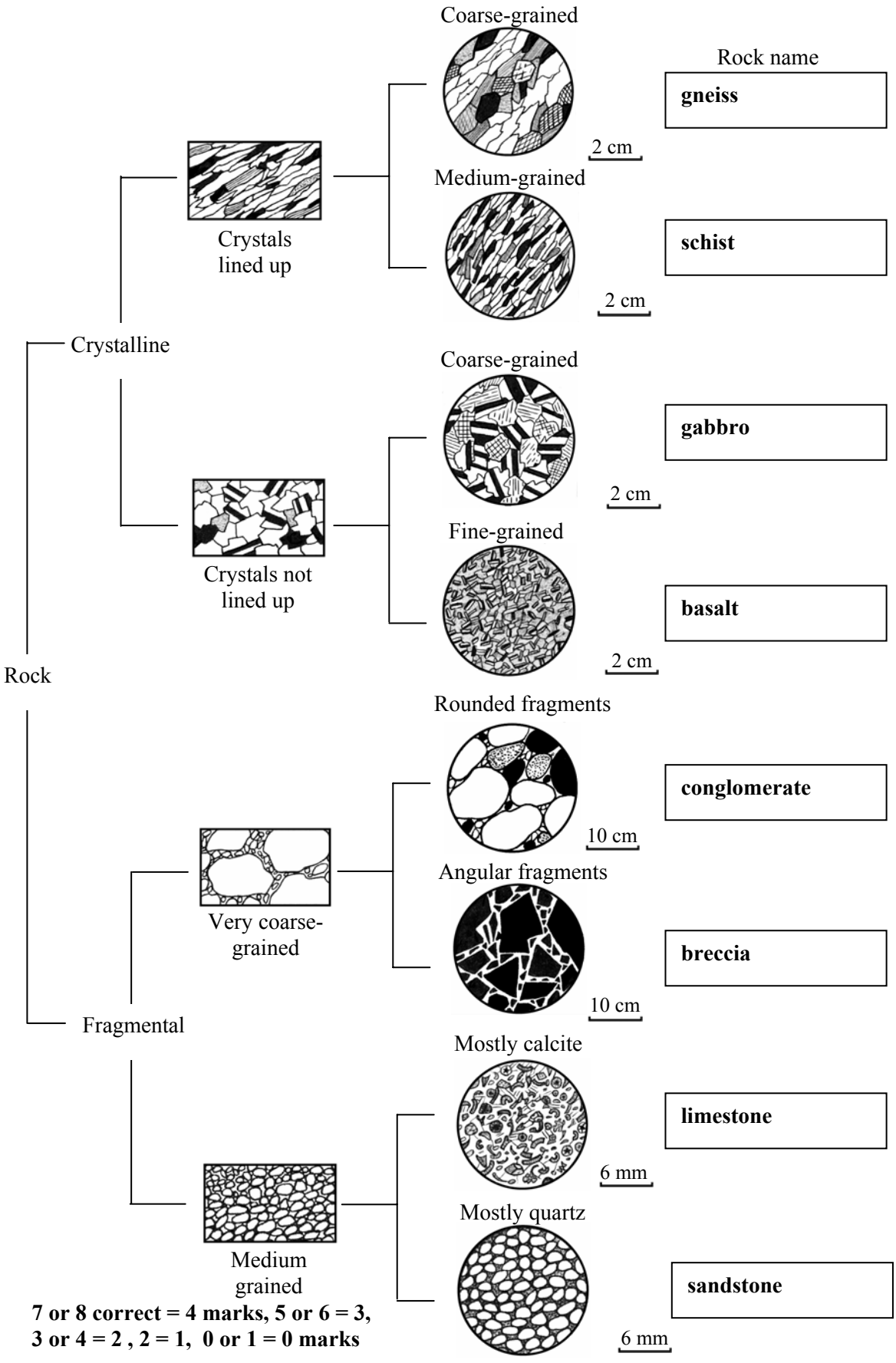
Colour	*Streak colour*	*Number of cleavages*	*Hardness*	*Crystal shape*	*Name of mineral*
Dark brown or black	white	**1**	**2**		Biotite
Dark red	white	none	**7**		Garnet
Clear or white	**white**	**3**	3		Calcite
Silvery	**grey**	3	2		Galena

7 or 8 correct = 4 marks, 5 or 6 = 3, 3 or 4 = 2, 2 = 1, 0 or 1 = 0 marks **4**

	Marks

(b) Use **eight** of the rock names from the word box to complete the key below.

basalt, breccia, conglomerate, dolerite, gabbro, gneiss, limestone, marble, obsidian, sandstone, schist, slate



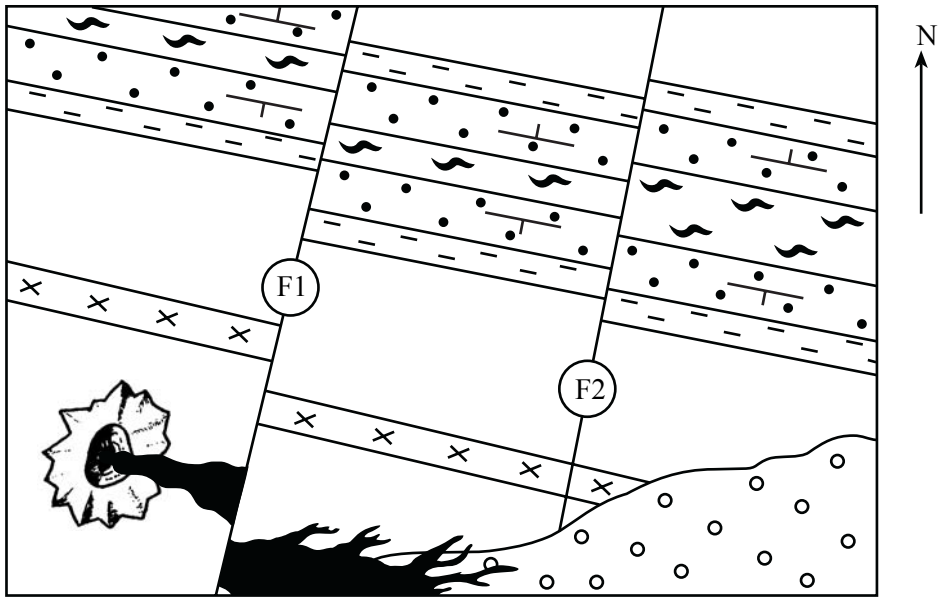
7 or 8 correct = 4 marks, 5 or 6 = 3, 3 or 4 = 2 , 2 = 1, 0 or 1 = 0 marks

4

		Marks
(c)	Which **two** of the following statements correctly describe mylonite?	
	A Mylonite is thermally metamorphosed mudstone.	
	B All mylonites are formed along thrust faults.	
	C Mylonite is usually coarse grained.	
	D Mylonite is finely banded streaky rock formed by intense squeezing and stretching of any rock.	
	E Mylonites may be formed in shatter zones.	
	F Mylonite forms as a result of dynamic metamorphism.	
	Give only the letters: **D** and **F**	
	One mark each	**2**

Marks

2. Study the map.



0 200 400
metres

Key

Sedimentary rocks in order of age

youngest

conglomerate

limestone

shale

sandstone

oldest

fault

Igneous and metamorphic rocks not in order of age

dolerite

gneiss

basalt lava

ancient volcano

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

- **Anticline** **1**

(ii) On the map, insert symbols ( ) to show the directions of strike and dip in the limestone on each side of the fold.

