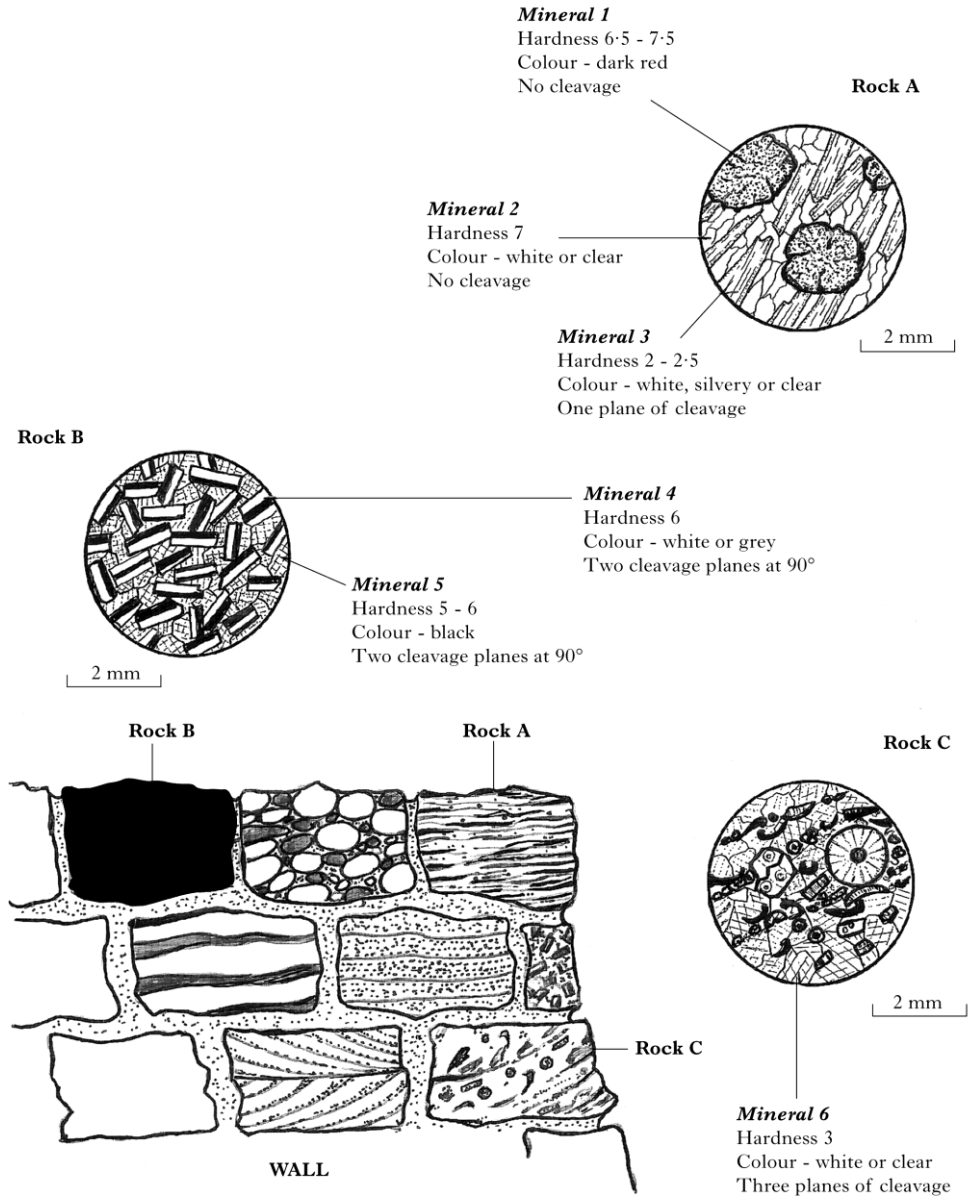
2011 Geology

Intermediate 2

Finalised Marking Instructions

Marks

1. **(a)** Three of the rocks making up the wall in the diagram below are labelled A, B and C. The minerals contained within each rock are shown in labelled magnified drawings. Some of the physical properties of these minerals are also given.



	Marks
Complete the table below with the help of the information given on the previous page and the word bank.	

Word bank:
amphibole : barite : biotite mica : calcite : cassiterite : feldspar : galena : garnet : gypsum : magnetite : muscovite mica : olivine : pyroxene : quartz : talc

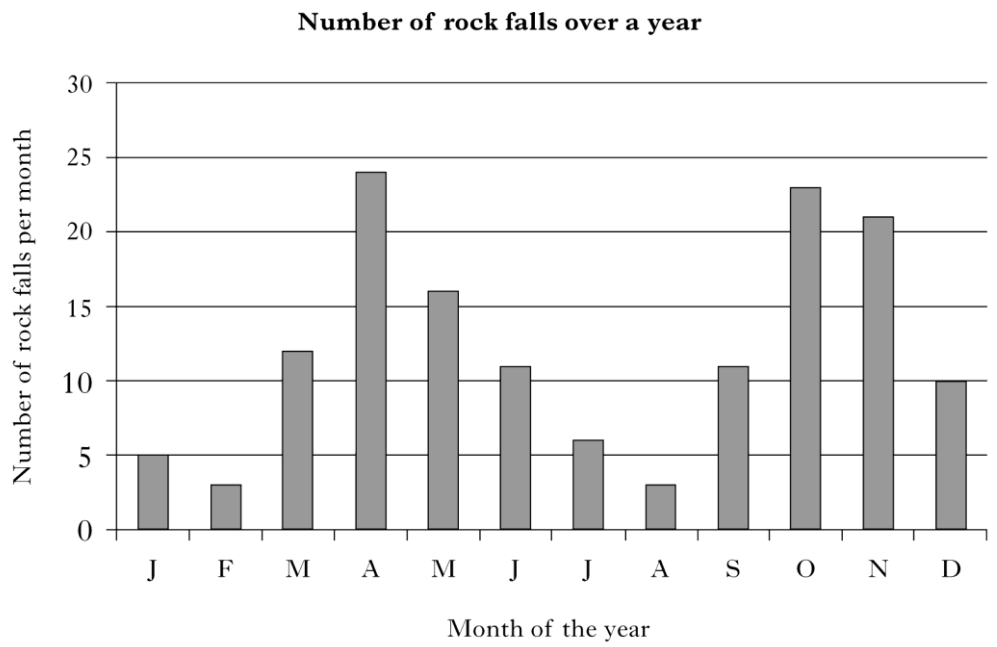
andesite : basalt : limestone : gabbro : granite : greywacke : hornfels : marble : sandstone : slate : schist

Name of mineral	Name of the rock	Is the rock igneous, Metamorphic or Sedimentary?
1. Garnet	Rock A: Schist	Metamorphic
2. Quartz		
3. Muscovite mica		
4. Feldspar	Rock B: Basalt	Igneous
5. Pyroxene		
6. Calcite	Rock C: Limestone	Sedimentary

1 mark for igneous/metamorphic/sedimentary all correct
1 mark for each correct rock name.
All 6 minerals correct = 4 marks
5 correct = 3 marks 3 or 4 correct = 2 marks 2 correct = 1 mark
The answers to the “Name of the rock” and the rock type depends on the answers given in the previous columns. **8**

	Marks

(b) Rocks in upland Norway are prone to frost (freeze/thaw) shattering. The graph shows the frequency of rock falls every month over a year in an area of upland Norway.



(i) Describe the change in the number of rock falls over the year.

