OCR ADVANCED SUBSIDIARY GCE IN GEOLOGY (3884)

OCR ADVANCED GCE IN GEOLOGY (7884)

Specimen Question Papers and Mark Schemes

These specimen assessment materials are designed to accompany the OCR Advanced Subsidiary and Advanced GCE specifications in Geology for teaching from September 2000.

The GCE awarding bodies have prepared new specifications to incorporate the range of features required by new GCE and subject criteria. The specimen assessment material accompanying the new specifications is provided to give centres a reasonable idea of the general shape and character of the planned question papers in advance of the first operational examination.

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Advanced Subsidiary GCE

A2

Oxford Cambridge and RSA Examinations

Advanced Subsidiary GCE

GEOLOGY

Global Tectonics and Geological Structures **2831**

Specimen Paper

Additional materials:
Answer paper

TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

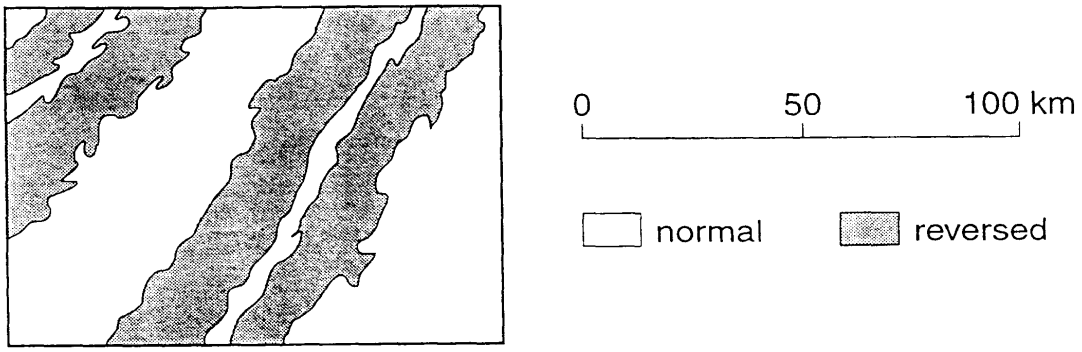
Write your name, Centre number and candidate number in the spaces provided on the answer booklet.
Write all your answers on the separate answer paper provided.
If you use more than one sheet of paper, fasten the sheets together.
Answer **all** questions.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.
You will be awarded marks for the quality of written communication in question 5.
Total marks for this paper is 90.

Answer **all** questions

1 The diagram below shows the results of a magnetic survey of an area of sea floor to the south-west of Iceland.



(a) Regions of normal and reversed polarity are shown.

(i) Mark the ocean ridge axis on the diagram. **[1]**

(ii) Give **two** reasons for your choice.

.....

.....

.....

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

(iii) What is meant by the term magnetic anomaly?

.....

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

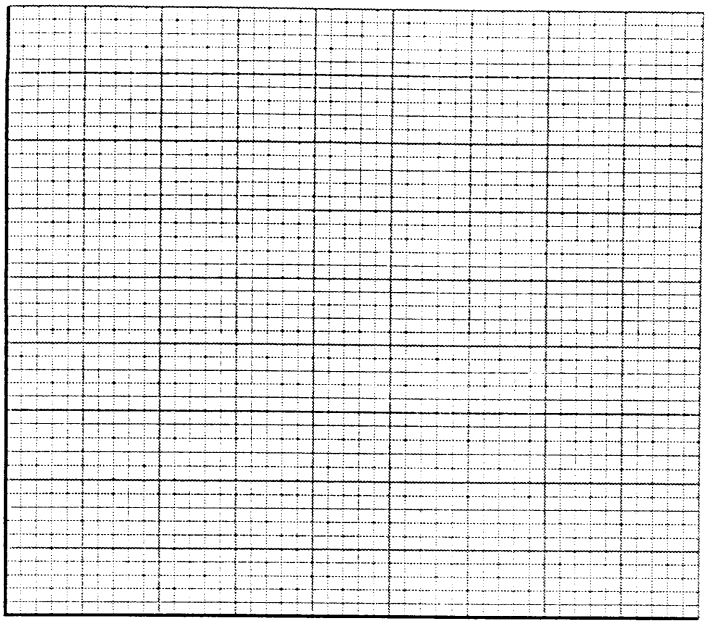
(iv) Explain why the junctions between the regions of normal and reversed polarity are irregular.

.....

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

(b) Using the information in the table below, plot a graph of distance from the ocean ridge against age of the ocean crust**.**

Distance from ocean ridge (km)	Age of ocean crust (Ma)
50	2
130	7
200	10
300	15
400	21
360	18



[3]

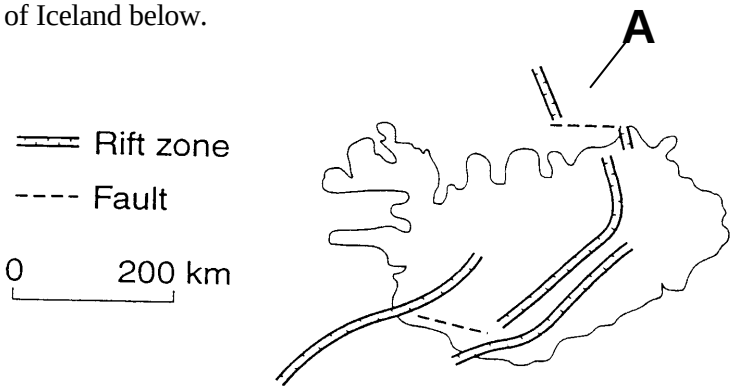
(c) **(i)** From your graph, and showing your working in the space below, determine the average rate of sea floor spreading in cm per year for one side of the ocean ridge

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

(ii) What is the rate, in cm per year, at which the ocean is widening in this region?

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

(d) Study the map of Iceland below.



(i) On the map of Iceland, clearly label where you would expect to find the **oldest** and **youngest** rocks. **[2]**

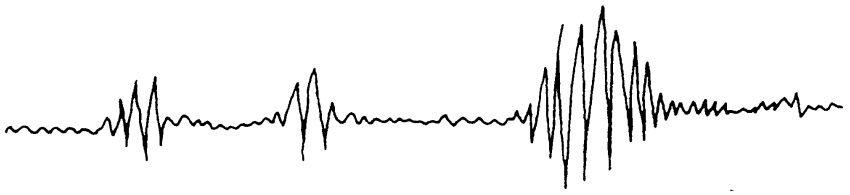
(ii) Label on the map on area where there are active volcanoes. **[1]**

(iii) The rocks at **A** have been displaced by a major fault. What type of fault is it?

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

[Total: 16]

2 **(a)** The diagram below shows a seismic record for a single earthquake.



Time ——————————————————————

(i) On the seismic record, accurately label the L, P and S wave arrivals. **[2]**

(ii) Which of the three types of seismic waves follow a path around the surface of the Earth?

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

(b) **(i)** Some seismic records do not show any S wave arrivals. Explain why.

.....

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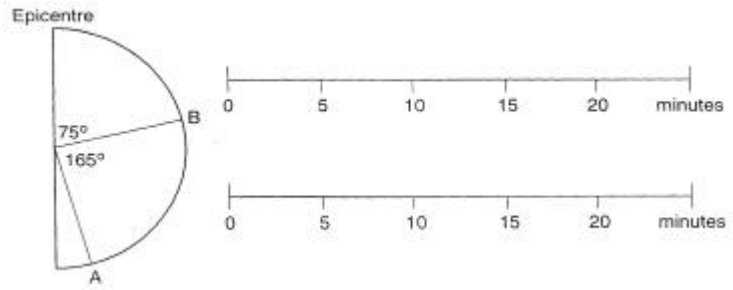
.....**[3]**

(ii) Seismic waves from a major earthquake in Japan were picked up by seismographs at the following locations.
Recording Station **A** which is at an epicentral angle of 165^{o} from Japan;
Recording Station **B** which is at an epicentral angle of 75^{o} from Japan;
No direct seismic waves were received at station **C**.

Draw seismograms for stations A and B on the time scales shown. **[4]**



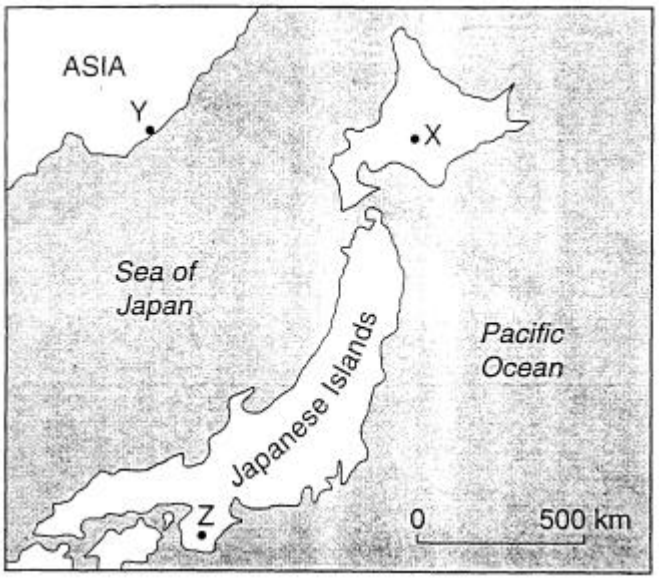
(iii) What could the epicentral angle of Station **C** be?

..... degrees. **[1]**

(c) The locations of recording stations for a shallow focus earthquake are shown on the map of part of Asia. The distance of the epicentre from each of the stations has been calculated.

Station **X**	400 km
Station **Y**	900 km
Station **Z**	1000 km

Use this information to plot the epicentre of the earthquake on the map. **[3]**



(d) **(i)** Describe **three** serious effects that an earthquake occurring in this area may have in Japan.

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.....**[3]**

(ii) Many of the buildings in Japan have been constructed to be earthquake proof. Describe **two** methods that have been used to construct safer structures.

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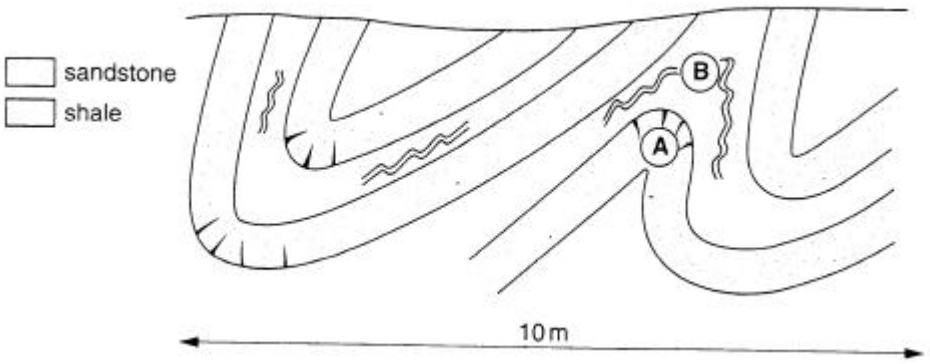
.....**[2]**

[Total 19]

3. The drawing below shows a cross section of a series of folds exposed in a cliff face.



(a) (i) Name the structural features shown at points **A** and **B**

Feature at **A** in the sandstone bed
……..