-

1 mark for correct pair **1**

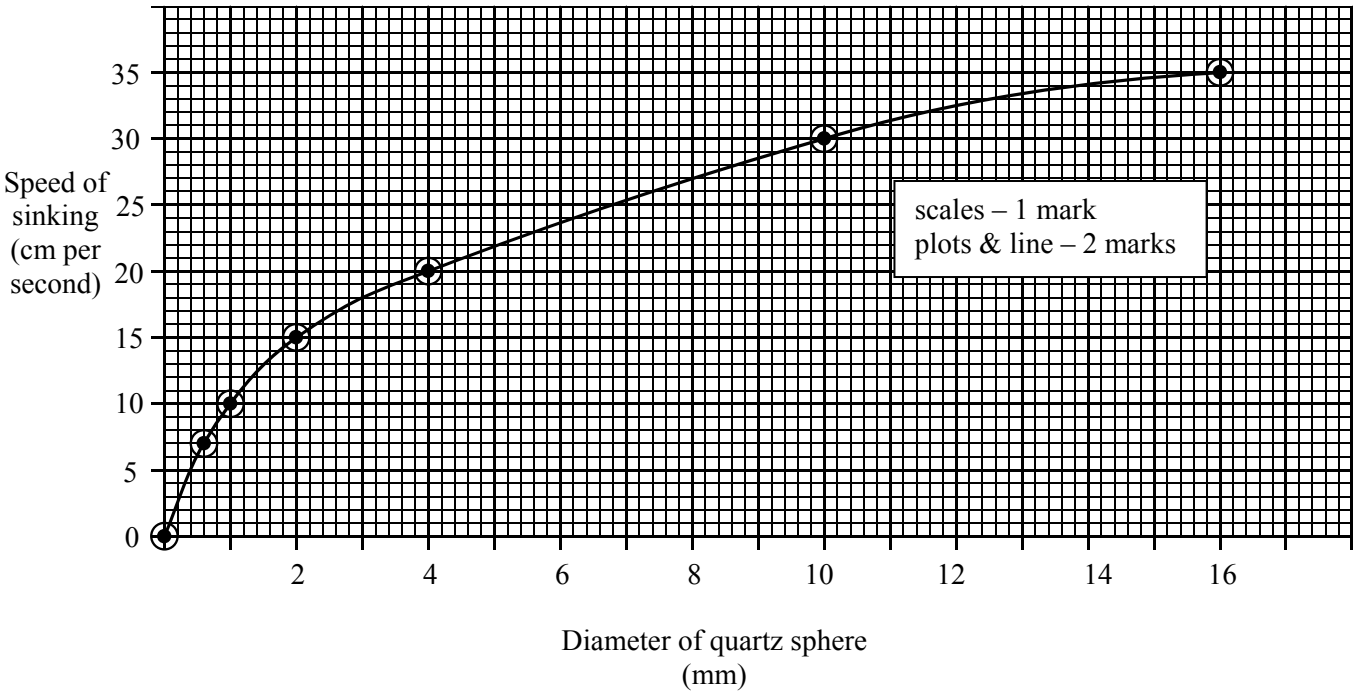
			Marks
(b)	**(i)**	What type of fault is F1?	
		• **Tear**	**1**
	(ii)	In what direction and how far have the rocks on the west side of fault F1 been moved?	
		Direction of movement: **to North/North East**	
		How far the rocks have moved: **190 – 210 metres**	
		both correct for 1 mark	**1**
(c)	**(i)**	How many unconformities are shown on the map?	
		• **Two/Three**	**1**
	(ii)	How many dykes are shown on the map?	
		• **One**	**1**
(d)		How can you tell that the rocks on the west side of the fault F2 have been moved down in relation to the rocks on the east side?	
		• **Sandstone on west now in contact with gneiss on east. Sandstone is younger than gneiss so it must have been moved down.**	
		OR	
		• **Gneiss outcrop on west is narrower than on east. Gneiss lies in core of anticline. Side downthrown has narrower outcrop of rock in fold core.**	**1**
(e)		Place the following events in the correct order from oldest to youngest.	
		A Intrusion of dolerite	
		B Formation of gneiss	
		C Eruption of lava	
		D Movement on fault F2	
		E Deposition of conglomerate	
		F Movement on fault F1	
		Give only the letters: **B → A → D → E → C → F** (oldest … youngest)	**3**
		all 6 correct 3 marks **5,4 in correct sequence 2 marks** **3 in correct sequence 1 mark** **otherwise 0**	

Marks

3. Quartz spheres of different sizes were dropped into water. The speeds at which they sank are shown in the table.

Diameter of quartz sphere (mm)	*Speed of sinking* (cm per second)
0·0	0·0
0·6	7·0
1·0	10·0
2·0	15·0
4·0	20·0
10·0	30·0
16·0	35·0

(a) **(i)** On the graph paper provided below, draw a line graph to show how speed of sinking changes with the diameter of the quartz spheres. **3**



	Marks

(ii) Describe the general relationship shown by the graph.

- **As diameter increases speed of sinking increases (1)**

- **Increase tails off as particles become bigger (1)**

or

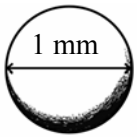
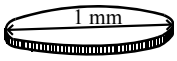
- **Large spheres sink more slowly than expected (1)**

or

- **Rate of increase gets less as particles become larger (1)**

A correct general statement such as the first bullet point 1 mark
A specific rate comment such as the other bullet points 1 mark **2**

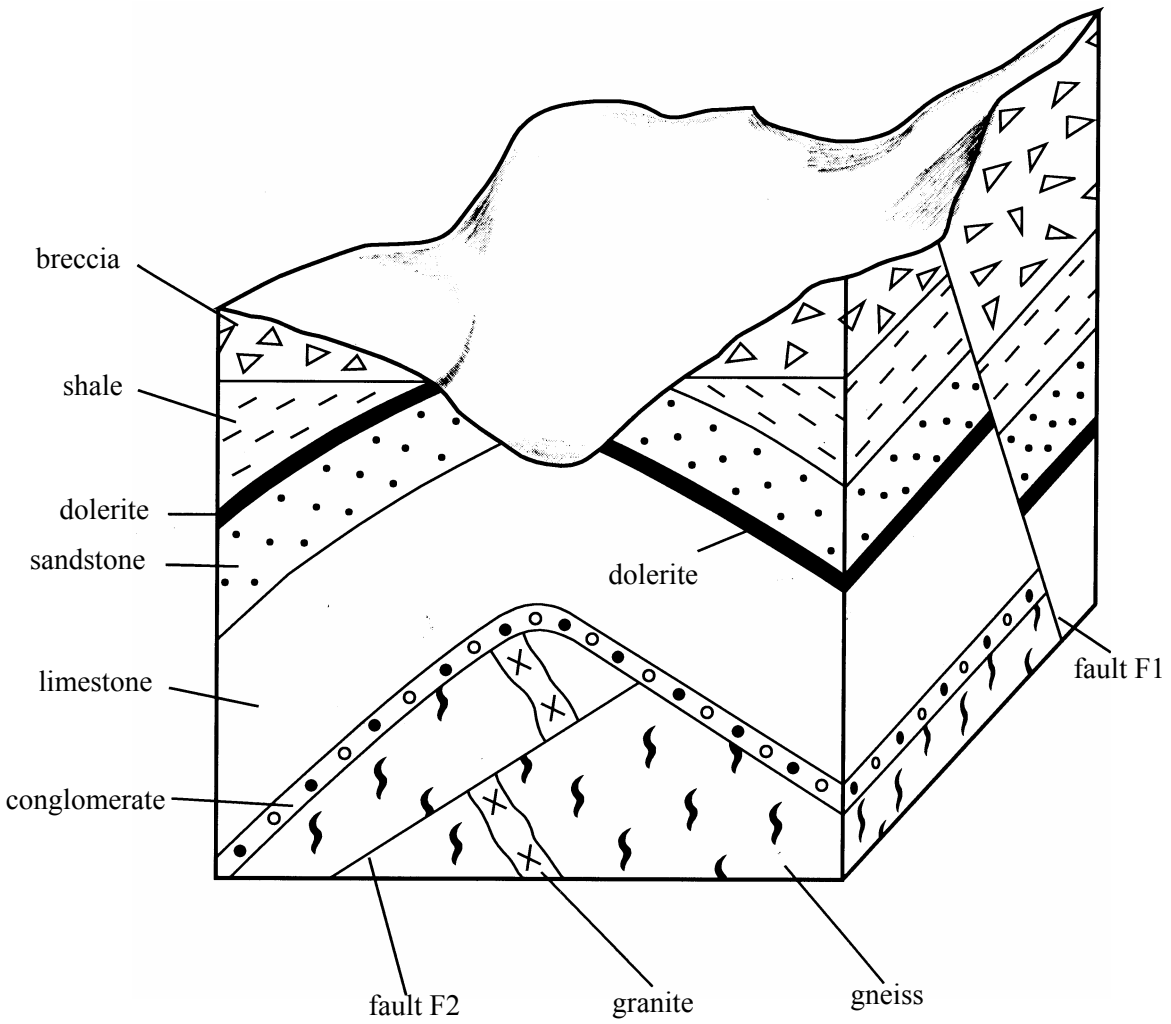
(b) Complete the table by saying if the mineral grain would sink more slowly or more quickly than a quartz sphere with a 1 mm diameter. Give a reason for each answer.