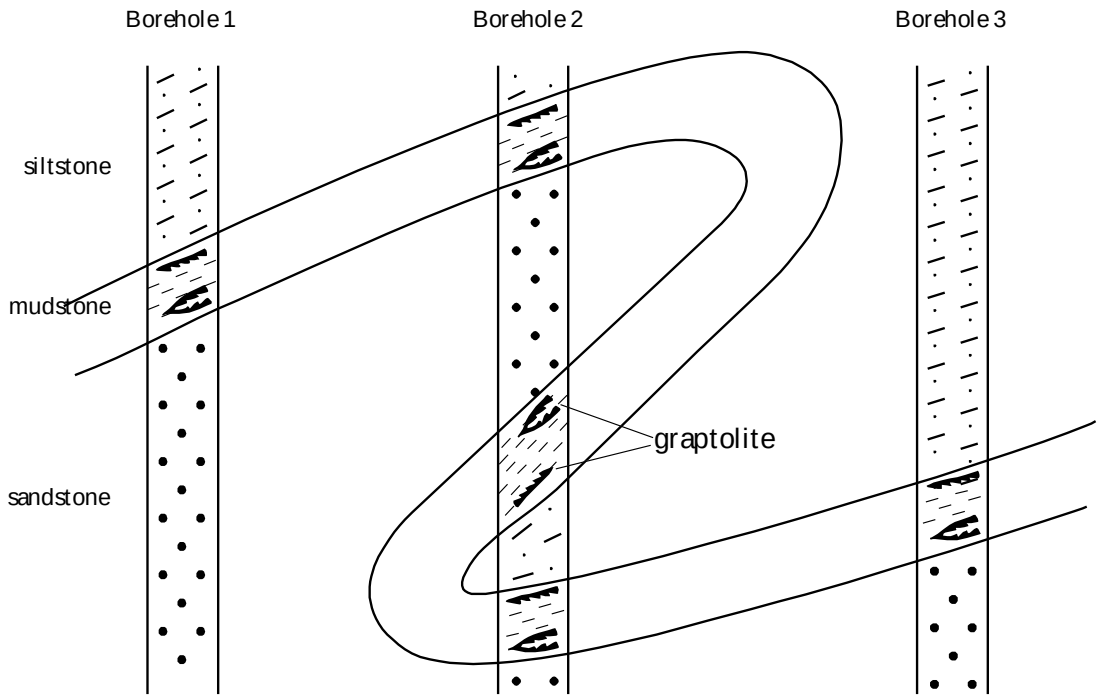
They fall to around 3/month in February then rise to a peak of around 24 in April, then drop to another minimum in August and reach a second peak in October of 22 before declining again.
Or
There are more than twice the number of rock falls in spring (March – May) and autumn (October – November) than in winter and summer.
Or
Any reasonable description of the trend quoting some figures **1**

(ii) Explain why the frequency of the rock falls varies with seasons in this part of Norway.

There are more freeze-thaw cycles in spring and autumn than summer or winter or similar (1) which leads to more inflow of water into cracks followed by expansion when it freezes or similar (1). **2**

	Marks

2. The diagram shows rocks found in boreholes sunk into folded rocks.



(a) Complete the diagram to show the folds. **1**

(b) How can one tell that the rocks are sometimes upside down? **1**

The more ancient two-branched graptolites lie above the younger single branched graptolites in part of borehole 2.

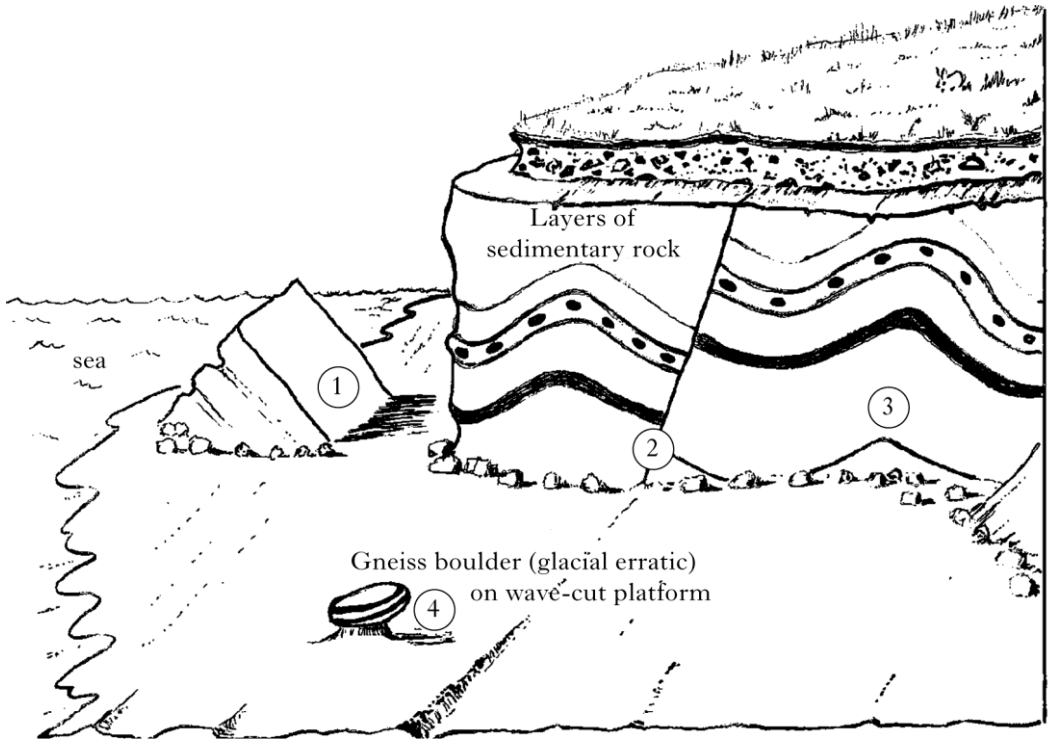
Any suggestion that the more advanced (indicator) fossil is underneath is acceptable.

(c) Name the oldest rock in the diagram. **1**

Sandstone.

	Marks

(d) The sketch shows a headland at low tide. The area was visited by a group of geology students in the month of February. They decided to carry out typical fieldwork measurements at positions 1 to 4. **1**



(i) State one measurement that could be taken at each location. Give a different measurement for each location.

Position	*Measurement*
1	Any stack dimension/dip and/or strike of exposed bed.
2	Angle of fault/displacement of beds.
3	Axial plane angle/bed thickness/grain size.
4	Crystal size/any boulder dimension/height of pedestal.

All 4 = 2 marks, 2 or 3 = 1,1 = 0 marks **2**

(ii) State four safety precautions that should be taken whilst carrying out fieldwork in this area.