Feature at **B** in the shale bed
……..……**[2]**

(ii) Draw and label the axial plane for each fold on the drawing above. **[2]**

(iii) Label the limb of a fold. **[1]**

(iv) Label the crest of a fold. **[1]**

(b) **(i)** Apply the terms *incompetent* and *competent* to the folded beds.

Shale is ……. Sandstone is …… **[1]**

(ii) Explain why slaty cleavage does not form in the sandstone.

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

(iii) Explain with the aid of diagrams why cleavage does form in the shale.

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.....**[3]**

(iv) The shale bed contains fossil bivalves which are normally roughly circular in outline. Explain with the aid of a diagram what happens to the shape of these fossils in the centre of the fold?

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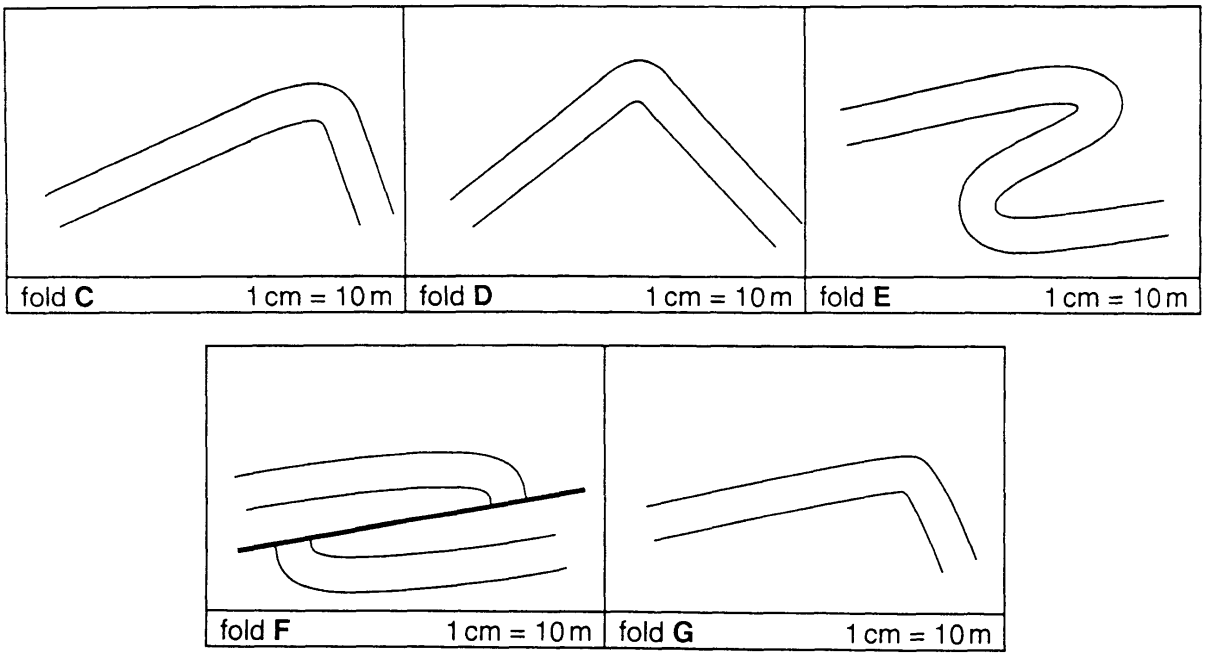
.....**[2]**

(c) All the cross sections of folds shown below were produced by compressive forces of varying amounts.



(i) Which fold was produced by equal forces from both sides?

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

Write down the letters **C** - **G** in the correct order to show the sequence of folds produced by increasing pressure.

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

(iii) Draw an arrow on diagram **E** to show the direction of maximum pressure **[1]**

(d) Explain how Fold structure **F** formed.

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

[Total: 20]

4. The map below shows North and South America and parts of the Pacific and Atlantic Oceans.

(a) (i) Mark on the map using the numbers below and arrows, the position of the following:

1 an ocean trench;
2 an island arc;
3 a conservative plate margin;
4 an ancient part of the sea floor;
5 fold mountain belt;
6 continental shield.

[6]

(ii) Draw a cross sectional diagram to show the ocean floor from **X** to **Y.** Label the following features on your diagram.

mid ocean ridge
continental slope
ocean basin (abyssal plain)
continental shelf **[4]**

(b) (i) Give the characteristic features of a fold mountain belt.

age of rocks	type of rocks	volcanic or seismic activity

[3]

(ii) Give the characteristic features of a continental shield.

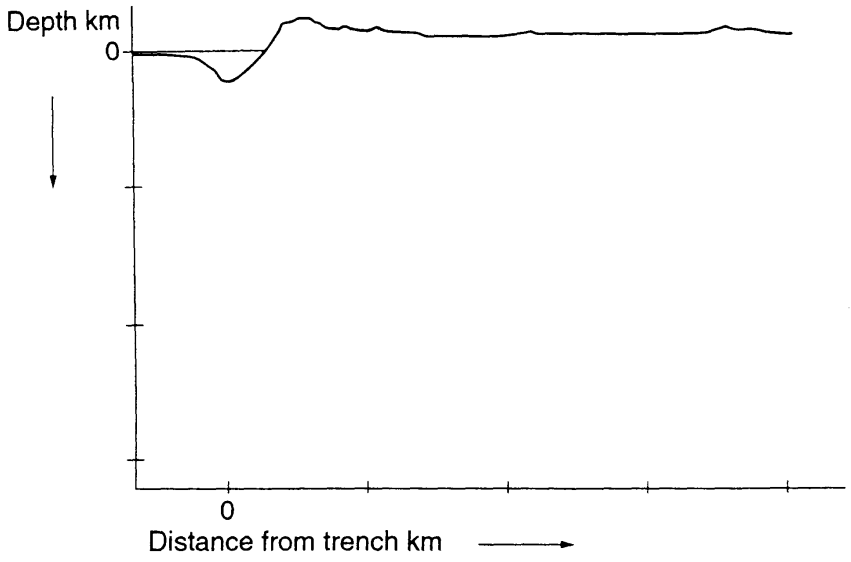
age of rocks	type of rocks	volcanic or seismic activity

[3]

(c) The table shows different depths of earthquakes below South America.

Distance from trench (km)	Depth (km)
100	50
400	320
250	150
180	100
300	200
150	80
350	300

(i) Select a suitable scale and plot the data onto the axes below **[3]**



(ii) What name is given to this pattern of earthquakes?

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[Total: 20]

5 *In this question, 2 marks are available for the quality of written communication.*

(a) Describe and illustrate the differences between a fault produced by tension and a fault produced by compression.

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(b) Describe the evidence for the composition and physical state of the outer core.

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[quality of written communication: 2]

[Total: 15]

Oxford Cambridge and RSA Examinations

Advanced Subsidiary GCE

GEOLOGY

Global Tectonics and Geological Structures **2831**

Mark Scheme

TOTAL MARK 90

1 **(a)** **(i)** in centre of white area (normal) to W [1] **[1]**

(ii) stripes are parallel to the ridge axis [1]
stripes are symmetrical to the ridge axis/equal on both sides/mirror image [1] **[2]**

(iii) different/variation in earth's magnetic field [1]
reversals/above/below average or positive/negative [1] **[2]**

(iv) varying rates of spreading at different locations/minor faults/lava flows into different areas [1] **[1]**

(b) labelled axes with suitable scale / line of best fit [1]
6/5/4 points accurate [2] **or** 1/2 points accurate [1] **[3]**

(c) **(i)**

$$\frac{30{,}000{,}000}{15{,}000{,}000}\ \frac{\text{cm}}{\text{years}}$$ [1]

= 2.0 cm per year ± 0.2 cm [1] **[2]**

(ii) double the rate in part **(i)** - ie. 4.0 cm approximately [1] **[1]**

(d) **(i)** youngest in centre and oldest west and east [1+1] **[2]**

(ii) in any of the rifts [1] **[1]**

(iii) transform [1] **[1]**

[Total:16]

2 **(a)** **(i)** P first, then S [1]
L at right [1] **[2]**

(ii) L waves [1] **[1]**

(b) **(i)** S waves do not pass through liquids / not transmitted [1]
beyond 103^{o} - no S waves / area in the Shadow Zone [1]
due to liquid outer core / lack of rigidity [1] **[3]**

(ii) (accurate seismograms not required - relative differences needed)
P wave arrives at A later than at B [1+1]
no S waves at A present at B [1+1] **[4]**

(iii) any between 103^{0}–142^{0} [1] **[1]**

(c) 2 cm south of X (mark for each correct arc) **[3]**

(d) **(i)** tsunami / tidal waves [1]
liquefaction of the ground and landslides [1]
destruction of buildings/transport systems etc by ground movement [1] **[3]**

(ii) Rubber joints / strong foundations
weights in buildings to counterbalance
flexible strong steel structures [1 mark for each to max 2] **[2]**

[Total: 19]

3 **(a)** **(i)** A tension joints / joints / tension fractures / tension cracks [1]
B Z or S folds / parasitic folds / minor folds [1] **[2]**

(ii) axial plane in centre of antiform and 1 synform [1+1] **[2]**

(iii) limb anywhere away from the crest [1] **[1]**

(iv) in the centre of the antiform fold [1] **[1]**

(b) **(i)** shale - incompetent and sandstone – competent [1] **[1]**

(ii) sandstone made of round quartz grains
they rotate as pressure is applied to the rock / cannot align grains
no clay minerals [1 mark for each to max 2] **[2]**

(iii) shale is made of flat, platy, clay minerals
these realign themselves at 90° to the maximum pressure
parallel to the axial plane of the fold [1 mark for each to max 2]
must include diagram [1] **[3]**

(iv) deformed / elongated / lengthened / squashed / distorted / become
oval / become ellipsoid or on diagram [1] at 90° to maximum force [1] **[2]**

(c) **(i)** fold D [1] **[1]**

(ii) D, G, C, E, F 0,1 or 2 correct = 0, 3 or 4 correct = 1, 5 correct = 2 **[2]**

(iii) arrow from left to right [1] **[1]**

(d) extreme pressure / pressure from the left [1] **[1]**
causes fold to break / fracture along thrust plane [1] **[1]**

[Total: 20]

4 **(a)** **(i)** 1 parallel to west coast [1]
2 Aleutians or Caribbean [1]
3 San Andreas [1]
4 east coast of Americas [1]
5 west coast of Americas [1]
6 Greenland / Canadian / South America [1] **[6]**

(ii) each feature shown in the correct position 1 mark **[4]**

(b) **(i)** young rocks <100 ma [1]
mainly sedimentary with andesitic volcanics granite batholiths [1]
lots of volcanic and seismic activity [1] **[3]**

(ii) old rocks >1000 ma [1]
mainly metamorphic [1]
no activity [1] **[3]**

(c) **(i)** scale [1]
points plotted accurately [2] **[3]**

(ii) Benioff zone / subduction zone [1] **[1]**
[Total:20]