Name of mineral	*Grain size and shape*	*Density of mineral (g/cm^3)*	*Rate of sinking (slower or faster than a quartz sphere)*	*Reason*
cassiterite	1 mm sphere 	7·0	**faster**	**denser materials sink faster**
mica	1 mm flake 	2·7	**slower**	**not streamlined/ although similar density the shape "catches" the fluid/ increased drag/ causes lots of turbulence**
quartz	1 mm angular 	2·7	**slower**	**more friction due to rough surface than a smooth sphere/ increased drag**

1 mark for each correct row (pair) **3**

	Marks

4. Study the block diagram.



(a) **(i)** What type of fault is F1?

- **Normal** **1**

(ii) What type of fault is F2?

- **Reverse or thrust** **1**

(b) From the diagram, how can you tell that the dolerite forms a sill and not a lava flow?

- **The sill moves from one layer to the next (transgresses), a lava flow would not.** **1**

(c) **(i)** On the diagram, shade and label an area where you would expect to find marble.

- **Shade where limestone is in contact with dolerite.** **1**

(ii) On the diagram, shade and label an area where you would expect to find hornfels.

- **Shade where shale is in contact with dolerite.** **1**

	Marks

(d) Place the following events in the correct order from oldest to youngest.

A Folding of conglomerate

B Deposition of sandstone

C Movement on fault F2

D Movement on fault F1

E Intrusion of granite

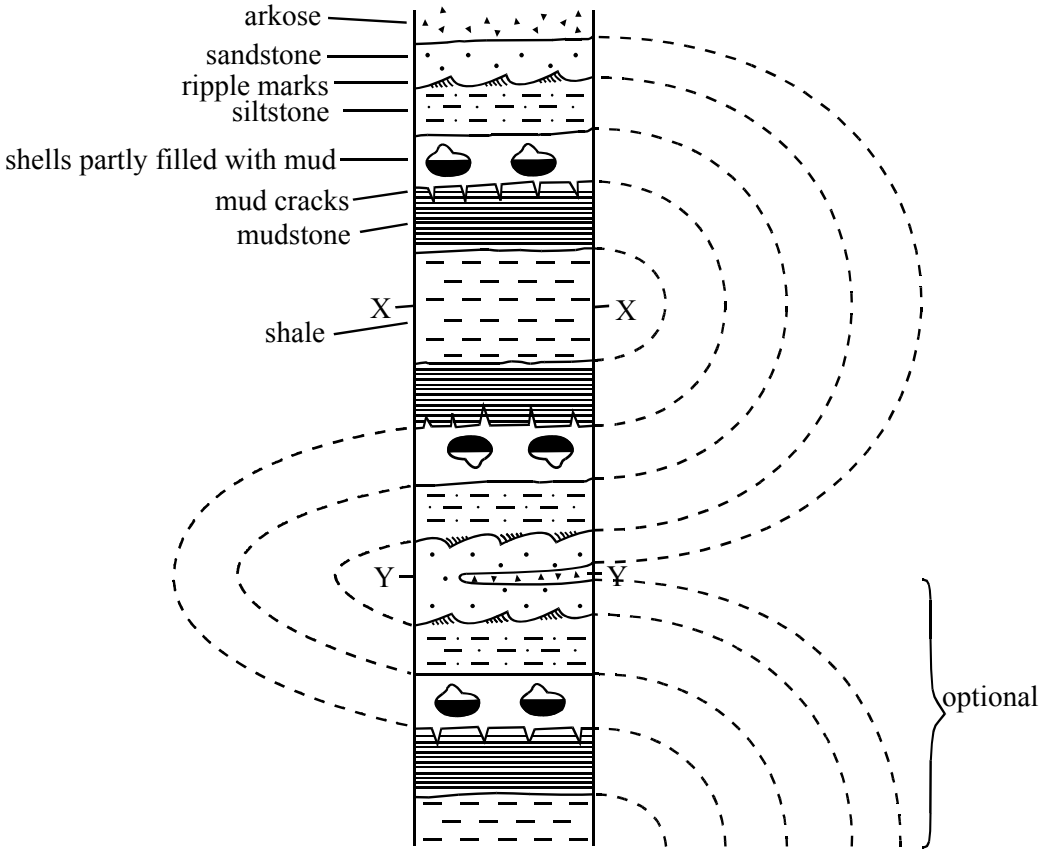
F Deposition of breccia

Give only the letters: **E** → **C** → **B** → **A** → **F** → **D** — **3**
oldest — youngest

All 6 correct 3 marks
5,4 in correct sequence 2 marks
3 in correct sequence 1 mark
otherwise 0

	Marks

5. **(a)** The rocks shown in the borehole diagram below have been folded.



(i) Name **three** structures which show that the rocks between X and Y have been turned upside down. Give a reason for each answer.

Structure **Mud cracks**

Reason **When right way up they open upwards but they are inverted higher up the borehole**

Structure **Half filled shells**

Reason **Sediments/mud lie at the top of the shell where they have been upturned. Originally they would have been in the lower part of the shell.**

Structure **Ripple marks**

Reason **Inverted they are concave downwards**

1 mark correct structure linked with reason **3**

Give 1 mark if all 3 structures identified are correct even if the reasons are wrong or incomplete.

		Marks
(ii)	Using four dashed lines, complete the fold in the space to the right of the borehole diagram.	
	See diagram **5 or 4 dashed lines**	**1**
(iii)	Name the oldest rock in the borehole.	
	• **Shale**	**1**
(b)	The diagram shows a piece of coal. Describe the processes involved in forming coal. You may use diagrams in your answer.	