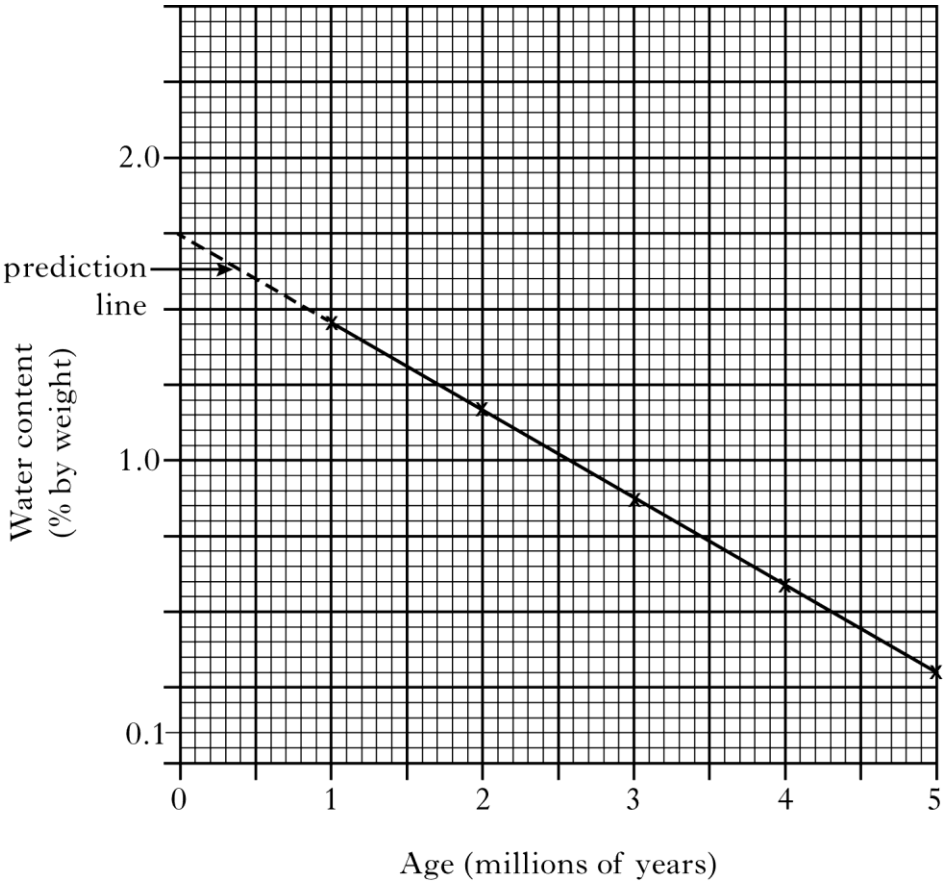
Time of high tide/Tide height/Hard hat worn/Suitable footwear/Suitable clothing/Mobile phone/First aid kit available/Wind strength and direction/ any other suitable answer.

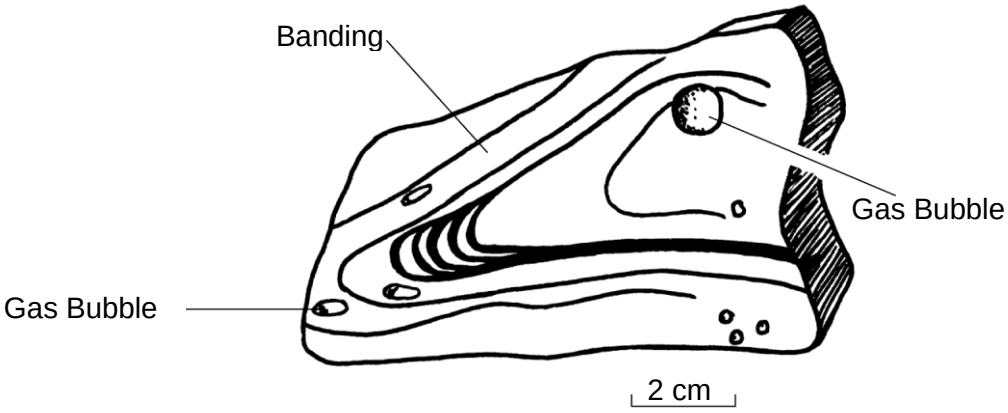
4 correct = 2 marks
2 or 3 = 1 mark
1 = 0 marks **2**

Marks

3. The table shows the water content of lavas of different ages that came from one volcano.

Age of lava (millions of years)	Water content (% by weight)
1	1.45
2	1.15
3	0.87
4	0.57
5	0.30

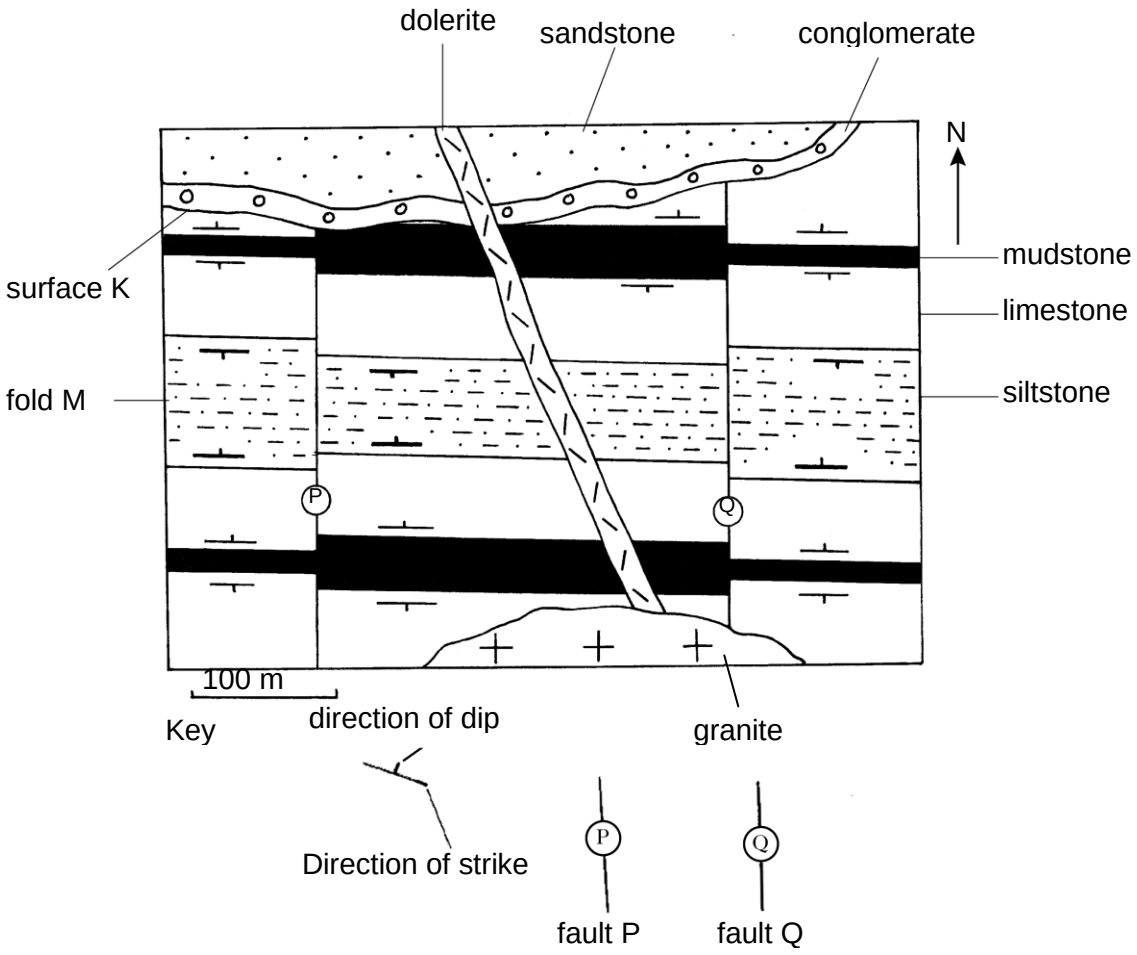


		Marks
(a)	On the graph paper provided draw a line graph of age of lava against water content. Suitable scales (plus greater than or equal to half the graph paper used) 1 Labelling axes with units 1 Plotting at least 3 points correctly and joining the plots 1 The X axis could run from 0-5 or 5-0.	**3**
(b)	Describe the general relationship shown up the graph. As the age of the lava increases the water content steadily decreases (or converse) or Water content is inversely proportional to age of lava.	**1**
(c)	Predict the percentage water content in lava erupted very recently. 1·75 ± 0·1%	**1**
(d)	How many times greater is the percent of water in the 1 million year old lava than the 4 million year old lava? Space for calculation – give your answer correct to 2 decimal places 1.45/0.57 = 2.544 (1 mark + 1 mark for rounding to 2.54) 2.54 times	**2**
(e)	The diagram shows a specimen of lava.  What name is given to gas bubbles trapped within lava? vesicle	**1**

	Marks
(f) Explain why banding forms in some lavas. Lava can have areas of different composition/viscosity. During flow these areas may be stretched giving banding or Crystals that are forming line up during flow.	**1**

	Marks

4. Study the geological map.



(a) **(i)** What type of structure is surface K?