5 **(a)** faults produced by tension will be a normal fault/or step fault/or rift valley/or grabenbut; a fault produced by compression will be a reverse fault or thrust fault; faults produced by tension will show no repetition vertically but faults produced by compression will show repetition vertically; in faults produced by tension the beds will be pulled apart but in faults produced by compression the beds will have been pushed together;.in faults produced by tension the downthrow side will be on the side of the hanging wall whilst in faults produced by compression the downthrow side will be on the footwall.
2 mark for each comparison (max 6)

diagram of normal fault and diagram of reverse fault (max 2) **[max 7]**
[Total: 20]

(b) evidence for the composition as iron-nickel is high density needed in the core to balance whole earth density of 5.5 and surface density of 2.7
Iron-nickel has density in excess of 12

- evidence from meteorites which come in two main composition types
- iron-nickel, believed to represent the core
- silicate materials, believed to represent the mantle
- evidence for liquid state is

- no S waves will pass through
- existence of shadow zone
- reduction in speed of P waves
- necessity for movement of iron-nickel to generate the earth's magnetic field

[max 6]

2 marks	Answers are structured clearly and logically, so that the candidate communicates effectively, uses a wide range of specialist terms with precision and spelling, punctuation and grammar are accurate.
1 mark	There are shortcomings in the structure of the answer, however, the candidate is able to communicate knowledge and ideas adequately, a limited range of specialist terms are used appropriately and spelling, punctuation and grammar are generally accurate with few errors.
0 marks	There are severe shortcomings in the organisation and presentation of the answer, leading to a failure to communicate knowledge and ideas. There are significant errors in the use of language, spelling, punctuation and grammar which makes the candidate's meaning uncertain.

[quality of written communication: max 2]

[Total:15]

Oxford Cambridge and RSA Examinations

Advanced Subsidiary GCE

GEOLOGY

The Rock Cycle – Processes and Products **2832**

Specimen Paper

Additional materials:
Answer paper

TIME 1 hour 30 minutes

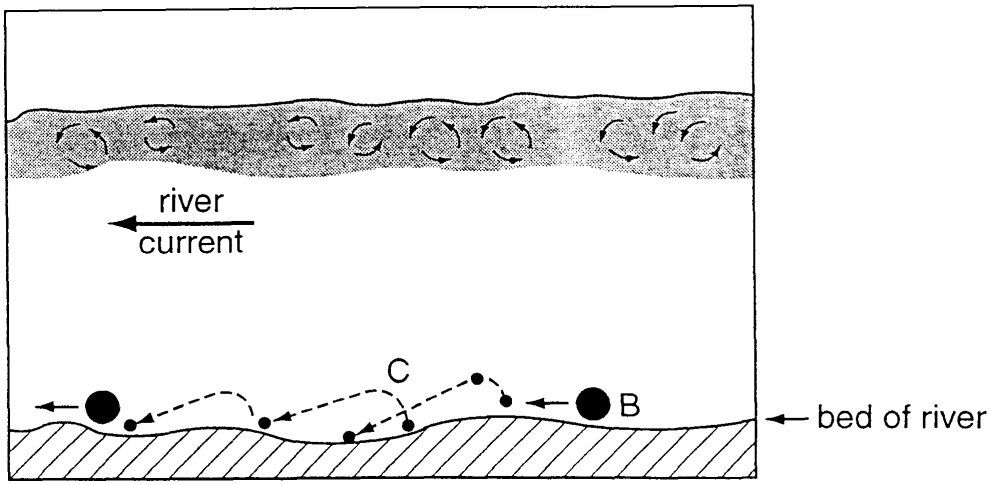
INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces provided on the answer booklet.
Write all your answers on the separate answer paper provided.
If you use more than one sheet of paper, fasten the sheets together.
Answer **all** questions.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.
You will be awarded marks for the quality of written communication in question 5.
Total mark for this paper is 90.

1 **(a)** **(i)** Name each of the methods of river transport **A**, **B** and **C** labelled on the diagram below.



A..... **B**.....

C ..... **[3]**

(ii) Describe how sediment is transported by method **C**.

.....

.....

.....

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

(b) What changes occur in the shape and size of particles as they are transported downstream?

shape : .....

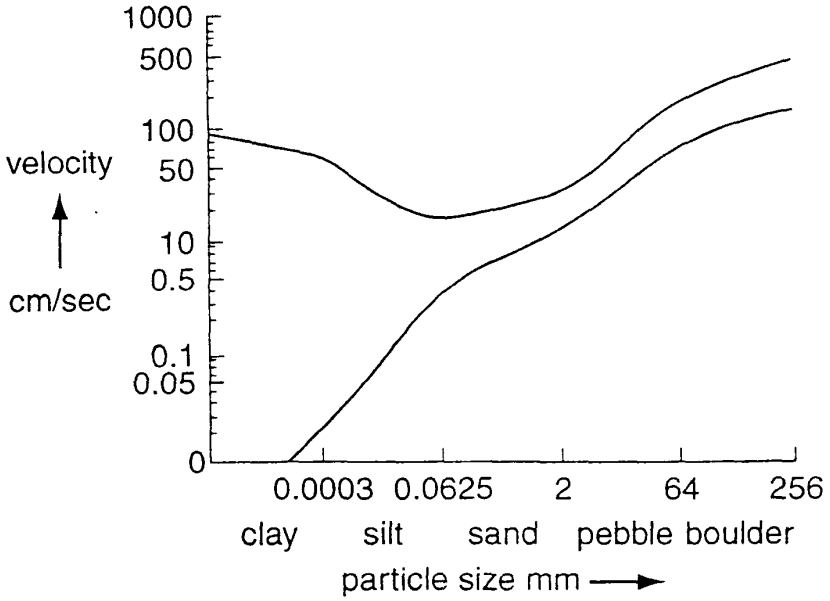
size : ..... **[2]**

(c) **(i)** Complete the table below using the data provided on the graph opposite showing the relationship between velocity, erosion and deposition.

Sediment	Maximum Particle Size (mm)	Velocity required for erosion (cm/sec)	Velocity required for deposition (cm/sec)
Boulder	256	400	130
Pebble	64	160	70
	2	30	
Silt	0.0625	17	0.4
Clay	0.0003	60	0.015

[2]

(ii) Label the areas of the graph where erosion, deposition and transport occur.



[2]

(d) **(i)** Explain why clay-size particles (<0.0003 mm) require higher velocities than sand-size particles for erosion to occur.

.....

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

(ii) State what conditions are necessary before clay-size particles are deposited.

.....……

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

(e) **(i)** Describe the shallow sea environments in which the pebble-size particles might be deposited.

.....……

.....……

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

(ii) Describe the shallow sea environments in which clay-size particles might be deposited.

.....……

.....……

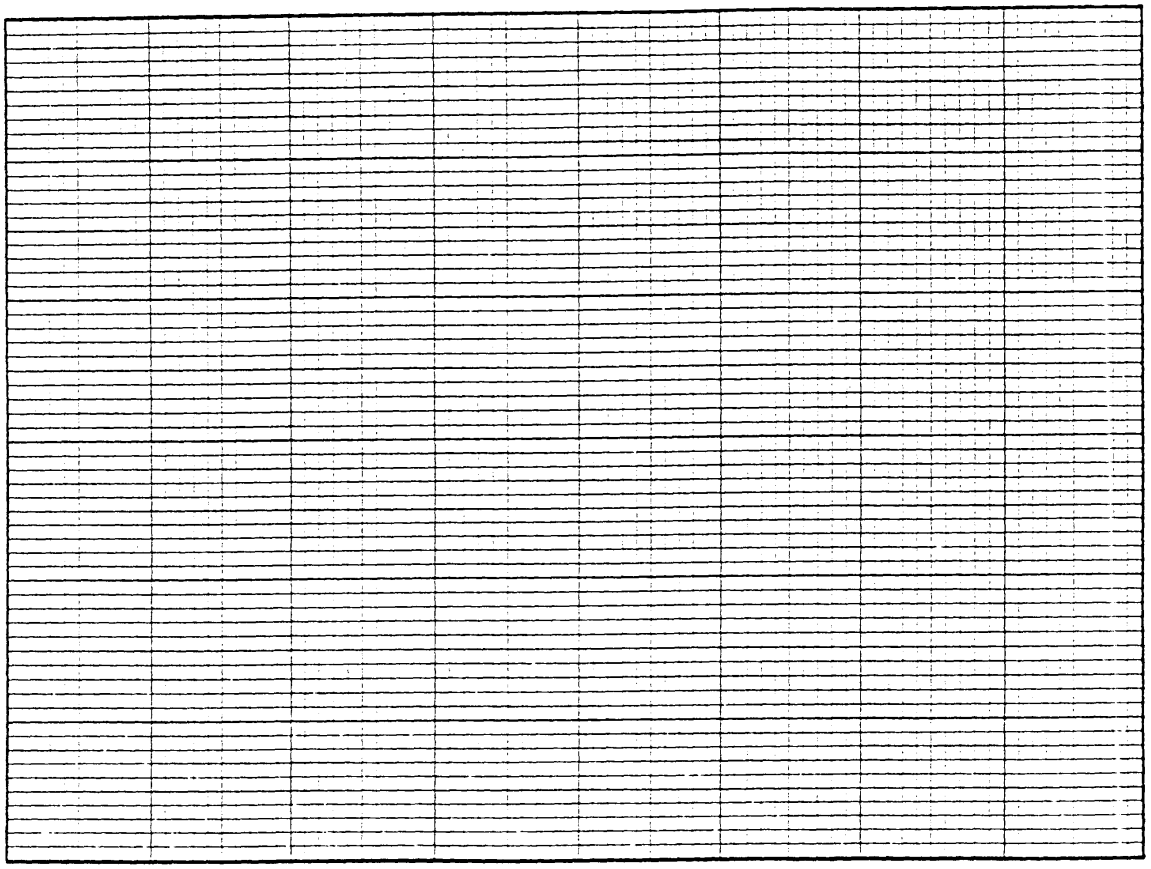
.....**[2]**

[Total: 18]

2 The following data were obtained by a student studying an igneous intrusion.

Distance from contact with sedimentary rocks (m)	**Average crystal grain size (mm) in igneous rock**
0	0.4
5	0.8
10	1.5
15	2.1
20	2.2
25	2.3
30	2.3

(a) **(i)** Plot a graph to show crystal grain size and the distance from the contact.



[5]

(ii) Explain why the crystal grain size decreases towards the contact with the sedimentary rocks.

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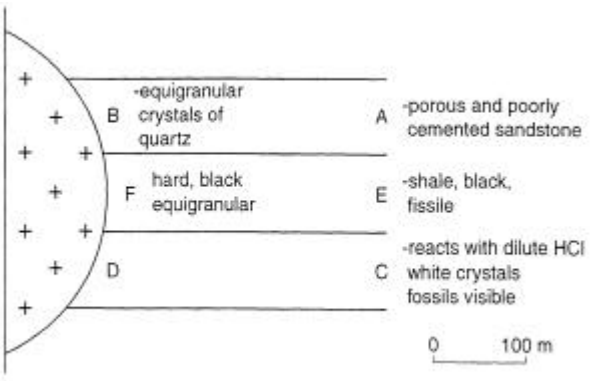
..... **[3]**

(b) The map below shows the intrusion and the sedimentary rocks into which it has been intruded. The student recorded the following field data about the rocks around the intrusion.