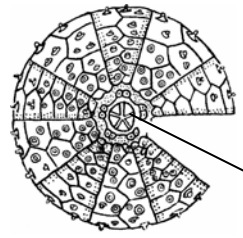
Key terms
- **Plants/trees**
- **growing in swamps/wet lands**
- **die but do not decay rapidly**
- **due to anaerobic/oxygen poor/waterlogged conditions.**
- **Remains accumulate into peat,**
- **the peat is compressed**
- **and heated**
- **and changed into coal.**

5 or 6 points = 3 marks
3 or 4 points = 2 marks
2 points = 1 mark
1 point = 0 marks
Relevant facts/key could be indicated in a diagram **3**

Marks

6. (a) (i) Name the parts of the fossils.

Fossil P

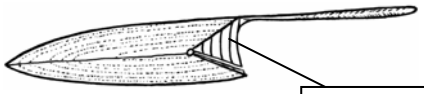


mouth or teeth or Aristotles' lantern

Fossil Q

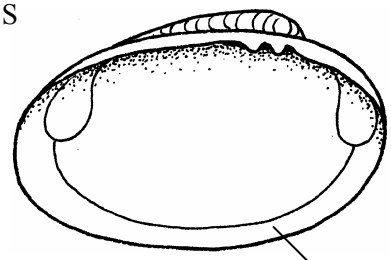
suture line

Fossil R



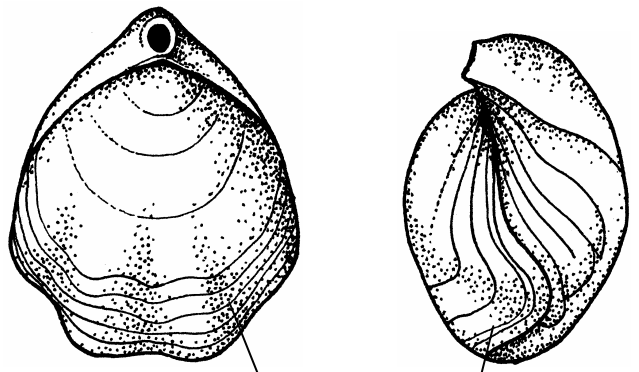
phragmocone

Fossil S



pallial line

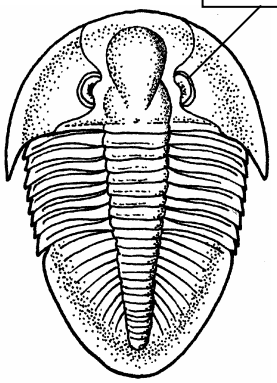
Fossil T



brachial valve

Fossil U

eye



5 – 6 = 3 marks
3 – 4 = 2 marks
1 – 2 = 1 mark

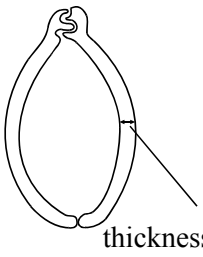
(ii) Name fossils P, Q, R, S, T and U.

Name of fossil P	**Echinoid or sea urchin**	
Name of fossil Q	**Ammonite**	
Name of fossil R	**Belemnite**	
Name of fossil S	**Bivalve**	
Name of fossil T	**Brachiopod**	**5 – 6 = 3 marks** **3 – 4 = 2 marks**
Name of fossil U	**Trilobite**	**1 – 2 = 1 mark**

3

	Marks

(b) Bivalve shells are made from calcium carbonate that the animal extracts from water. The table gives the thicknesses of shells of bivalves living in different environments.

Environment of bivalve	*Thickness of shell* (mm) 
Bed of rapidly flowing river	1·0
Attached to rocks between high and low tides. Often affected by strong waves. Many predators.	2·5
Floor of deep sea. Bivalve does not burrow. Weak currents. Few predators.	1·5

(i) Account for the following two observations.

The thinnest shells are found in the river.

- **Very little calcium carbonate in fresh water (thus not enough to make a thick shell).** **1**

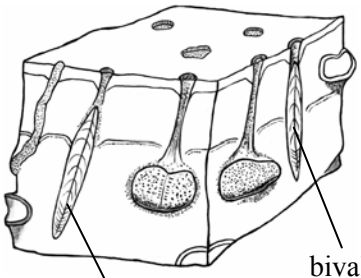
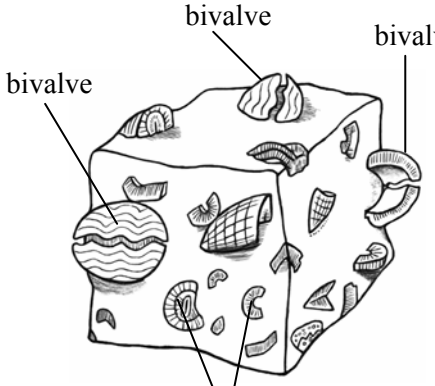
The thickest shells are found between high and low tides.

- **Very thick shell gives protection against abrasion or predators or desiccation.** **1**

(ii) Predict a possible thickness for the shell of a bivalve that lives in burrows on the sea bed and has no predators.

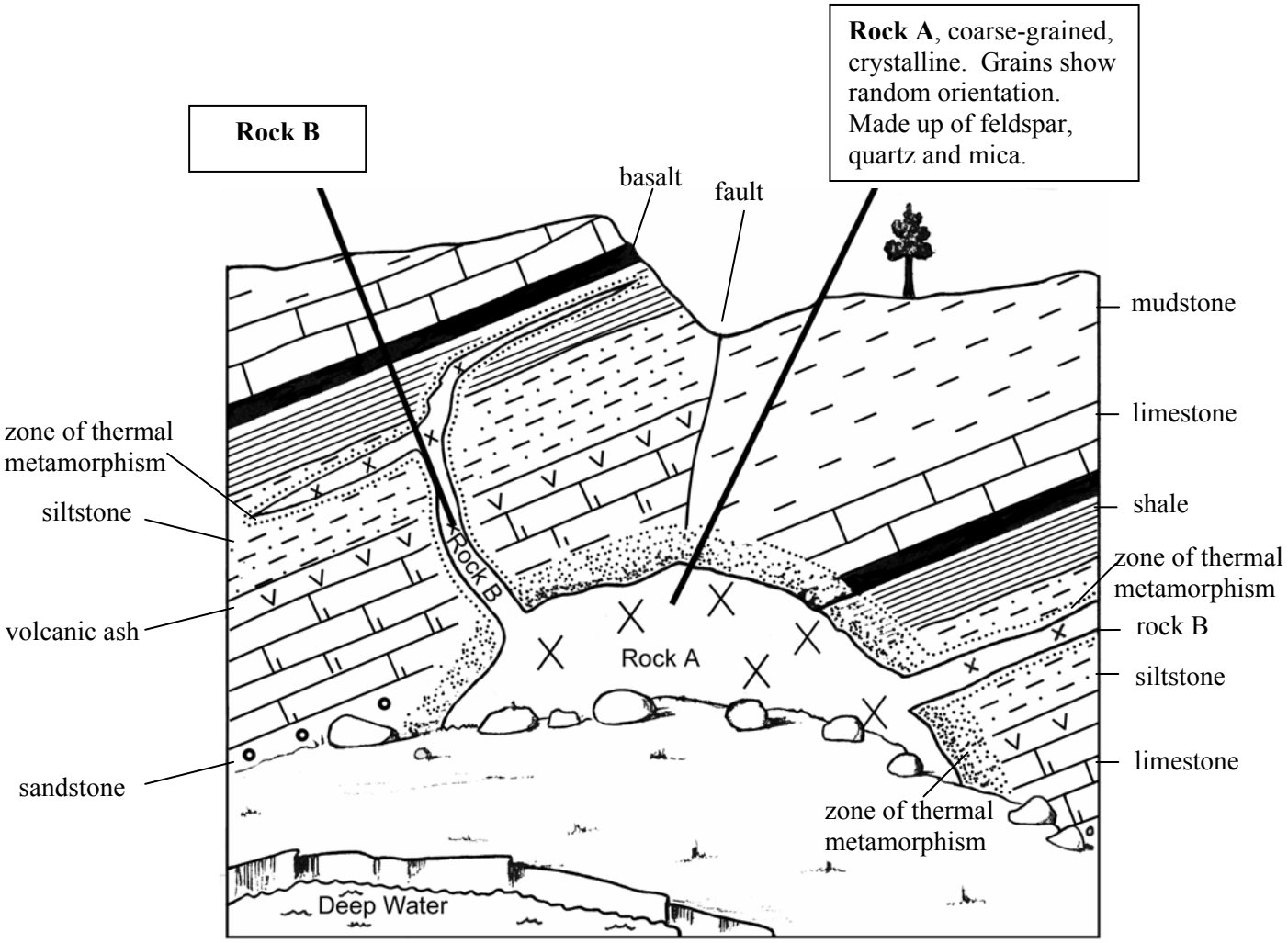
- **> 1.0 but < 1.5 or just < 1.5 or very thin (< 1.0) – (no need for protection from physical or biological threat)** **1**