An unconformity **1**

(ii) How has surface K formed?

A long period of erosion (of the folded sedimentary rocks) was followed by deposition. (The eroded surface is the unconformity). **1**

(b) What type of intrusion is formed by the dolerite?

A dyke **1**

(c) What type of fold is M?

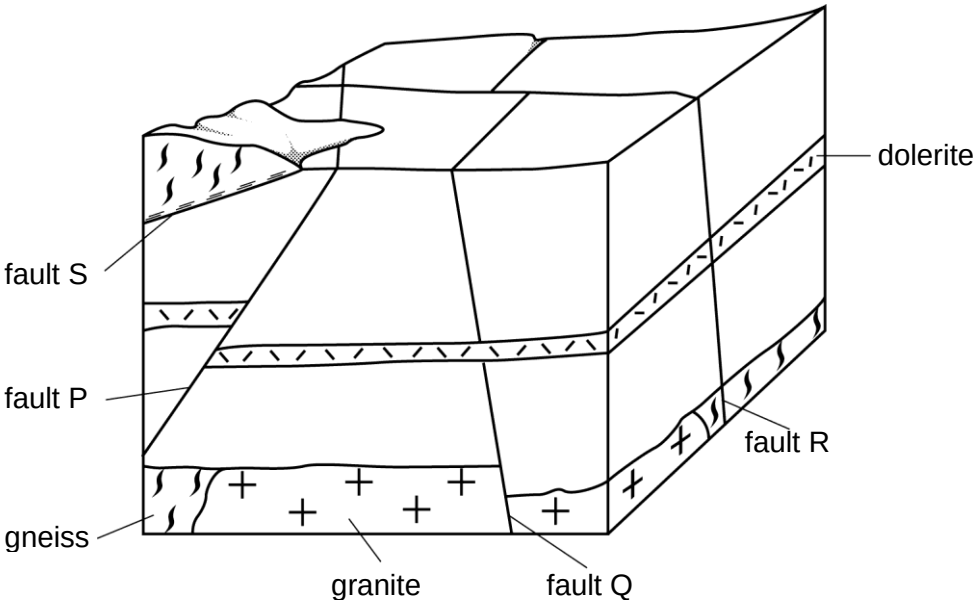
1

Syncline

			Marks
(d)	**(i)**	Name the oldest sedimentary rock on the map.	
		Mudstone	**1**
	(ii)	Name the youngest sedimentary rock on the map.	
		Sandstone	**1**
(e)		On which side of fault P have the rocks been moved up? Give a reason for your answer.	
		Side of fault P: East side	**1**
		Reason: There is a narrower exposure of siltstone on the E side than the W side. This shows that it has suffered more erosion. Or There is older rock on the E side set across from younger rock on the W side indicating that the older rock has been lifted up. Or There is a narrower exposure of siltstone on the E side than on the W side. When a syncline is moved up the outcrop of the bed in the core becomes narrower.	**1**
(f)		Place the following events in the correct order from oldest to youngest.	
		A Folding of rocks B Intrusion of dolerite C Deposition of siltstone D Movement on fault P E Intrusion of granite F Formation of surface K	
		Give only the letters: C → A → D → F → B → E Oldest Youngest	**3**
		All 6 in correct order = 3 marks 4 or 5 = 2 marks 2 or 3 = 1 mark	

	Marks

5. Study the block diagram.



(a) What types of fault are P, Q, R and S?

Fault P: Reverse Fault Q: Normal
Fault R: Tear Fault S: Thrust
-1 mark for every mistake **3**

(b) Name the metamorphic rock that has formed along fault S?

Mylonite **1**

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

A Slate is formed from metamorphosed sandstone.

B Metamorphic rocks can be metamorphosed again.

C Metamorphic rocks are all formed from igneous rocks.

D Metaquartzite consists mainly of calcite.

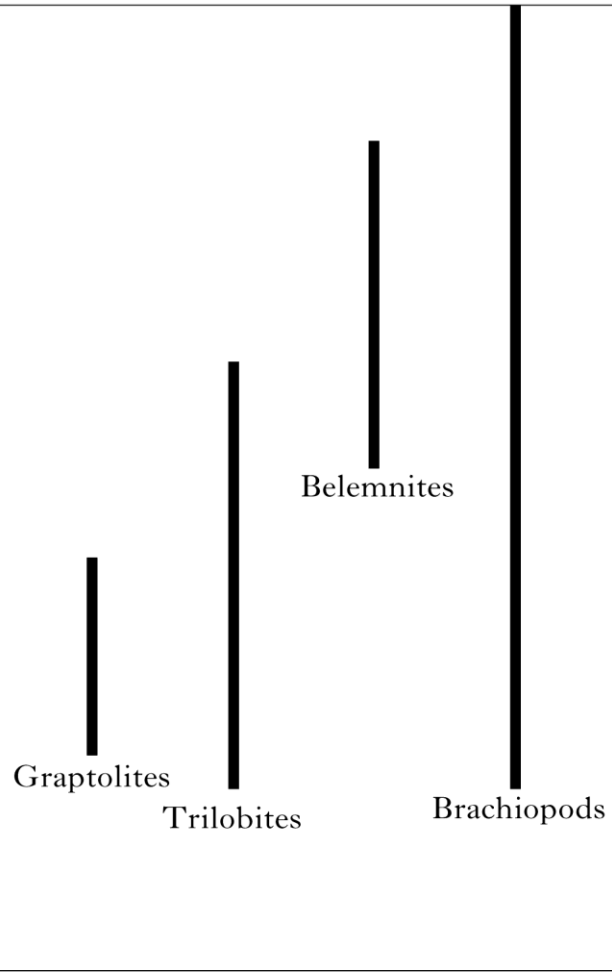
E Schist usually forms when gneiss melts.

F Mudstones can be turned into hornfels as a result of thermal metamorphism.

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

Marks

6. The table shows the geological history of four fossil groups.

Eras/Periods since the formation of the Earth	*Duration (Millions of years)*	*Time span line of four fossil groups*
Quarternary	2	
Tertiary	65	
Cretaceous	80	
Jurassic	65	
Triassic	35	
Permian	45	
Carboniferous	70	
Devonian	50	
Silurian	30	
Ordovician	70	
Cambrian	60	
Precambrian	4000	

(a) Which fossil on the time diagram would allow rocks to be most accurately dated? Give a reason for your answer.

Fossil: Graptolite **1**

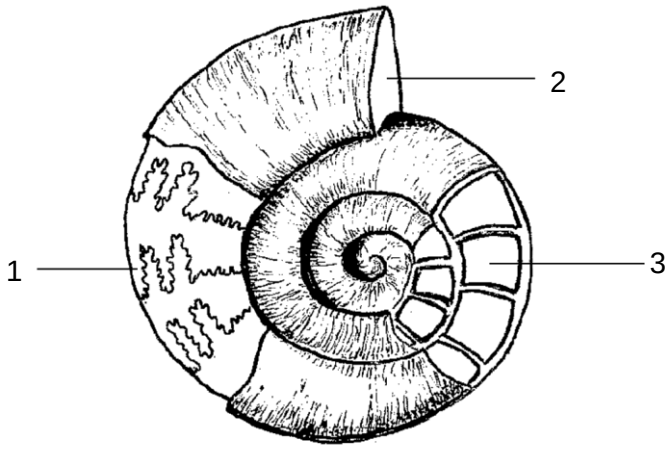
Reason: They live over the shortest period of time. **1**

(b) A rock was found to contain trilobites, belemnites and brachiopods. Name a geological period in which it formed.