(i) Name the rocks found at:

B ..... **D** .....

C ..... **F** .....

[4]

(ii) Describe using technical terms the texture of rock **D**

.....……

.....……..**[2]**

(iii) Explain why rocks **B**, **D** and **F** have no foliation.

.....……

.....…….....……**[1]**

(c) **(i)** Draw and label on the diagram above the metamorphic aureole **[1]**

(ii) Define the term *metamorphic aureole*.

.....

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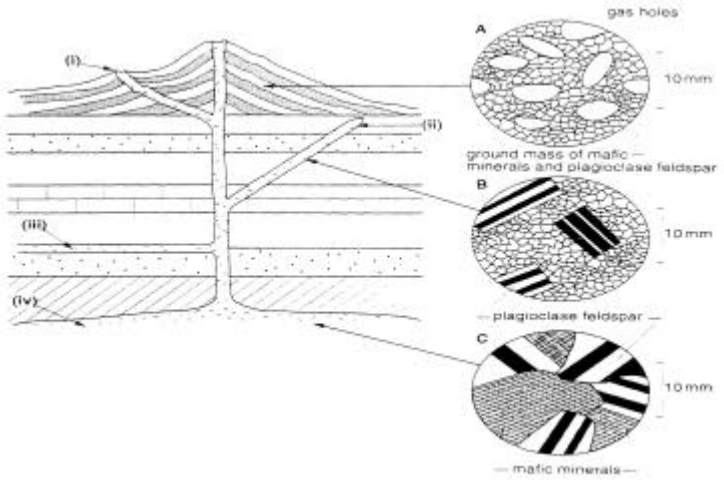
.....**[1]**

[Total: 17]

3 The cross sectional diagram below shows the relationship between igneous features (it is **not** to scale).



(a) What names are given to the igneous features shown in the diagram above?

(i) …….. **(ii)** ……..

(iii) …….. **(iv)** …… **[4]**

(b) **(i)** What term could be used to describe the relationship of feature (ii) to the beds?

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

(ii) Label on the diagram the position of a crater. **[1]**

(c) **(i)** Describe **one** possible advantage to living close to this volcano.

.....

.....

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

(ii) Describe **one** possible disadvantage to living close to this volcano.

.....

.....

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

(d) **(i)** Describe the crystal grain size for each of the thin sections.

A .....

B .....

C ..... **[2]**

(ii) Explain why there is a difference in the average crystal grain size in thin sections **A**, **B** and **C.**

.....

.....

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

(e) **(i)** Name the textures shown by thin sections **A** and **B**.

A .....

B ..... **[2]**

(ii) Explain how the texture in thin section **A** formed.

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

(iii) Explain how the texture in thin section **B** formed.

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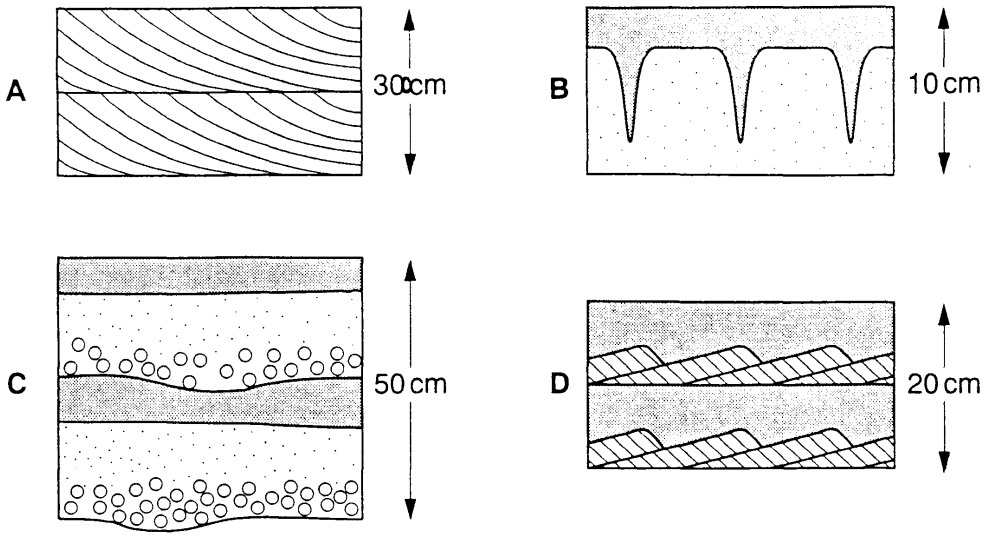
..... **[2]**

[Total: 20]

4



(a) Identify the sedimentary structures illustrated in vertical cross section above.

A …….. **B** ……..

C …….. **D** …… **[4]**

(b) **(i)** On diagram **A** above, indicate the direction of sediment transport **[1]**

(ii) On the diagram above, indicate the younging direction for sedimentary structure **A.** **[1]**

(iii) Sedimentary structure **A** formed in a hot desert environment. Describe and illustrate the possible method of formation.

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.....**[3]**

(c) **(i)** Describe with the aid of diagrams how sedimentary structure **B** formed in a hot desert environment. State the names of the two rock types forming the structure. (There is no key on the diagram.)

upper rock type .....

lower rock type .....

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.....**[4]**

(ii) Describe how sedimentary structure **C** formed.

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.....**[3]**

(d) Sedimentary structure D can form in hot desert areas or in shallow seas. Explain what differences you would expect to see in structures formed in the two environments.

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..... **[4]**

[Total: 20]

5 *In this question, 2 marks are available for the quality of written communication.*

(a) How would you differentiate between igneous and sedimentary rocks in the field?

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(b) Describe the effects of diagenesis in sedimentary rocks.

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.....**[6]**

[quality of written communication:2]

[Total 15]

Oxford Cambridge and RSA Examinations

Advanced Subsidiary GCE

GEOLOGY

The Rock Cycle – Processes and Products **2832**

Mark Scheme

TOTAL MARK 90

1 **(a)** **(i)** A is suspension [1]
B is sliding or traction [1]
C is saltation [1] **[3]**

(ii) where sediments/grains are picked up by the current, raised up [1]
and then fall under the influence of gravity more slowly [1] **[2]**

OR move by bouncing along the river bed [max 1]

(b) Shape - particles become more rounded [1]
Size - particles become smaller [1] **[2]**

(c) **(i)** Sand [1]
Velocity required for deposition = 10 [1] **[2]**

(ii) Erosion in the top third of the graph
Transport in the middle third of the graph
Deposition in the bottom third of the graph (2 correct 1, all three correct 2) **[2]**

(d) **(i)** Clay particles tend to stick together/clump into larger masses/cohesion [1]
The flat shape makes it more difficult to pick up [1] **[2]**

(ii) Very low velocity / or detail eg less than 0.015 / stagnant water [1] **[1]**

(e) **(i)** Pebbles will be deposited in a high energy environment, [1]
typically on a beach where there is wave action [1] **[2]**

(ii) Clay-size particles will be deposited under low velocity conditions [1]
offshore where there is no wave or current action [1] **[2]**

[Total: 18]

2 **(a)** **(i)** best fit line [1]
scales and axes labelled [1]
points: more than 4 correct [3]
3 - 4 points correct [2]
2 - 1 points correct [1] **[5]**

(ii) chilled margin [1]
rate of heat loss greater there/cooled faster [1]
rest insulated and cooled more slowly [1] **[3]**

(b) **(i)** B: quartzite/metaquartzite [1]
C: any limestone [1]
D: marble [1]
F: hornfels [1] **[4]**

(ii) equigranular / interlocking mosaic of grains [1]
sugary [1] **[2]**

(iii) no directed stress / low pressure / contact metamorphism / only heat [1] **[1]**

(c) **(i)** between BFD and AEC [1]

(ii) areas/zone of alteration/change/metamorphism around intrusion [1] **[2]**

[Total: 17]

3 **(a)** **(i)** flank / secondary / parasitic / cone / vent [1]
(ii) dyke [1]
(iii) sill [1]
(iv) magma chamber / pluton [1] **[4]**

(b) **(i)** discordant [1]

(ii) top of volcano [1] **[2]**

(c) **(i)** geothermal power / energy sources [1]
hot springs as a source of heating for water / central heating etc [1] **[2]**

(ii) dangers from ash fall / explosive activity / lava / gas [1]
detail [1] **[2]**

(d) **(i)** A fine/<1 mm
B fine with phenocrysts
C coarse > 5mm (2 correct 1 mark, all 3 correct 2 marks) **[2]**

(ii) fine grained A and B cooled quickly close to or at the surface [1]
coarse grained C cooled slowly deep below the surface [1] **[2]**

(e) **(i)** A vesicular [1]
B porphyritic [1] **[2]**

(ii) gas bubbles in the lava {1]
trapped as the lava cooled [1] **[2]**

(iii) 2 stages of cooling [1]
or slow cooling – phenocrysts [1]
then rapid cooling – groundmass [1] **[2]**

[Total:20]

4 **(a)** A cross bedding [1]
B desiccation cracks [1]
C graded bedding [1]
D ripples [1] **[4]**

(b) **(i)** left to right [1] **[1]**

(ii) up is young [1] **[1]**

(iii) slip face of a sand dune [1]
wind blown deposit / wind ward side eroded [1]
drawing of sand dune showing faces and wind direction [1] **[3]**

(c) **(i)** upper sand / silt - lower clay [1]
clay dries out on edge of lake [1]
cracks form as water evaporated or drawing [1]
cracks infilled by sand or silt often wind blown [1] **[4]**

(ii) in water with no/low current / still / calm [1]
large particles settle out first [1]
small particles settle out last [1] **[3]**

(d) shallow sea ripples are symmetrical [1]
due to tidal action – currents in two directions [1]
ripples in desert are asymmetrical [1]
due to unidirectional current [1] **[4]**

[Total: 20]

5 **(a)** igneous rocks are crystalline but sedimentary rocks are often plastic
igneous rocks will never contain fossils but sedimentary rocks often do
igneous rocks show no layering or bedding, they are massive but sedimentary rocks show various types of bedding and perhaps sedimentary structures
igneous rocks consist of silicate minerals such as quartz, feldspar and mica but sedimentary rocks consist of quartz, clay minerals and carbonate minerals such as calcite
igneous rocks are generally hard but sedimentary rocks are generally slightly softer
igneous rocks will often have chilled and baked margins and show cross-cutting relationships but sedimentary rocks will often show erosional contacts with older rocks.