	Marks
(c) Complete the table by saying how the fossil bivalve lived and by saying how the shape of the bivalve was suited to its way of life.	

Rock showing fossil bivalve	*How the bivalve lived*	*How the shape of the shell suited its way of life*
	Burrowing **(1)**	Narrow shell allows for easy movement through sediment **(1)**
	Non burrowing	Rounded shape/ Very strong **(1)**

3

7. **(a)** This is a field sketch made by a student in **quarry X**.



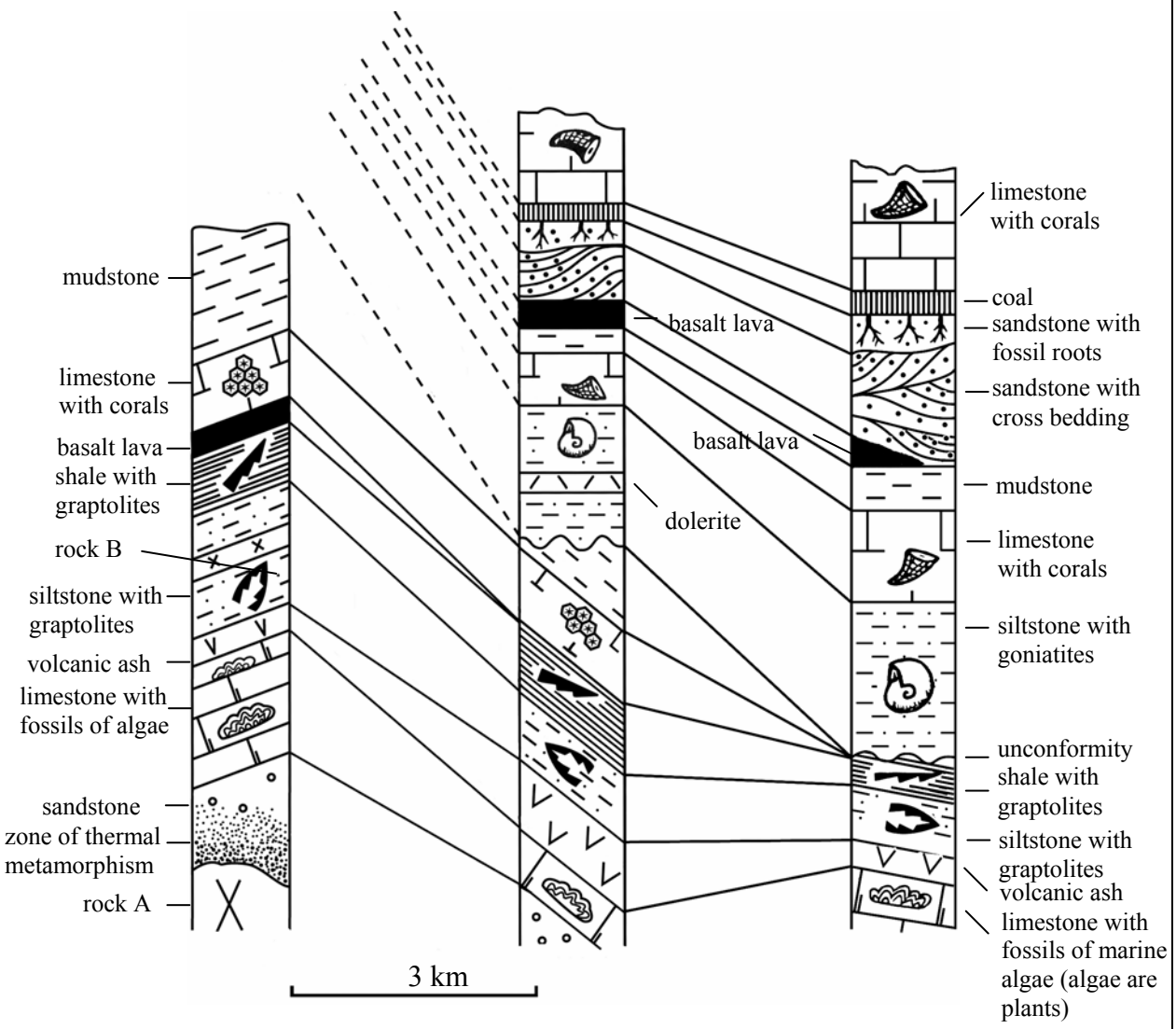
		Marks
(i)	Name rock type A.	
	• **Granite**	**1**
(ii)	Explain why the zone of thermal metamorphism varies in width around rocks A and B.	
	• **The rocks around A are exposed to high temperatures for longer (because of the greater mass of rock at A).**	
	• **Rocks beside rock B exposed to high temperatures for less time because of lesser mass of rock B in narrower sill or dyke.**	**1**

		Marks
(iii)	Identify **two** risks that are present in **quarry X** and state how they could be reduced. Risk 1 **Drowning** How risk could be reduced **stay away from water edge/ party warned** **both for 1 mark** Risk 2 **Head damage/rock fall** How risk could be reduced **Wear hard hats** **both for 1 mark** **Any reasonable answers will do.**	**2**

	Marks

(b) The diagram shows the rock sequences in quarry X and in two other quarries, Y and Z, which both lie to the East of quarry X. Lines have been drawn to show the correlation between the rocks in quarries X and Y.

(i) On the diagram, draw lines between the rock sequences to match up (correlate) the rocks in the quarries Y and Z.