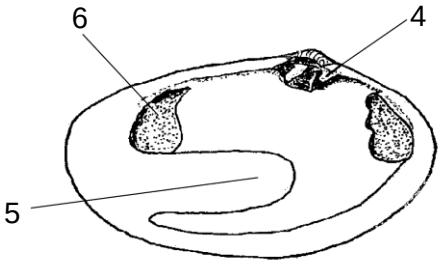
Permian/Carboniferous **1**

				Marks
7.	**(a)**	**(i)**	In the table below name the parts numbered 1 to 6 of the fossils A and B.	

Fossil A



Fossil B



Plane of symmetry

Number	*Name*
1	Suture line
2	Aperture
3	Chamber
4	Tooth
5	Pallial sinus
6	Muscle scar

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

(ii) Name fossils A and B.

Name of fossil A: Ammonite

Name of fossil B: Bivalve both correct for 1 mark **1**

	Marks

(b) Explain why fossil A is often found as a complete fossil in many types of sediment.

It has a hard exoskeleton/hard/strong shell or
It has been mineralised or
On death many sink to a relatively calm sea floor (low energy environment) **1**

(c) Draw a line through fossil B to show its plane of symmetry. **1**

(d) From the sketches of fossil B suggest where it lived. Give a reason for your answer.

Where it lived: Burrowed in soft sediment **1**

Reason: The pallial sinus is large/has a deep bend where the long siphons were housed.
Or shell open at both ends or shell narrow or valves thin. **1**

(e) Indicate which of the following are trace fossils Place a tick (✓) opposite a correct option.

Type of fossil	If a trace fossil add a ✓
Dinosaur footprint	✓
Hair of a woolly mammoth	
Test of echinoid	
Bite marks of a predator fish on a smaller fish	✓
Grazing trail of a trilobite	✓
Burrow of a piddock (a rock boring bivalve)	✓
Brachiopod pedicle valve	
Belemnite guard	

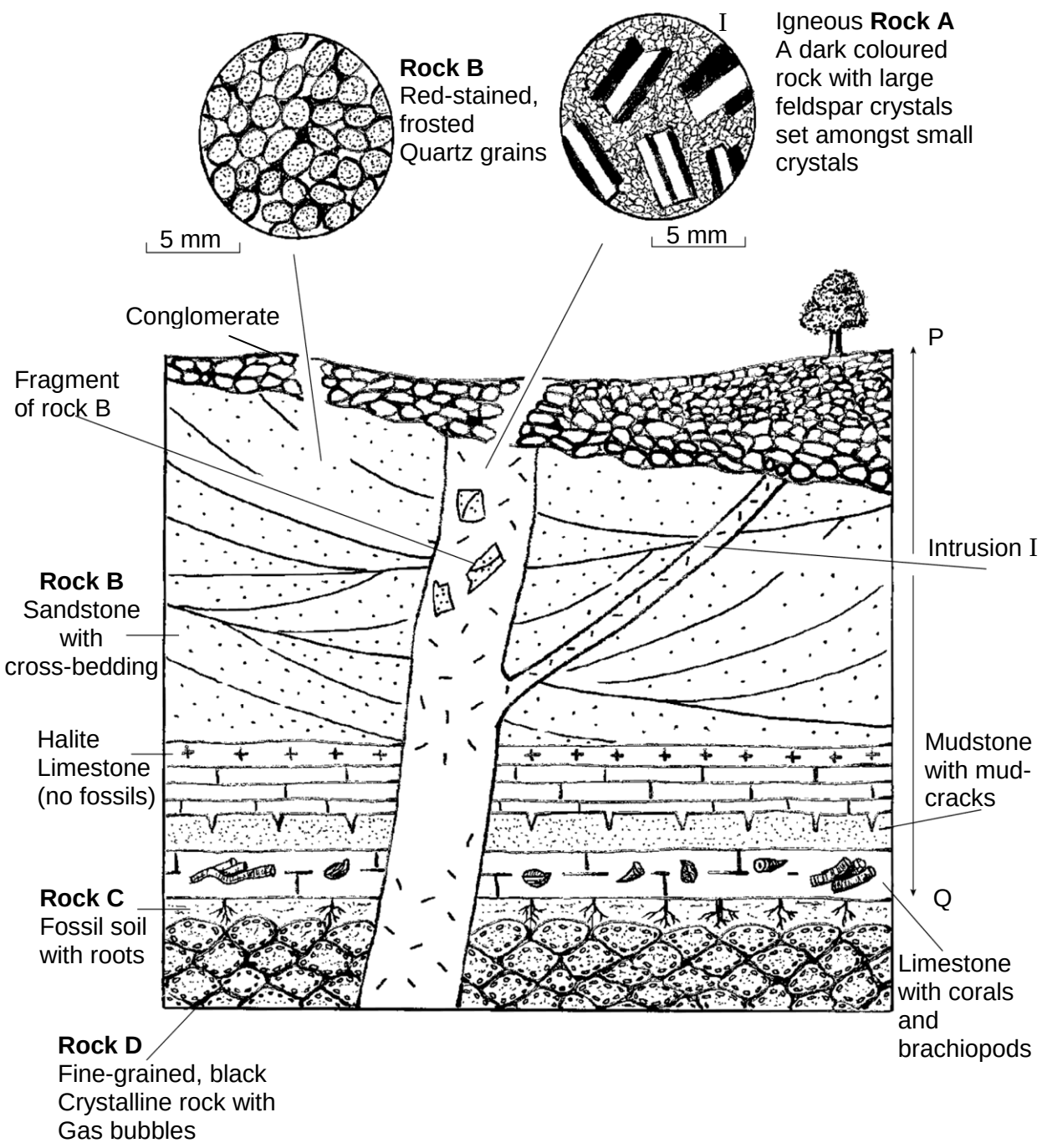
All 4 = 2 marks, 2 or 3 = 1, 1 = 0. **2**

If 5 or 6 boxes are ticked deduct 1 mark.

If 7 or 8 boxes are ticked deduct 2 marks.

Marks

8. The diagram shows a section through a quarry and magnified drawings of rock A and rock B.



(a) Describe the processes involved in forming igneous rock A.

Rock A has undergone two-stage cooling. The magma initially lay at a greater depth and cooled slowly at first hence (feldspar) crystals grew to a good size. The remaining magma and already formed crystals were then pushed upwards where the magma cooled quickly giving small (fine) crystals. Rock A is made up of material/magma that has pushed its way up.