[max 7]

(b) Diagenesis causes compaction due to the weight of overlying sediment
the effect of de-watering
the grains undergo closer packing
the porosity and permeability is reduced
cementation causes the grains to be joined together by mineral cements such as quartz or calcite
the rock becomes thinner
it becomes harder **[max 6]**

Quality of Written Communication

2 marks	Answers are structured clearly and logically, so that the candidate communicates effectively, uses a wide range of specialist terms with precision and spelling, punctuation and grammar are accurate.
1 mark	There are shortcomings in the structure of the answer, however, the candidate is able to communicate knowledge and ideas adequately, a limited range of specialist terms are used appropriately and spelling, punctuation and grammar are generally accurate with few errors.
0 marks	There are severe shortcomings in the organisation and presentation of the answer, leading to a failure to communicate knowledge and ideas. There are significant errors in the use of language, spelling, punctuation and grammar which makes the candidate's meaning uncertain.

[quality of written communication: max 2]

[Total: 15]

Oxford Cambridge and RSA Examinations

Advanced Subsidiary GCE

GEOLOGY

Economic and Environmental Geology **2833/01**

Specimen Paper

Additional materials:
Answer paper

TIME 1 hour

INSTRUCTIONS TO CANDIDATES

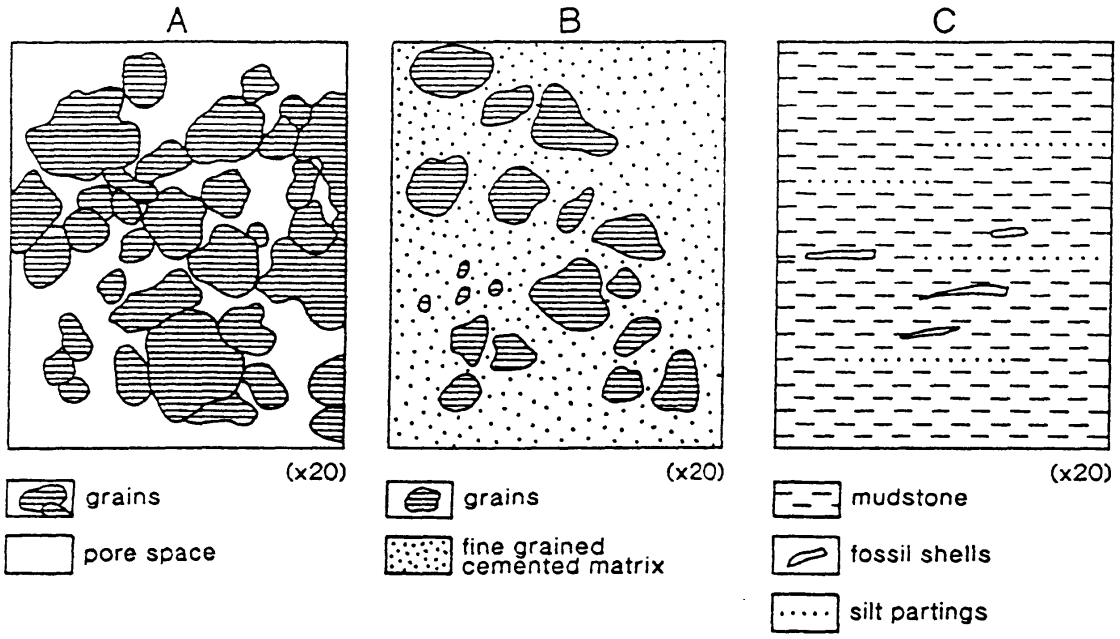
Write your name, Centre number and candidate number in the spaces provided on the answer booklet.
Write all your answers on the separate answer paper provided.
If you use more than one sheet of paper, fasten the sheets together.
Answer **all** questions.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.
You will be awarded marks for the quality of written communication in question 4.
Total mark for this paper is 60.

Answer **all** questions

1 The diagram illustrates three different sediments.



(a) **(i)** Which sediment has the greatest porosity?

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

(ii) Describe an experiment to determine the porosity of a sediment.

.....

.....

.....

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

(iii) What does the term *permeability* mean?

.....

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

(iv) Which sediment is impermeable?

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

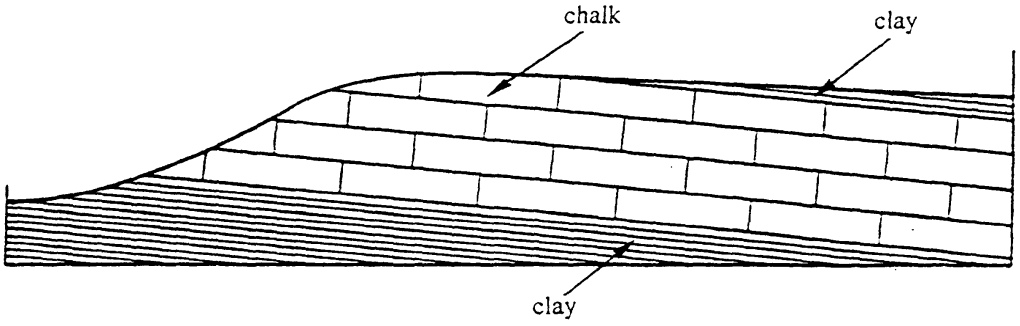
(v) Explain your choice.

.....

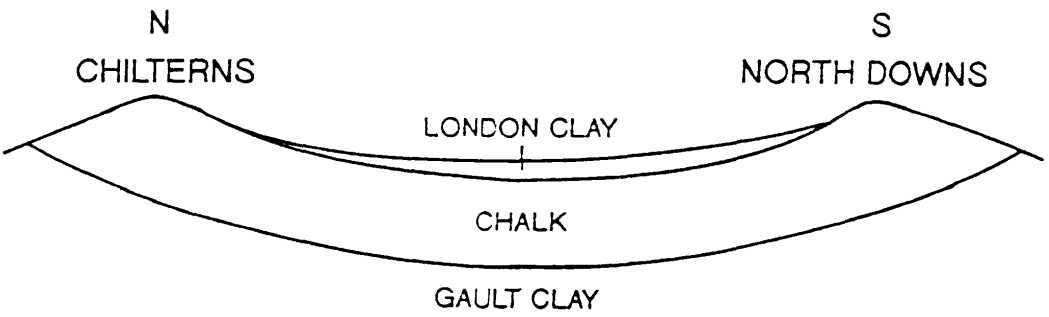
..... **[1]**

(b) In eastern England, most water supplies are obtained from underground sources. On the diagram below label correctly the following features:

(i) aquifer
(ii) water table
(iii) impermeable strata
(iv) spring **[4]**



(c) The following diagram is a geological cross section of the London area. Artesian waters were once obtained from the Chalk.



(i) What type of geological structure is formed by the Chalk?

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

(ii) Indicate on the diagram of the London area where an artesian well would be sited to obtain the maximum hydrostatic pressure. **[1]**

(iii) State the geological features of the London area which makes it a suitable artesian basin.

.....

.....

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

(iv) Describe how water in the London area is a sustainable resource.

.....

.....

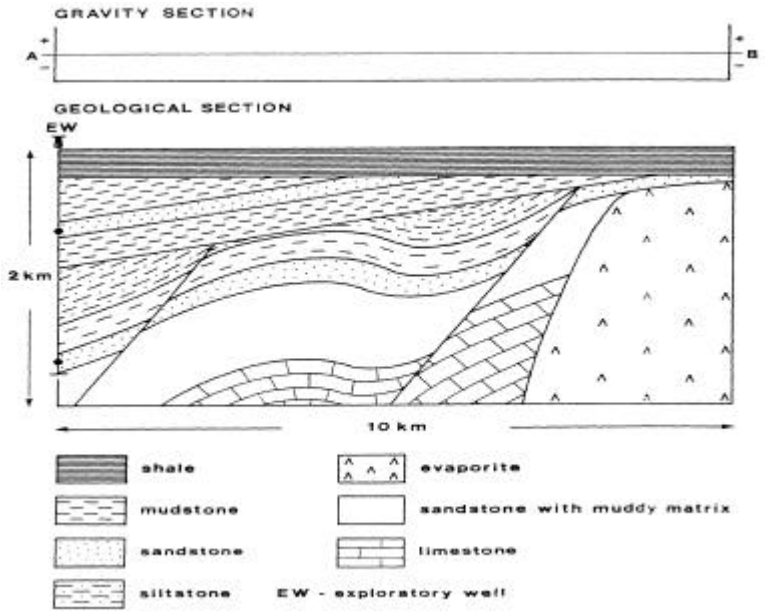
.....

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

[Total 16]

2 The geological section below is an interpretation of a seismic reflection profile across a sedimentary basin. A gravity survey was carried out across the same area.

The Exploratory Well shows oil traces in the sandstone beds.



(a) **(i)** Sketch a gravity profile from **A** to **B** on the gravity section above. **[1]**

(ii) Explain the form of the profile you have drawn.

.....

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

(b) **(i)** State **two** properties of the sandstone which would make it a suitable reservoir rock.

.....

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

(ii) Why are the sandstones with a muddy matrix unsuitable as reservoir rocks?

.....

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

(c) **(i)** Name **two** rocks in the sequence that would form suitable cap rocks.

1. ..... 2. ..... **[2]**

(ii) Explain why they would make good cap rocks.

.....

.....

.....

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

(d) On the geological section,

(i) shade in **two** areas where oil may be trapped. **[2]**

(ii) label each trap with the trap-type. **[2]**

(e) Many potential traps do not contain economic qualities of oil. Explain the processes that can leave a trap with no oil.

.....

.....

.....

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

(f) Explain why it is difficult to extract more than 60% of the oil from a reservoir rock.

.....

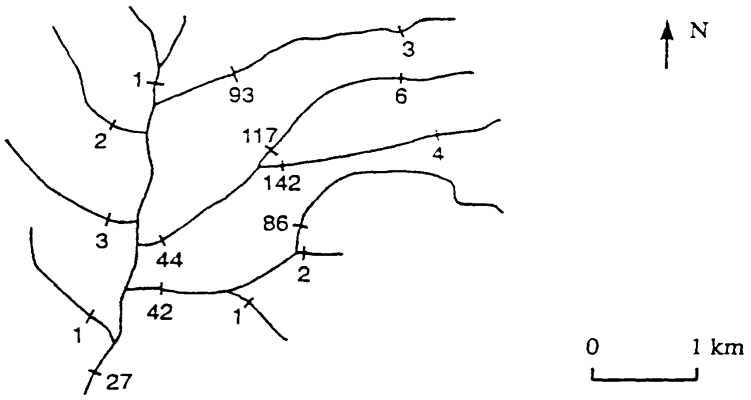
.....

.....

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

[Total: 16]

3 The map below shows the results of a geochemical survey for copper mineralisation. The figures show the concentration of copper in parts per million (ppm), taken from stream samples.



(a) **(i)** **On the map**, shade and label a likely area for the copper deposit. **[2]**

(ii) Explain why the concentration of copper decreases downstream.

.....