13 – 10 correct = 3 marks
8 – 9 correct = 2 marks
5 – 7 correct = 1 mark
≤ 4 = 0 marks **3**

	Marks

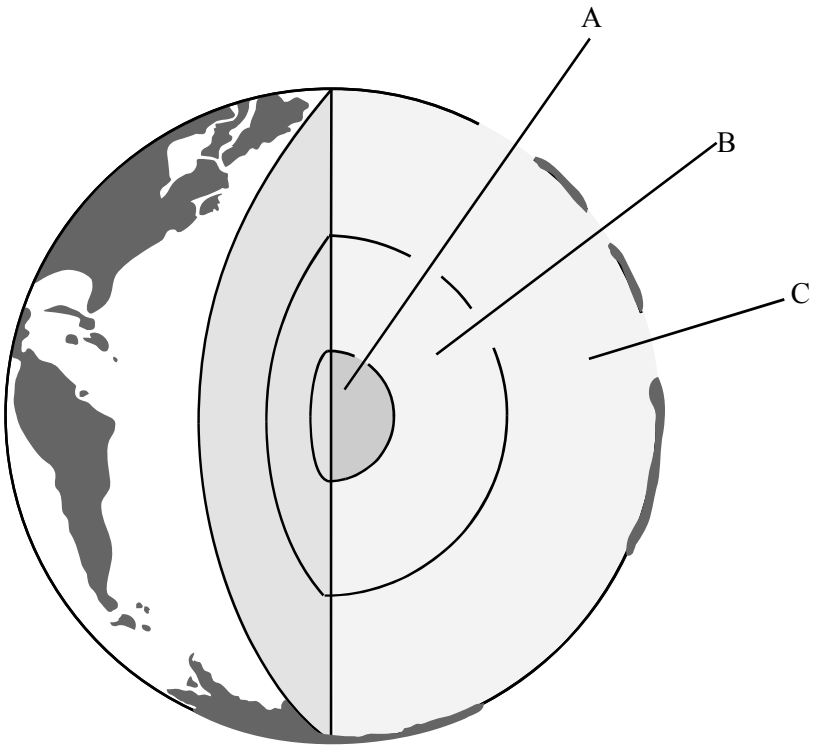
(ii) The table shows some of the rocks in quarry Y. Complete the table.

Age	*Sedimentary rock*	*Environment of deposition*	*Reason for coming to this conclusion*
Youngest ▲	sandstone with cross bedding	**delta**	**Large scale cross bedding is a characteristic of deltas. Also overlying rocks show remains of plants that grew on the delta.**
	limestone with corals	**warm, (clear, shallow) sea**	**Modern corals live in this environment. It is likely that ancient corals did the same.**
	siltstone with goniatites	**sea with weak to medium bottom currents**	**Goniatites lived only in the sea. Silt sized particles will only settle where currents are not too strong.**
	shale with graptolites	sea with weak bottom currents	**Graptolites lived only in the sea. Shale consists of very small particles that will only settle out from stagnant or slow flowing water.**
Oldest	limestone with marine algae	**shallow sea**	Algae are plants hence they need light to survive. Light does not penetrate deep water

7 or 8 correct = 4 marks, 5 or 6 = 3 marks , 3 or 4 = 2 marks, 1 or 2 = 1 mark **4**

Marks

8. **(a)** Using the diagram of the Earth given below, name layers A, B and C and then name the material or materials making up each layer.



Layer	*Name*	*Materials making it up*
A	**Inner Core**	**(solid) iron and nickel**
B	**Outer Core**	**(liquid) iron (and sulphur)**
C	**Mantle**	**olivine and pyroxene/peridotite**

5 – 6 correct = 3 marks
3 – 4 correct = 2 marks
1 – 2 correct = 1 mark **3**

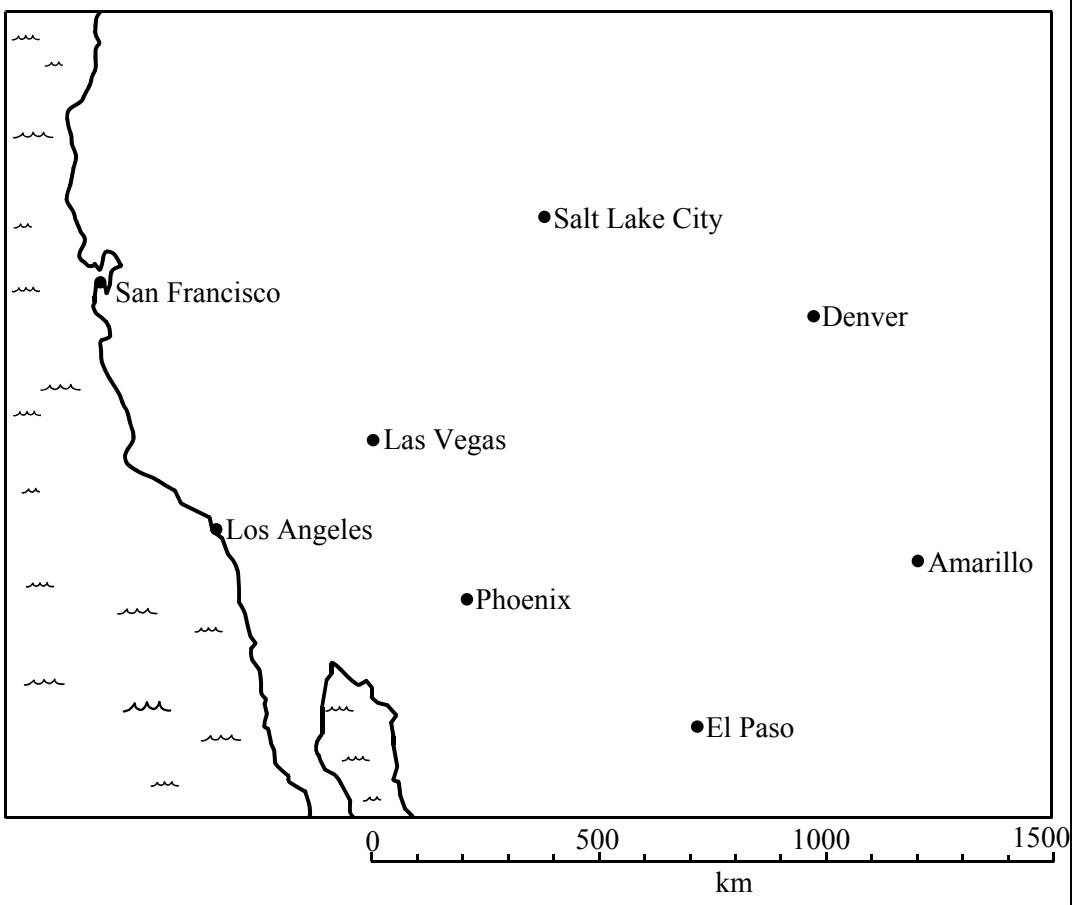
	Marks

(b) How does the speed of P-waves change when they move from layer B into layer A? Explain your answer.