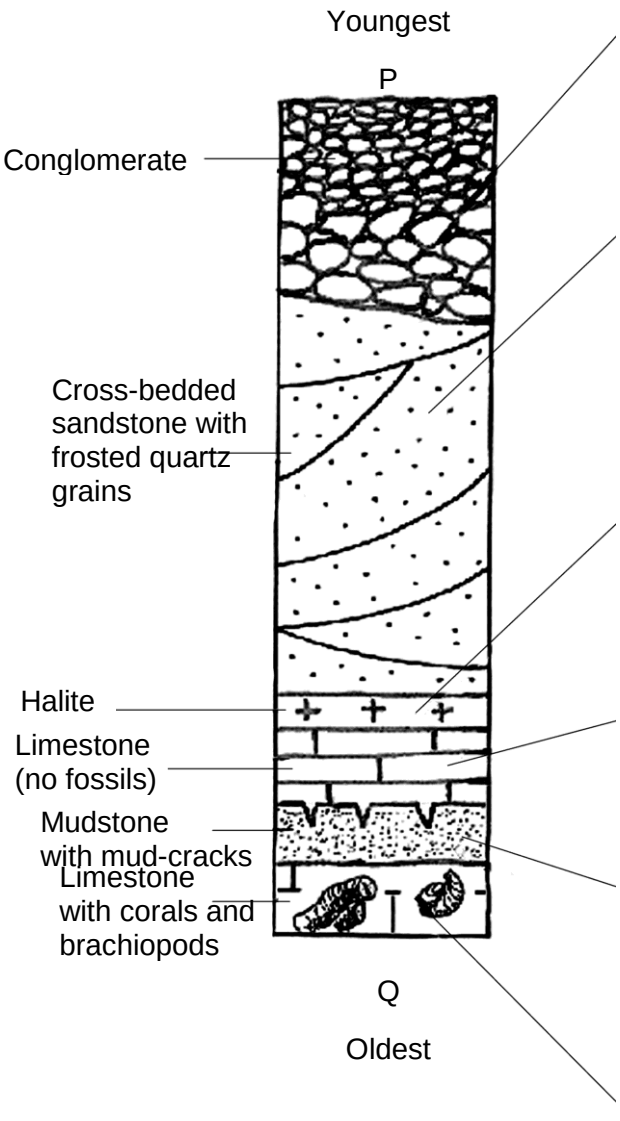
1

			Marks
(b)	**(i)**	Igneous rock A contains fragments of rock B. What name is given to a fragment of another rock found within an igneous rock?	
		A Xenolith B Phenocryst C Concretion D Amygdale	
		Give only the letter: A	**1**
	(ii)	Account for the red colour in rock B (sandstone).	
		An iron oxide (cement) around the quartz grains Or Terrestrial deposit (or exposed to air during deposition) so iron oxidised.	**1**
	(iii)	Account for the shape of the quartz grains in rock B (sandstone).	
		Collisions between the quartz grains during wind transport (in a desert).	**1**
(c)	**(i)**	Intrusion I is 100 cm wide. The table below gives the average size of crystals from one side of the intrusion to the other.	

Distance from one side of the intrusion to the other (cm)	Crystal size (mm)
2	0.20
30	1.25
38	2.00
45	2.50
52	3.00
62	2.20
78	1.00
94	0.40

		Describe the general relationship shown in the table between crystal size and distance from the sides of the intrusion.	
		The size of crystal increases towards the middle of the vent.	**1**
	(ii)	Explain why crystal size changes across the width of intrusion I.	
		The magma at the edges (in contact with the country rock) cools faster forming small crystals (2) or the magma in the middle cooled more slowly giving larger crystals (2). A statement simply stating that cooling occurred at different rates obtains 1 mark.	**2**

	Marks
(d) Give two reasons for identifying rock D as a lava flow and not a sill.	
1. The fossil soil above it suggests that the upper part of the rock was exposed to the atmosphere and subjected to weathering processes (1). **2.** It displays pillow structure that is typical of lava coming in contact with sea water (1). **3.** It has a high abundance of vesicles (1). **4.** It has no chilled margins (1).	**2**
(e) The diagram shows rocks seen in a section of the quarry between P and Q. Describe the geological events and environment of deposition of the rocks and structures seen in this part of the quarry by completing the boxes below. One box has been completed for you.	**5**



Fast flowing rivers erode the landscape. The large rounded boulders, (gravel) and sand are then deposited (on the eroded surface).	
Migrating desert sand dunes invade the dried up lagoon/coastal area.	
The rock salt/halite in the sea water precipitates with continued evaporation.	
Sea invades a land area. The climate becomes drier and limestone precipitates from solution as water evaporates.	
Mud brought down by rivers is deposited in still water. The mud then dries out to produce desiccation cracks.	
Limestone is deposited in a shallow warm sea lagoon area or shallow tropical water.	

Every box correct = 1 mark

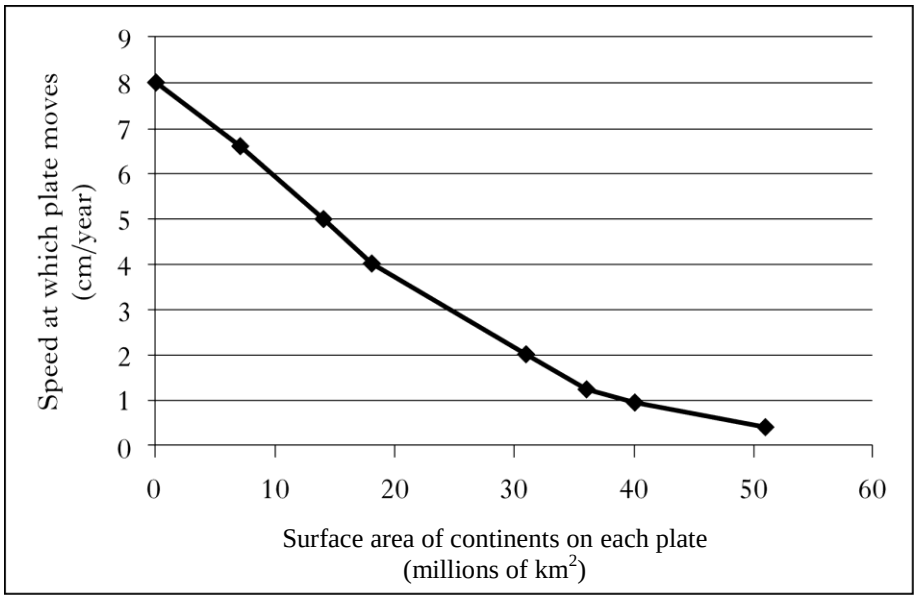
Marks

9. Research was carried out into the speed of movement of the eight largest plates on the earth's surface. The aim was to discover if there was a relationship between rate of movement of the plates and:

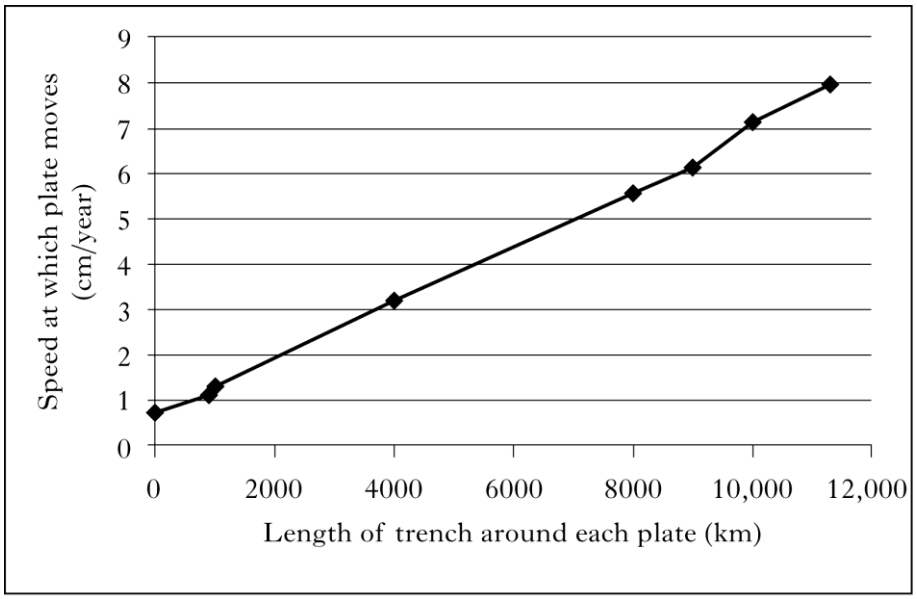
a. the surface area of the continents on each plate
b. the length of trench around each plate.

The results are shown in graphs 1 and 2.

Graph 1: Surface area of continents on each plate plotted against speed at which each plate moves.



Graph 2: Length of trenches around each plate plotted against the speed at which each plate moves.



Marks

The table gives more detailed information about four of the plates.