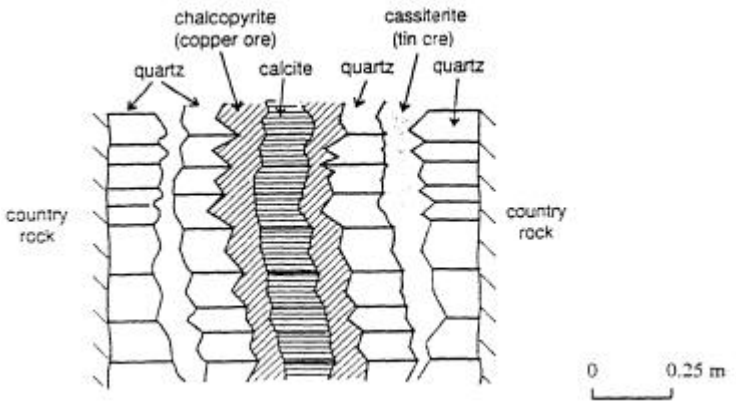
..... **[1]**

(b) Name two other methods which could be used to detect copper deposits without a drilling programme.

.....

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

(c) The diagram below shows a cross section of a hydrothermal mineral vein from the copper deposit.



(i) State the order in which the minerals were deposited in the hydrothermal mineral vein.

First .....

.....last **[3]**

(ii) Explain how the hydrothermal mineral vein could have formed.

.....

.....

.....

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

(iii) Describe two problems that could occur if this mineral was mined.

.....

.....

.....

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

(d) **(i)** The cassiterite is transported downstream and deposited to form placer deposits. State **two** properties of minerals which make them likely to form placer deposits.

.....

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

(ii) Describe one environment in which placer deposits are likely to form. You may use an annotated diagram if you wish.

.....

.....

.....

.....

..... **[4]**

[Total: 18]

4. *In this question, 2 marks are available for the quality of written communication.*

Explain how coal deposits form in economic quantities.

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..... **[8]**

[quality of written communication:2]

[Total: 10]

Oxford Cambridge and RSA Examinations

Advanced Subsidiary GCE

GEOLOGY

Environmental and Economic Geology **2833/01**

Mark Scheme

TOTAL MARK 60

Answer **all** questions

1 (a) (i) A [1] **[1]**

(ii) Volume of pore space determined
Volume of rock determined
Determination of porosity from data
[any 2] **[2]**

(iii) Ability of rock to allow fluid to pass through it/ rate of flow through a rock.[1] **[1]**

(iv) C [1] **[1]**

(v) contains clay minerals / it is a mudstone [1] **[1]**

(b) (i) in chalk [1]
(ii) below surface in chalk meeting surface at chalk/clay boundary at the left [1]
(iii) anywhere in clay [1]
(iv) at left base of chalk clay boundary [1] **[4]**

(c) (i) syncline/synform [1] **[1]**

(ii) Where arrow for London Clay is / in centre of syncline [1] **[1]**

(iii) caprock / seal of clay above and below
synclinal / basin structure traps water
porous chalk aquifer [1 mark for each to max 2] **[2]**

(iv) recharge areas extensive [1]
regulation so no overpumping [1] **[2]**

[Total: 16]

2 (a) (i) To show +VE over rocks to -VE over salt [1] **[1]**

(ii) salt has lower density (not mass) than surrounding rocks gravitation field less/-VE anomaly [1] **[1]**

(b) (i) good sorting/well rounded grains/poorly cemented/
high porosity/high permeability must have two properties [1] **[1]**

(ii) impermeable / no porosity / filling of pores [1] **[1]**

(c) (i) mudstone/shale; evaporites [1+1] **[2]**

(ii) impermeable [1]
crystalline, fine grained [1] **[2]**

(d) **(i)** 1 mark for each shaded trap (max 2) **[2]**

(ii) 1 mark for each label of trap type (max 2) **[2]**

(e) heat > 200^{o}C destroys oil
due to extreme diagenesis/deep burial/igneous intrusion.
oil escapes - trap unsealed - migrates away due to earth movements
[1 mark for each to max 2] **[2]**

(f) surface tension makes oil stick to grains
permeability too low / cemented
oil too viscous (any 2) **[2]**
[Total: 16]

3 **(a)** **(i)** Shaded area must lie upstream of high values across all four streams [2];
or part of the area correct [1] **[2]**

(ii) Dilution [1] **[1]**

(b) remote sensing/magnetometer/seismics/resistivity/gravity/soil sampling/geological mapping/vegetation survey/looking for copper minerals [1 mark for each to max 2] **[2]**

(c) **(i)** last - quartz, [1]cassiterite, quartz, chalcopyrite,[1] calcite – first [1] **[3]**

(ii) hot water fluids, reaction with country rock
rise along fissures / faults
cooling
precipitation of minerals [1 mark for each to max 2] **[2]**

(iii) pollution of water supply
air / soil pollution
tips / waste material [1 mark for each to max 2] **[2]**

(d) **(i)** dense / high S.G.
resistant to chemical decay
hardness / resistance to abrasion [1 mark for each to max 2] **[2]**

(ii) named suitable place: waterfall plunge pool, inside meander bend, potholes, beach, downstream of tributaries [1]
diagram of suitable site [2]
description consistent with diagram [1] **[4]**
[Total:18]

4 luxuriant vegetation growing
in tropical / equatorial rainforest
tees die and fall to the ground
into a swamp or delta/between distributary channels
where there are anaerobic/anoxic conditions so that bacterial decay is limited
topset area of delta
organic deposits must not be eroded away before compaction - washouts
oganic material is covered in fine sediments as delta sinks
Area stable for great thickness of peat to form
dagenesis or lithification occurs mainly compaction due to weight of overlying sediments
to turn the organic material from peat to lignite to bituminous coal or anthracite

[max 8]

Quality of written communication

2 marks Answers are structured clearly and logically, so that the candidate communicates effectively, uses a wide range of specialist terms with precision and spelling, punctuation and grammar are accurate.

1 mark There are shortcomings in the structure of the answer, however, the candidate is able to communicate knowledge and ideas adequately, a limited range of specialist terms are used appropriately and spelling, punctuation and grammar are generally accurate with few errors.

0 marks There are severe shortcomings in the organisation and presentation of the answer, leading to a failure to communicate knowledge and ideas. There are significant errors in the use of language, spelling, punctuation and grammar which makes the candidate's meaning uncertain.

[quality of written communication max 2]

[Total: 10]

Oxford Cambridge and RSA Examinations

Advanced GCE

GEOLOGY

Palaeontology **2834**

Specimen Paper

Additional materials:
Answer paper

TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces provided on the answer booklet.
Write all your answers on the separate answer paper provided.
If you use more than one sheet of paper, fasten the sheets together.

Answer **all** questions.

INFORMATION FOR CANDIDATES

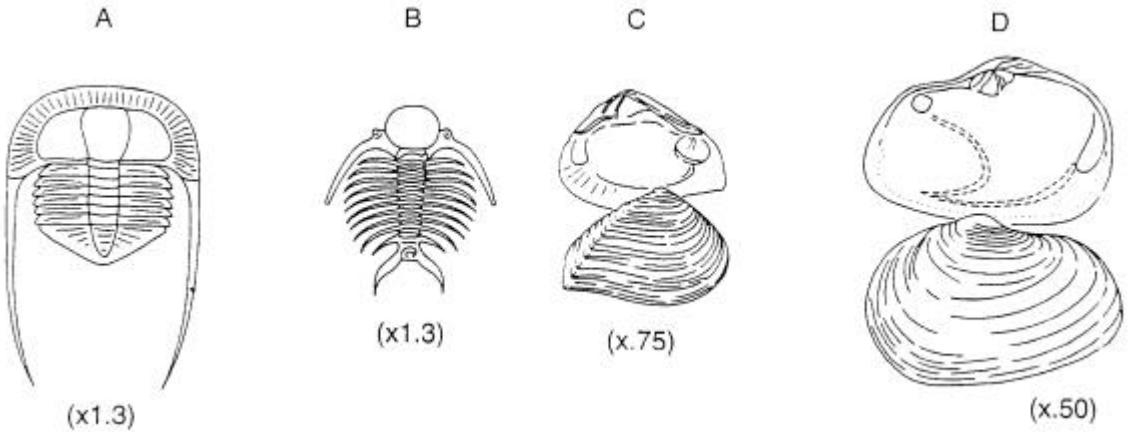
The number of marks is given in brackets [ ] at the end of each question or part question.
You will be awarded marks for the quality of written communication in question 5.

In this paper you are expected to show your knowledge and understanding of different aspects of Geology and the connections between them.

Total marks for this paper is 90.

Answer **all** questions

1 Study the diagrams of the fossils illustrated below.



(a) **(i)** What mode of life may be inferred from the morphology of trilobite A?

..... ….. **[1]**

(ii) Label three features which support your conclusion and explain their possible function.

.....……

.....……

.....…..

..... ……**[4]**

(b) **(i)** What mode of life may be inferred from the morphology of trilobite B?

.....……. **[1]**

(ii) Label three features which support your conclusion and explain their possible function.

.....……..

.....……..

.....……..

.....…… **[4]**

(c) **(i)** What mode of life may be inferred from the morphology of bivalve C?

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

(ii) Explain your answer.

.....

.....

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

(d) **(i)** What mode of life may be inferred from the morphology of bivalve D?

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

(ii) Explain your answer.

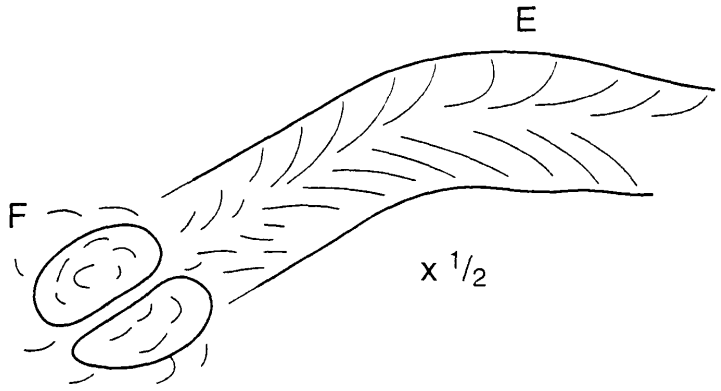
.....

.....

.....

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

(e) The field-sketch below shows trace fossils E and F which were found on the same bedding plane as trilobite body fossils.



(i) Suggest how Trace fossil E may have been formed:

.....

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

(ii) Suggest how Trace fossil F may have been formed:

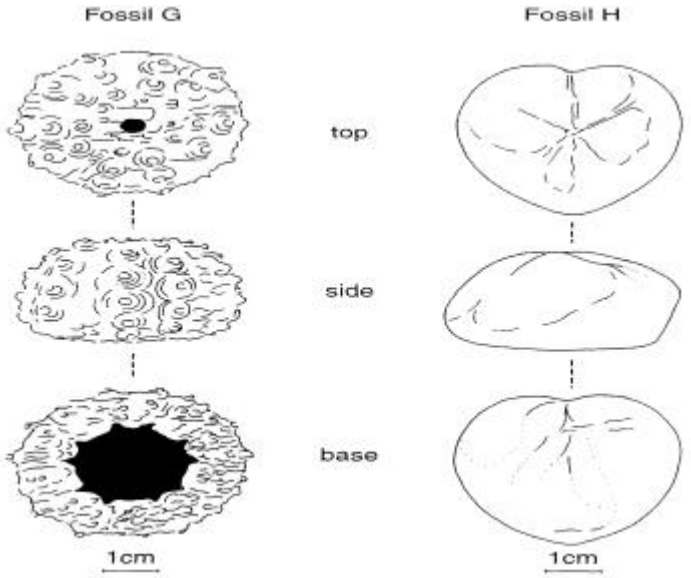
.....……

.....…….. **[1]**

[Total: 18]

2 The diagrams below illustrate genera from two different groups of echinoids.

(a) **(i)** What type of echinoid is Specimen H?