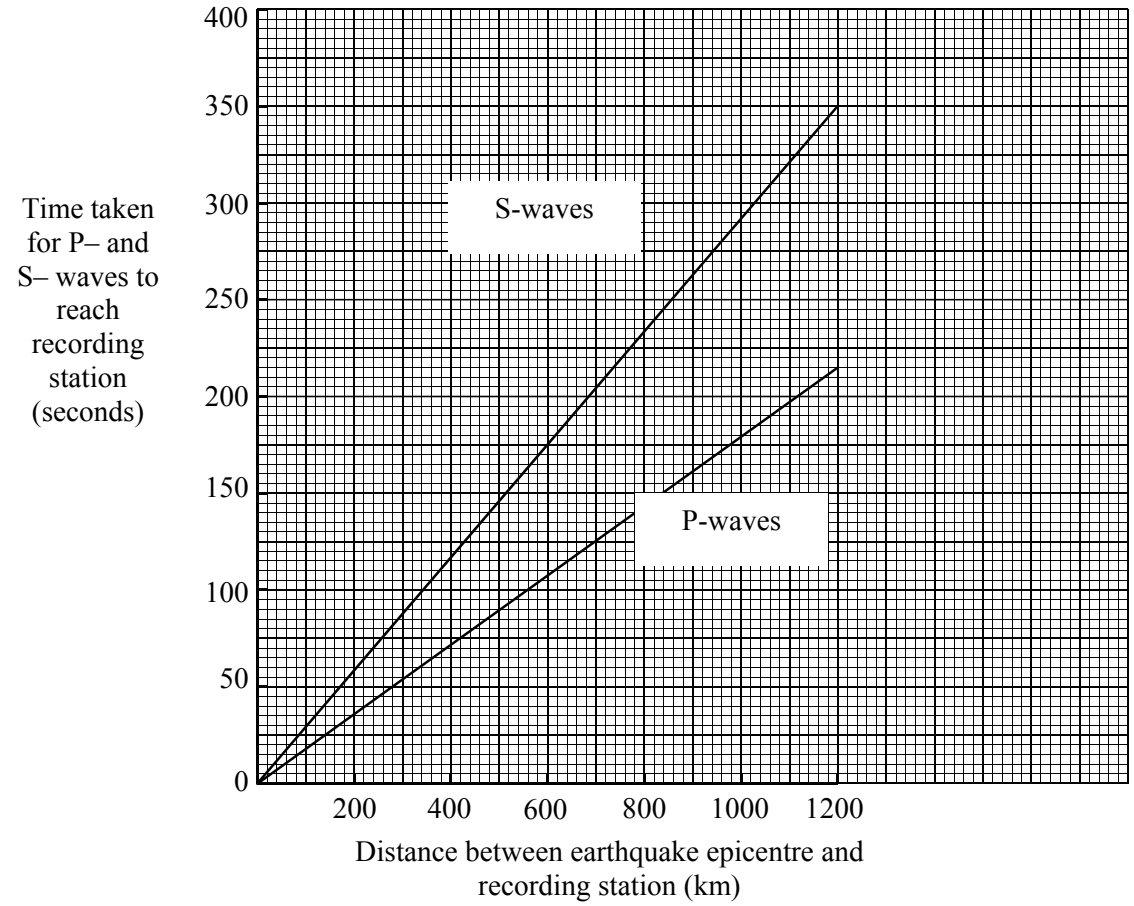
Change in speed • **Increase (1)**

Explanation • **They travel faster in solids than in liquids (1)** **2**

(c) The map shows part of the USA and Mexico. The graph shows time plotted against distance for P– and S– waves from an earthquake.



		Marks



(i) Speed =

From the graph, calculate the speeds of the P– and the S–waves.

Speed of P–waves: **5·6 km s^{-1}** **± 0·1 (1)**

Speed of S–waves: **3·4 km s^{-1}** **± 0·1 (1)** **2**

			Marks
	(ii)	Which waves (P or S) would be the first to reach a recording station at any distance from the earthquake epicentre?	
		• **P–waves**	**1**
	(iii)	As distance from the epicentre increases, what happens to the time interval between the arrival of the P– and S–waves?	
		• **It increases**	**1**
(d)	**(i)**	An earthquake took place at a position on the map. Use the graph to complete the table.	

Position of earthquake recording station	*Time interval between the arrival of the P– and S–waves (seconds)*	*Distance between epicentre and recording station (km)*
Amarillo	125	**1100 km (± 60)**
Los Angeles	85	**780 km (± 40)**
Denver	80	**710 km (± 30)**

3

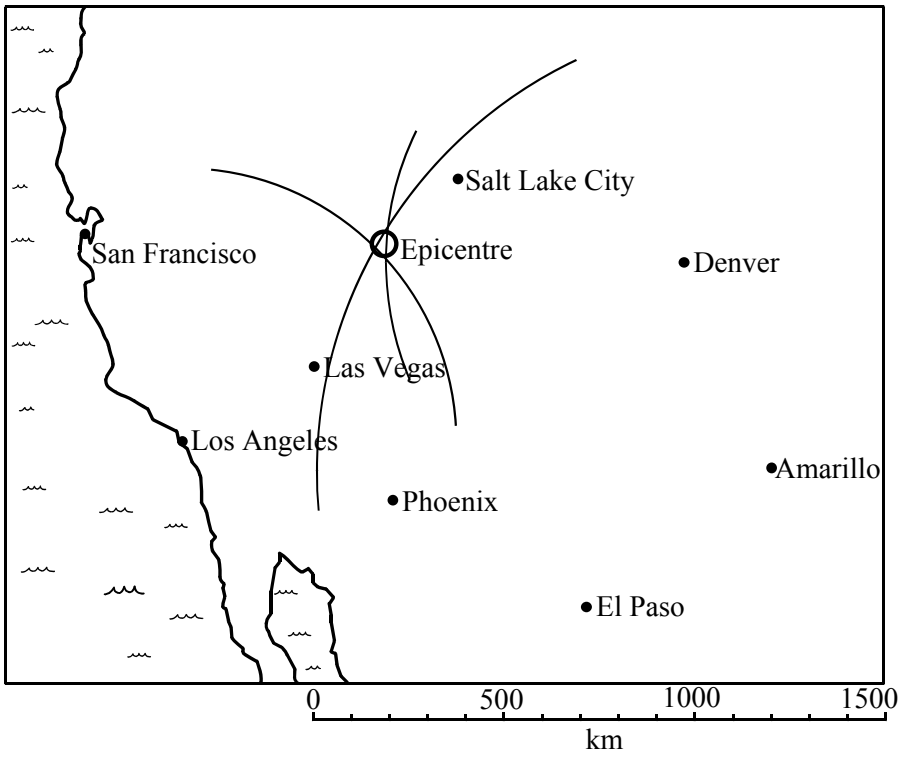
(ii) Using the scale on the map:

1 draw circles centred on Amarillo, Los Angeles and Denver which have radii equal to the distances between the epicentre and the recording stations;

2 marks for all arcs approximately in the correct position
1 mark for 2 correct arcs
0 marks for 1 correct arc **2**

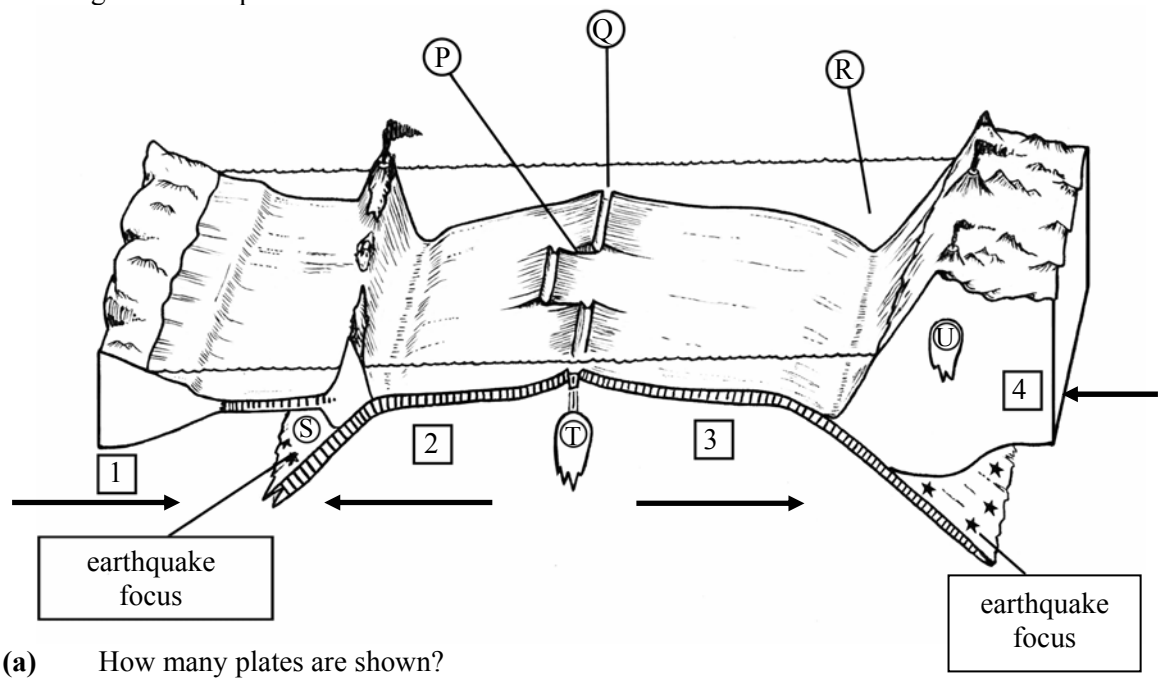
2 label the epicentre

1 mark for epicentre **1**



	Marks

9. The diagram shows plates.



(a) How many plates are shown?