Name of plate	Surface area of continents on the plate (millions of km^2)	Length of trench around each plate (km)
Pacific	0	11300
North American	36	1000
Eurasian	51	0
African	31	900

(a) Using the information in the graphs and table decide which plate is moving fastest. What observations did you make to come to this conclusion?

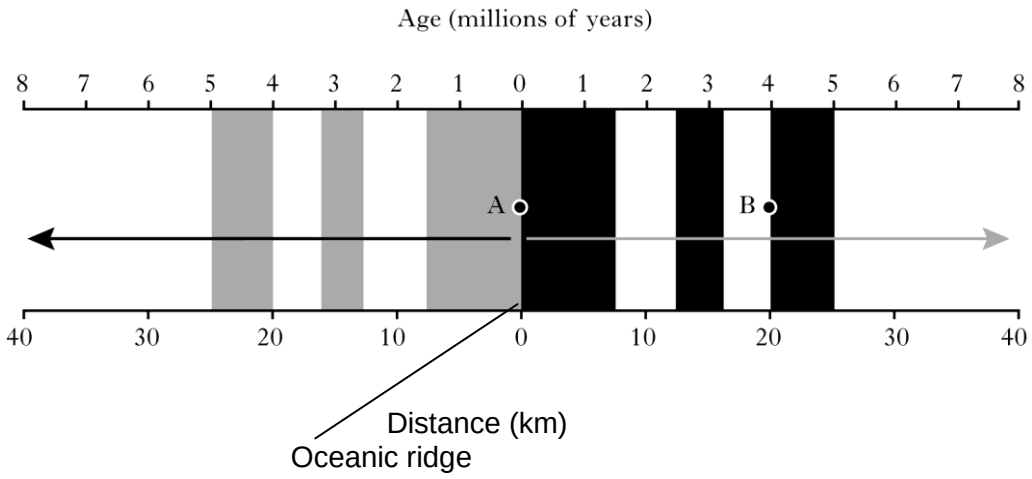
Plate moving fastest: Pacific **1**

Observations:

It has no continents/least surface area – 1 mark.
It has the longest trenches – 1 mark.

Or indicate trends on each graph correctly – 1 mark each. **2**

(b) The diagram shows a set of magnetic stripes in an area of oceanic crust east of an oceanic ridge.



		Marks
(i)	Calculate the rate of sea floor spreading between A and B in centimetres per year. *Space for calculation.* *2 000 000/4 000 000 = 0.5* Answer: 0.5 cm/year	**1**
(ii)	Complete the diagram to the west of the oceanic ridge to show the magnetic stripes.	**1**
(iii)	Add arrows to the diagram to show the directions of plate movements.	**1**
(iv)	Name the type of plate boundary shown in the diagram? Divergent or constructive.	**1**

	Marks
10. The porosity of a segment is the percentage of pore space between the sediment fragments.	**2**

The table gives:

- the porosity of some sediments as they would have been as **they formed as surface deposits.**
- the thickness of these deposits **before** and **after** they have been compacted due to other sediments being deposited on them.

- Note: a sediment in which all the particles have a similar size is referred to as "well-sorted".

Sediment	Porosity of Surface Deposits (% pore space)	Thickness when deposited (m)	Thickness after burial (m)
Well-sorted gravel	30	10	9
Well-sorted sand	39	10	8
Mixed sand and gravel	25	10	8.5
Well-sorted silt	52	10	5
Well-sorted clay	55	10	2
Glacial deposits	13	10	9

(a) Explain why the mixed sand and gravel has a lower porosity than the well-sorted gravel and the well-sorted sand.

The (smaller) sand particles fit between the (larger) gravel particles (and reduce porosity). **1**

(b) Which sediment has been compacted the most after burial?

Well-sorted clay **1**

		Marks
(c)	Express as a whole number ratio the porosities of well-sorted sand to well-sorted silt to glacial deposits. *Space for calculation.* 39 : 52 : 13 Well-sorted sand: 3 Well-sorted silt: 4 Glacial deposits: 1	**1**
(d)	Which **one** of the following three sediments will have the greatest porosity and therefore be the best reservoir for oil and gas after burial? Assume that no cementation occurs. Well-sorted sand Well-sorted silt Glacial deposits Note: Calculations must be shown to obtain full marks. *Space for calculation.* 39 × 0.8 = 31.2 well-sorted sand 52 × 0.5 = 26 well-sorted silt 13 × 0.9 = 11.7 glacial deposits Sediment: Well-sorted sand 1 If any workings are shown that make sense = 1 mark (ie an answer without working obtains a max of 1 mark).	**2**

	Marks

11. **(a)** What is the epicentre of an earthquake?

The point on the surface of the Earth above the focus of an earthquake. **1**

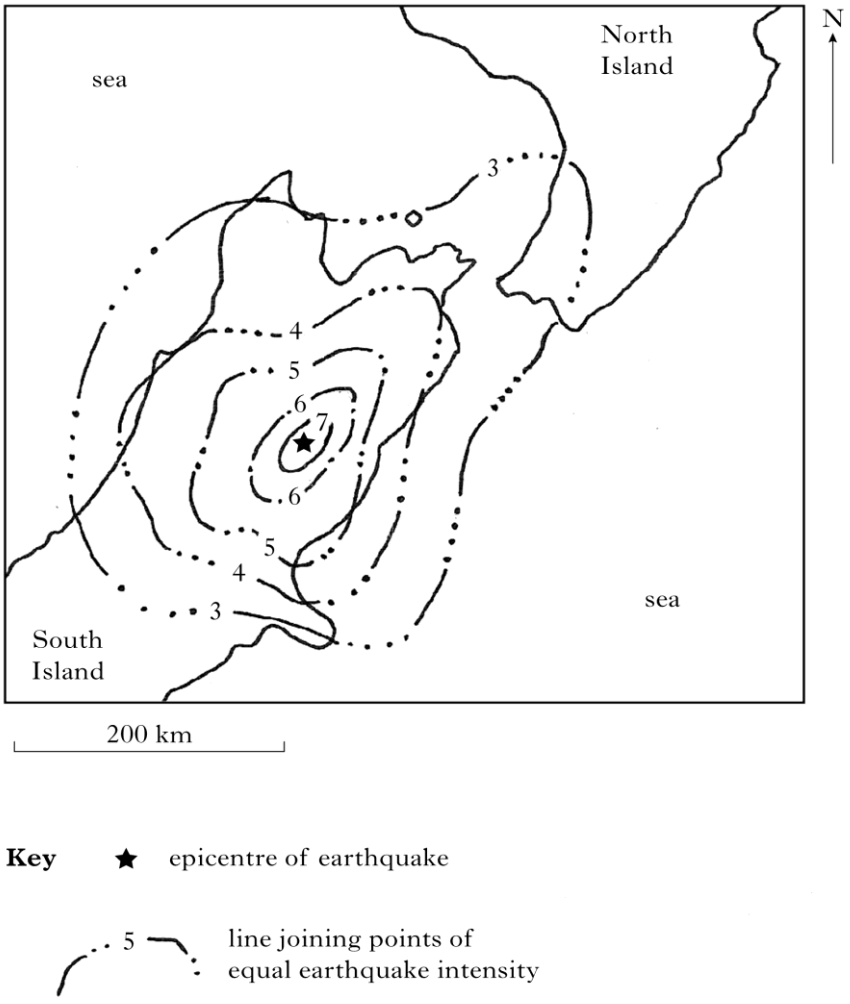
(b) Give the order in which the three types of seismic waves from an earthquake arrive at a seismometer.

1st: Primary/P-wave 2nd: Secondary/S-wave 3rd: Long wave/L-wave **1**

(c) What is the intensity of an earthquake?