.....…….**[1]**

(ii) Fully describe the type of symmetry shown by Specimen G.

.....……. **[1]**

(iii) Clearly label the following features on the diagrams of specimen G.

ambulacra and interambulacra
spine boss
apical system
mouth **[4]**

(b) Diagram J shows the internal morphology of a modern nautiloid shell.

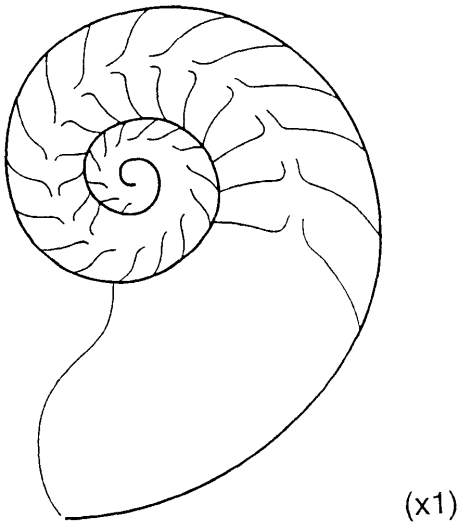


Diagram J

(i) Clearly label the following features on diagram J.

body chamber
septum
septal neck
siphuncle **[4]**

(ii) Draw and label a diagram to show the internal morphology of an ammonoid shell. **[3]**

(iii) Describe how the position of the septal necks and siphuncle differ between the nautiloid and the ammonoid.

.....
.
.....

.....

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

[Total: 15]

3 **(a)** Define the terms benthonic and pelagic.

(i) benthonic

.....

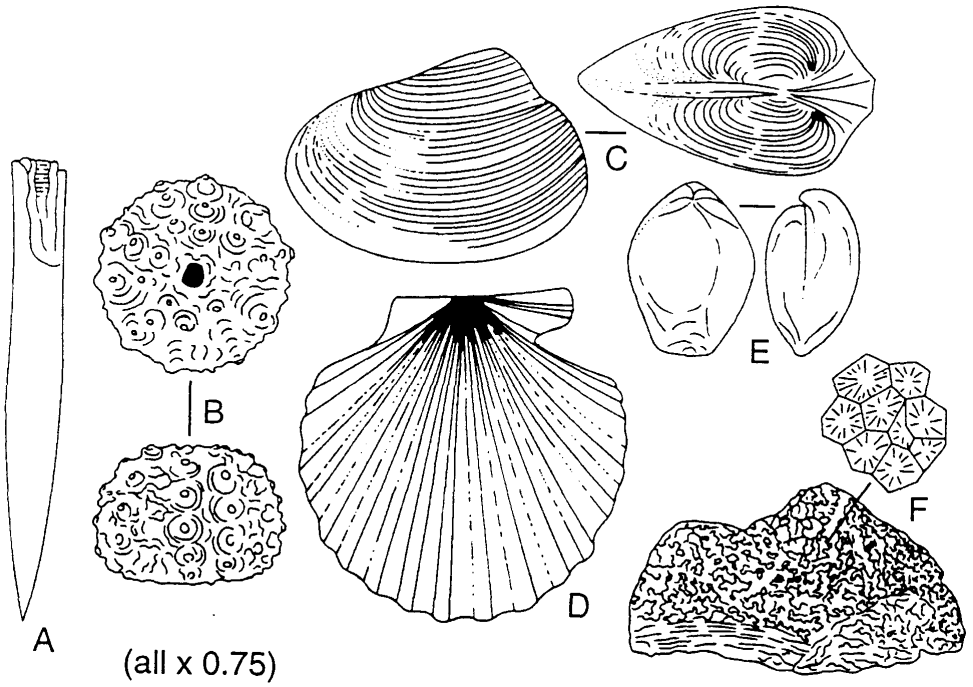
.....

(ii) pelagic

.....

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

(b) **(i)** Name each of the fossils A, B, C, D, E and F.



A ..... **B** .....

C..... **D** .....

E ..... **F** .....

[6]

(ii) Which of the fossils A, B, C, D, E and F shown has a mode of life as

a swimmer .....

attached epifaunal .....

infaunal .....

[3]

(c) Describe and explain the characteristics of a fossil assemblage that can be used to identify each of the following depositional environments.

(i) high energy shelf

.....

.....

.....

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

(ii) low energy shelf

.....

.....

.....

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

(iii) deeper ocean basins

.....

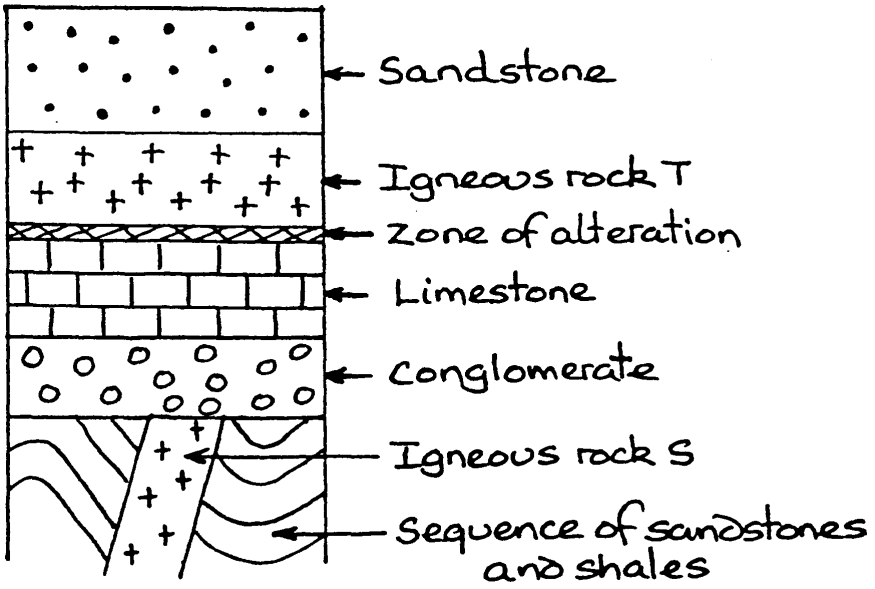
.....

.....

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

[Total: 17]

4



The igneous rocks in the sequence above have been dated using the Potassium - Argon method.
Igneous rock S gives a date of 500 ± (30 Ma)
Igneous rock T gives a date of 120 ± (10 Ma)

(a) **(i)** Name the daughter product of this dating method.

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

(ii) Give the approximate half life used for this radiometric dating method.

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

(iii) State two factors the geologist must consider concerning the accuracy of Potassium-Argon dating.

.....

.....

.....

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

(iv) Name one other method used for radiometric dating.

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

(b) **(i)** Describe two methods of relative dating that could be used to determine the sequence of events on the diagram.

.....

.....

.....

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

(ii) Explain the difference between the terms *absolute dating* and *relative dating*

.....

.....

.....

.....

.....

..... **[3]**

(c) Starting with the oldest, describe the events which occurred to form the sequence shown.

Oldest

.....

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..... **[5]**

[Total: 15]

5 *In this question, 2 marks are available for the quality of written communication.*

(a) Describe four methods by which organisms are preserved as fossils in rocks. **[12]**

.....

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(b) Outline the main morphological changes which occurred during the evolution of the graptoloids. **[11]**

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[quality of written communication: 2]
[Total 25]

Oxford Cambridge and RSA Examinations

Advanced GCE

GEOLOGY

Palaeontology **2834**

Mark Scheme

TOTAL MARK 90

1 **(a)** **(i)** infaunal/burrower/grubber/benthic [1] **[1]**

(ii) all 3 features correctly labelled [1]
and
no eyes needed as in mud
long genal spine to support in mud
broad curved cephalic border as a shovel
pitted, sensory cephalic fringe to sense position (any 3) **[4]**

(b) **(i)** pelagic/float/swim/nektonic [1] **[1]**

(ii) all 3 features correctly labelled [1]
and
very large / inflated glabella as buoyancy aid
protruding position of eyes to look down an forward
deeply divided thoracic segments for increased surface area
increased surface area by spines (any 3) **[4]**

(c) **(i)** vagrant/benthos [1] **[1]**

(ii) strong dentition as opens and closes valves often
entire pallial line as no siphons
isomyarian = muscles equal as opens and closes valves often
strong growth lines/heavily ornamented for high energy seafloor (any 2) **[2]**

(d) **(i)** burrower/infaunal/benthic [1] **[1]**

(ii) reduced dentition as as opens and closes valves less often
anisomyarian = unequal muscle as opens and closes valves less often
prominent pallial sinus where siphons for feeding and respiration
smooth shell/fine growth lines s buried in sediment - low energy (any 2) **[2]**

(e) **(i)** track made by legs/movement [1]

(ii) resting mark/imprint of lower part of trilobite/of thorax [1] **[2]**

[Total:18]

2 **(a)** **(i)** Irregular [1] **[1]**

(ii) five fold radial [1] **[1]**

(iii) 1 for each correct label or pair of labels **[4]**

(b) **(i)** 1 for each correct label **[4]**

(ii) 1 for quality of drawing
1 for siphuncle at side
1 for septal necks pointing forward **[3]**

(iii) septal necks point back to protoconch in nautiloid, forward in ammonoid [1]
siphuncle in centre in nautiloid and at edge in ammonoid [1] **[2]**

[Total: 15]

3 **(a)** **(i)** animals which live on sea bed / bottom dwelling [1] **[1]**

(ii) animals which live in open sea but not on sea bed [1] **[1]**

(b) **(i)** A: cephalopod/belemnite [1]
B: echinoid [1]
C: bivalve [1]
D: bivalve [1]
E: brachiopod [1]
F: coral [1] **[6]**

(ii) Swimmer: A/D [1]
Attached Epifaunal: A/B/D/E/F [1]
Infaunal: C [1] **[3]**

(c) **(i)** robust molluscs / brachiopods / regular and irregular echinoids/ massive corals / broken shell fragments common [1]
with thick strong shells / ribs common able to withstand wave action
or burrowing in sediment
or attached or on sea floor with adaptations [1] **[2]**

(ii) trace fossils common / delicate molluscs / brachiopods / echinoids /
branching and solitary corals / trilobites [1]
shells often complete / thin / delicate shells / ornamentation few ribs [1] **[2]**