- **4** **1**

(b) Match six of the features below with the letters P, Q, R, S, T and U shown in the diagram above.

Feature	*Letter*
Basalt magma chamber	**T**
Island arc	
Zone of regional metamorphism	
Destructive plate margin	**R**
Constructive plate margin	**Q**
Conservative plate margin	**P**
Wadati-Benioff Zone	**S**
Granite intrusion	**U**

3

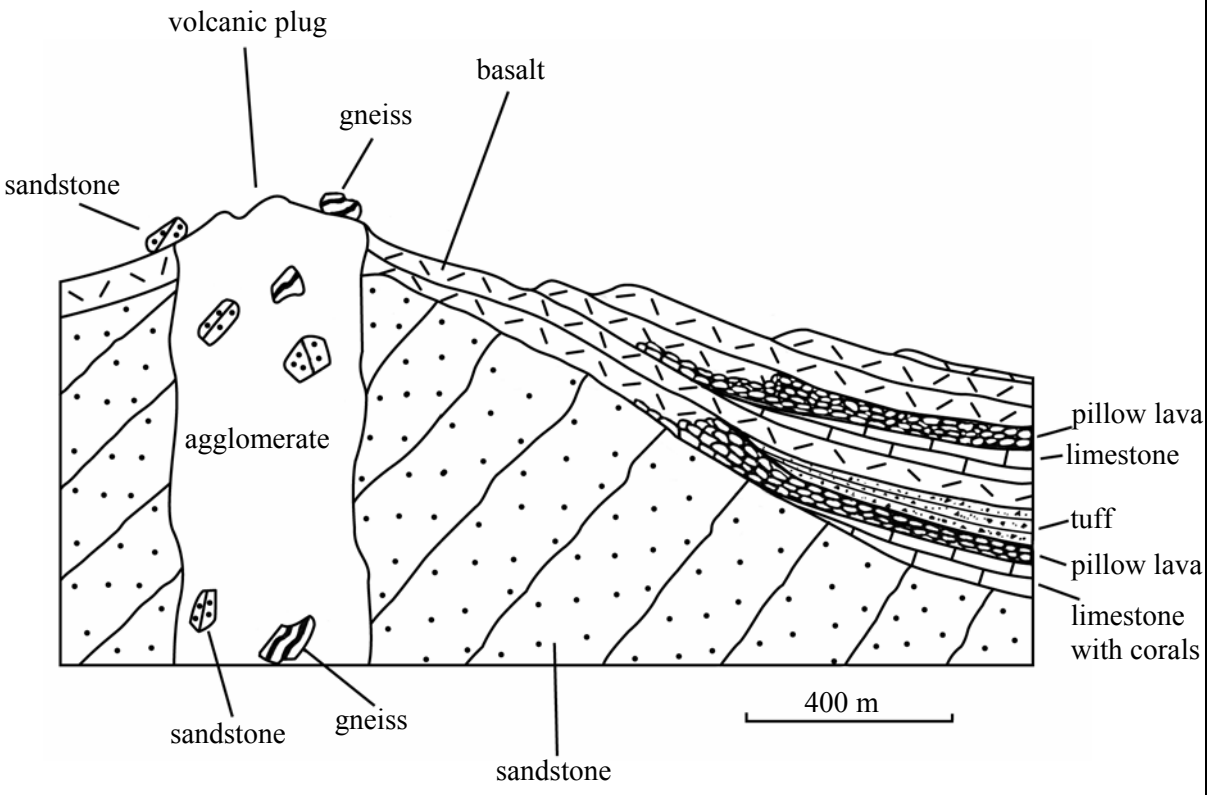
5 or 6 correct = 3 marks
3 or 4 correct = 2 marks
1 or 2 correct = 1 mark

(c) On the diagram, draw arrows at positions 1, 2, 3 and 4 to show the directions of plate movements.

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

	Marks

10. The diagram shows a section through an ancient volcano and nearby rocks.



(a) Explain why the basalt sometimes shows pillow structure.

- **The lava has run from land to the sea. On meeting the sea water pillows have formed.** **1**

(b) Give **one** piece of evidence that suggests that the volcanic plug previously extended to a higher level.

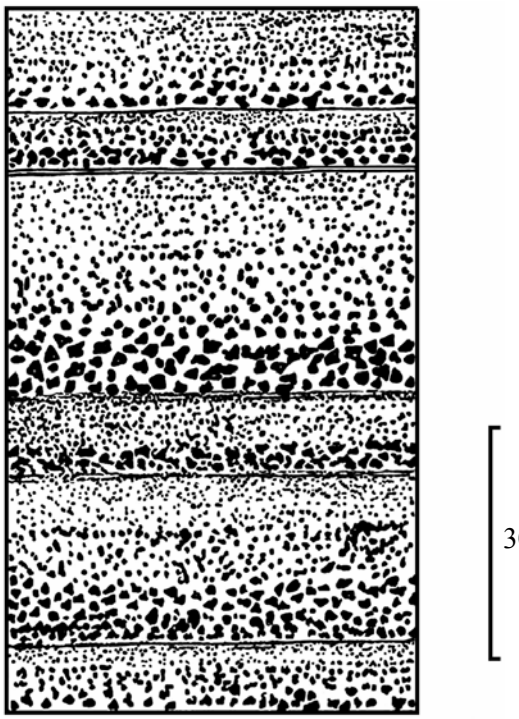
- **The top of the highest lava layer is higher than the top of the volcanic plug (if extended upwards). Thus in the past the plug must have been higher.**

OR

- **Xenoliths on the surface of the plug have been left behind as the plug has been weathered or eroded down.** **1**

	Marks

(c) The tuff lies in beds of the type shown in the diagram.



(i) Name this type of bedding and say how it was formed.

Type of bedding **Graded bedding** **1**

How formed **(Ash thrown into the air). Large particles fall faster (1). Deposited layer coarse at bottom, fine at top (1).**
OR
(Ash lands in water). Large particles sink faster (1). Deposited layer coarse at bottom, fine at top (1). **2**

(ii) Explain why the beds are of different thicknesses.

Thick layer – heavy ash fall
Thin layer – light ash fall

(Could be because eruptions are more or less vigorous or because wind blows ash towards or away from the area of deposition) **1**

		Marks
(d)	Which statement is correct?	
	A Agglomerate is an igneous rock made up of xenoliths.	
	B The limestone with corals was deposited in a lake.	
	C The gneiss forms a xenolith.	
	D The basalt forms lava flows that are all the same age.	
	Give only the letter: **C**	**1**

[END OF MARKING INSTRUCTIONS]