It is a measure of how strongly an earthquake shakes the ground/It is a measurement that indicates what people actually feel and see at the surface. **1**

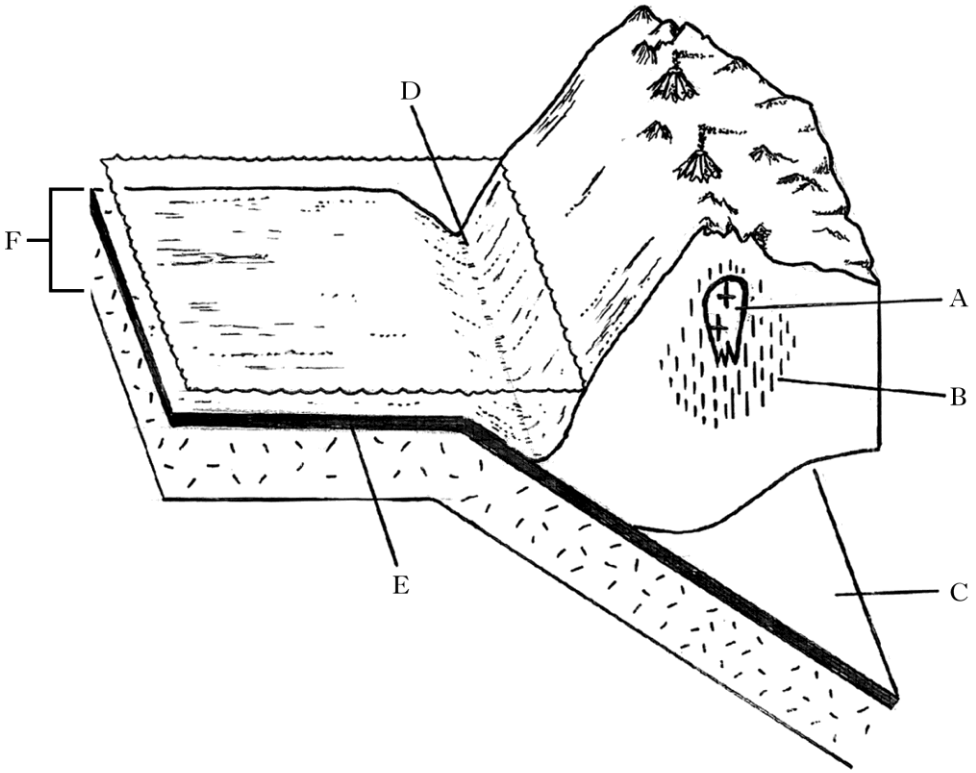
(d) The map shows lines of equal intensity surrounding the epicentre of an earthquake that took place in New Zealand.



	Marks
Which **one** of the following statements is correct? A Earthquake intensity decreases at an equal rate in all directions from the epicentre. B Earthquake intensity decreases more rapidly towards the North East than towards the East. C At the epicentre, earthquake intensity is greater than 7. D Earthquake intensity depends only on distance from the epicentre. *Give only the letter*: C	**1**

Marks

12. Study the diagram.



(a) Complete the table by naming features A to F. Use six names from the following list.

Asthenosphere
Gabbro intrusion
Granite batholith
Lithosphere
Oceanic crust
Oceanic trench
Site of regional metamorphism
Site of deep focus earthquakes
Site of shallow focus earthquakes

Number	*Name of feature*
A	Granite batholith
B	Site of regional metamorphism
C	Site of deep focus earthquakes
D	Oceanic trench
E	Oceanic crust
F	Lithosphere

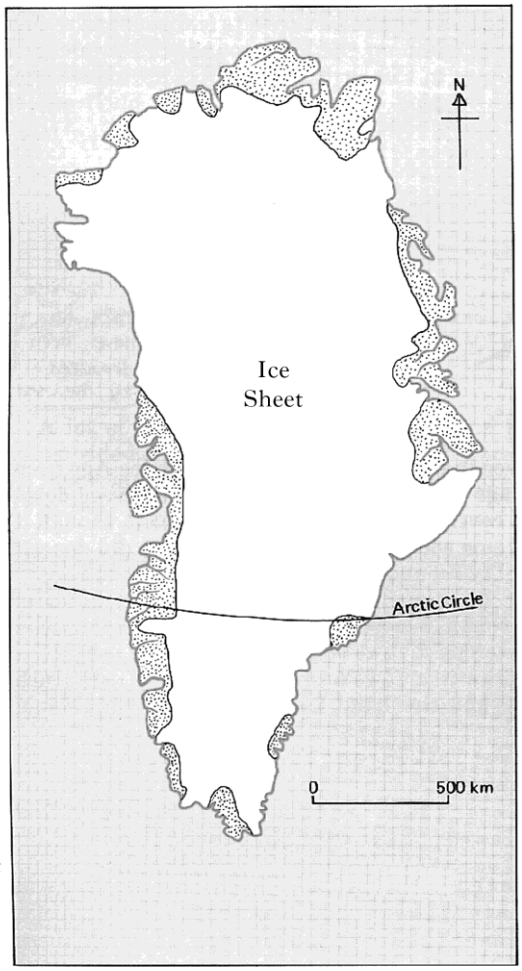
All 6 = 3, 4 or 5 = 2, 2 or 3 = 1 mark **3**

		Marks
(b)	Name the type of plate margin shown in the diagram	
	destructive or convergent	**1**
(c)	Which type of lava typically erupts from the volcanoes shown in the diagram?	
	andesitic	**1**

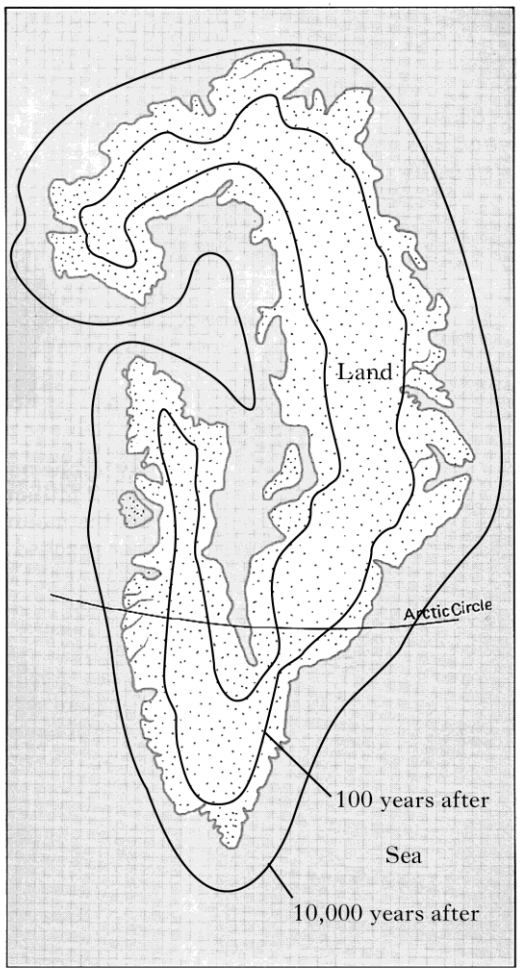
	Marks

13. Map 1 shows Greenland as it is today. It is mostly covered by a large ice sheet. Map 2 is an imaginary map of Greenland showing the coastline after all ice has been removed but sea level kept at today's position.

Map 1



Map 2



Map 2 does not take into account two consequences that would result from a worldwide ice melt.

(a) What will be the two consequences of this worldwide ice melt on Greenland over the next 10 000 years.

1. Sea level will rise
2. Land will rebound (due to isostasy) **2**

(b) On map 2 draw in two possible coastlines. One for 100 years after the worldwide ice melt (and labelled 100) and the other for 10 000 years after the melt (labelled 10 000). **1**

Note: The 10 000 year coastline might be inside the current coastline, but as long as it is outwith the 100 year coastline give 1 mark.

[END OF MARKING INSTRUCTIONS]