(iii) pelagic microfossils/graptolites / pelagic trilobites
small size to float or swim in upper waters [1+1] **[2]**

[Total: 17]

4 **(a)** **(i)** argon 40 [1] **[1]**

(ii) 12900my +/- 900 [1] **[1]**

(iii) weathering of rocks which can loss of argon [1]
metamorphic / chemical changes which can cause gain of argon [1] **[2]**

(iv) uranium lead / rubidium strontium [1] **[1]**

(b) **(i)** cross cutting relationships
included fragments
fossil content [1 mark for each to max 2] **[2]**

(ii) absolute gives a date in millions of years
but only can be used in rocks that contain suitable minerals
relative only gives dates younger or older than other rocks
or events or a sequence [1 mark for each to max 3] **[3]**

(c) sandstones and shales laid down
folding
intrusion of dyke
erosion and unconformity
beds of conglomerate, limestone and sandstone laid down
sill intruded (any 5 in correct order) **[5]**

[Total: 15]

5 (a) Body fossils occasionally consist of whole organisms unaltered - very rare (eg frozen mammoths, tar pit traps, insects in amber) Soft part preservation such as Burgess shales. **[max 3]**

Loss of soft tissues with unaltered preservation of hard parts - common (eg shells of molluscs, carapaces of trilobites, bones of vertebrates) **[max 3]**

Petrification and replacement - very common. Organic hard tissues are replaced by secondary minerals, eg. silicification, pyritisation, carbonisation, phosphatisation. **[max 3]**

Cast and mould preservation common - process described
Moulds = impressions of the exterior of organisms
Casts = sediment of cement fills of interior **[max 3]**

[max 12]

(b) graptoloids are extinct (mainly Lower Palaeozoic) marine hemichordates
they evolved from the dendroids at the end of the Cambrian
became very abundant in the Ordovician and Silurian
they formed colonies or rhabdosomes from an initial sicula
the individuals (polyps) were housed in similar thecae
rows of thecae, budded off one another, form branches or stipes
early forms (Lower Ordovician) had numerous branches - Tetragraptus
later Ordovician forms had fewer branches from two-branched (pendant) forms e.g. didymograptus - Ord
to single branched forms with thecae back-to-back (biserial) eg Diplograptus - Ord and ultimately to a single row of thecae forming single branch colonies (uniserial)
e.g. Monograptus - Sil
general evolution from forms with more branches and many individuals
to forms with few or with only one branch and very few individuals
the direction of growth of the branches evolved from pendant to scandent
the thecae evolved different distinctive shapes

Diagrams with scales and labels should be included

[max 11]

Quality of Written Communication

2 marks	Answers are structured clearly and logically, so that the candidate communicates effectively, uses a wide range of specialist terms with precision and spelling, punctuation and grammar are accurate.
1 mark	There are shortcomings in the structure of the answer, however, the candidate is able to communicate knowledge and ideas adequately, a limited range of specialist terms are used appropriately and spelling, punctuation and grammar are generally accurate with few errors.
0 marks	There are severe shortcomings in the organisation and presentation of the answer, leading to a failure to communicate knowledge and ideas. There are significant errors in the use of language, spelling, punctuation and grammar which makes the candidate's meaning uncertain.

[quality of written communication max 2]

[Total: 25]

Oxford Cambridge and RSA Examinations

Advanced GCE

GEOLOGY

Petrology **2835**

Specimen Paper

Additional materials:
Answer paper

TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces provided on the answer booklet.
Write all your answers on the separate answer paper provided.
If you use more than one sheet of paper, fasten the sheets together.

Answer **all** questions.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

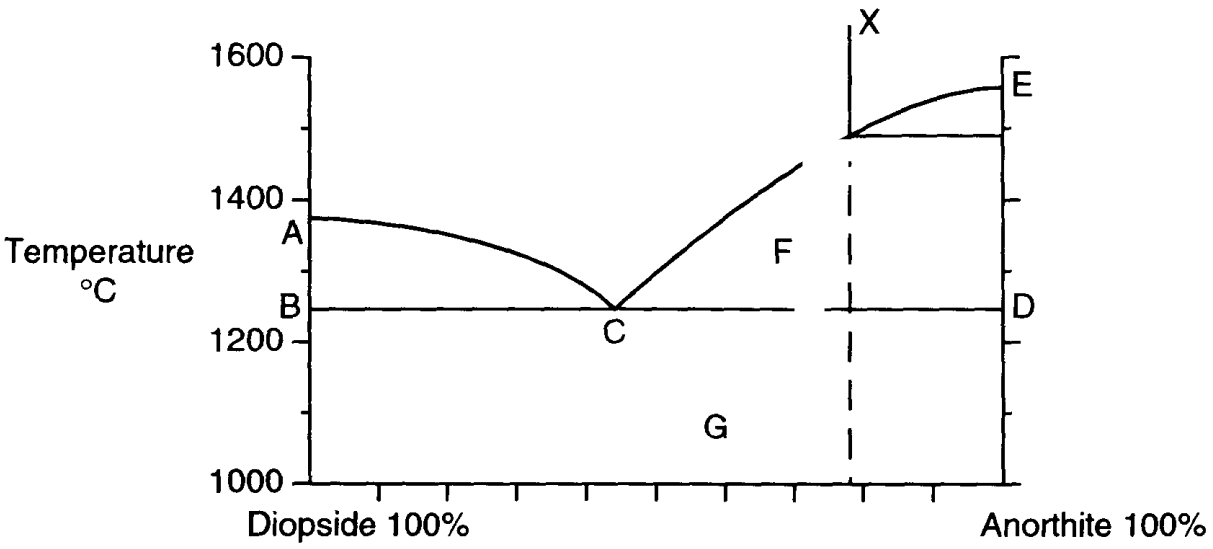
You will be awarded marks for the quality of written communication in question 5.

Some questions in this paper are synoptic in nature. In your answer to these questions you are encouraged to show your knowledge and understanding of different areas of Geology and apply these and the geological skills you have learned, to the situations in the questions.

Total mark for this paper is 90.

Answer **all** questions

1. The diagram below shows a two component system comprising the two minerals Diopside and Anorthite.



Assume a cooling melt to have the composition **X**

(a) (i) Name the line ACE .....

(ii) Name the line BCD .....

(iii) Name the point C ..... **[3]**

(b) (i) At what temperature will

crystallisation begin	crystallisation be complete

[2]

(ii) What will be the composition of the first formed crystals?

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

(iii) What is the composition of the final solid when cooling is complete?

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

(c) State and explain the physical state of the material in zones F and G on the diagrams above.

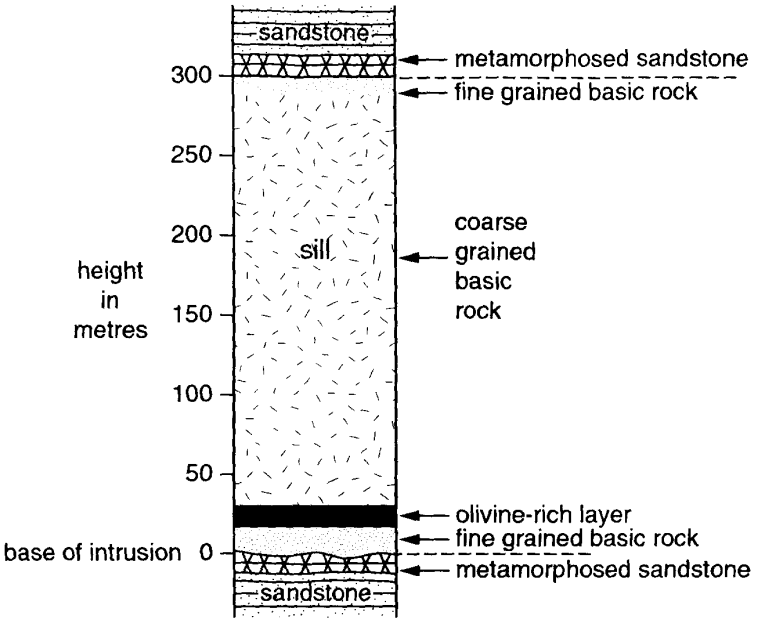
F: .....

.....

G:.....

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

(d) The diagram below is a section through a basic sill.



(i) Explain the changes in grain size within the intrusion.

.....

.....

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

(ii) Explain why there is an olivine-rich layer at the base of the intrusion.

.....

.....

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

(iii) Describe and explain how the composition of the plagioclase feldspars and the pyroxene is likely to vary through the intrusion.

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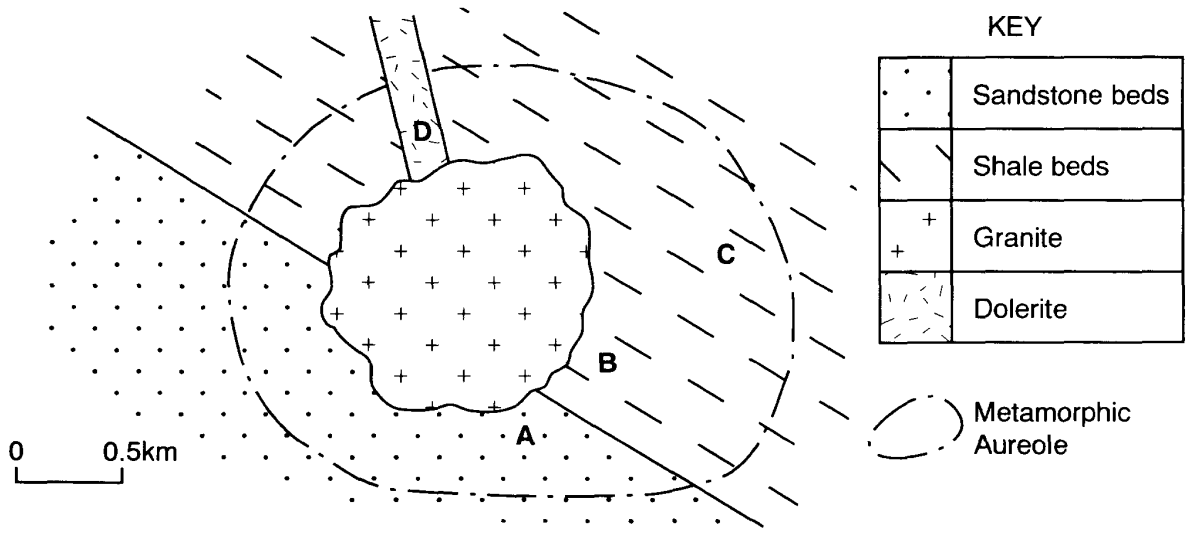
..... **[3]**

[Total 16]

2. The diagram below shows an area of country rock that has been intruded by a granitic intrusion.



(a) (i) What type of metamorphism has the country rock been subject to ?

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

(ii) Name the rocks found at the following locations :

A : ..... **B** : .....

C : ..... **D** : ..... **[4]**

(iii) Explain the changes in texture that occur between the sandstone and rock A.

.....

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

(b) Explain why new minerals grow in the shale within the metamorphic aureole.

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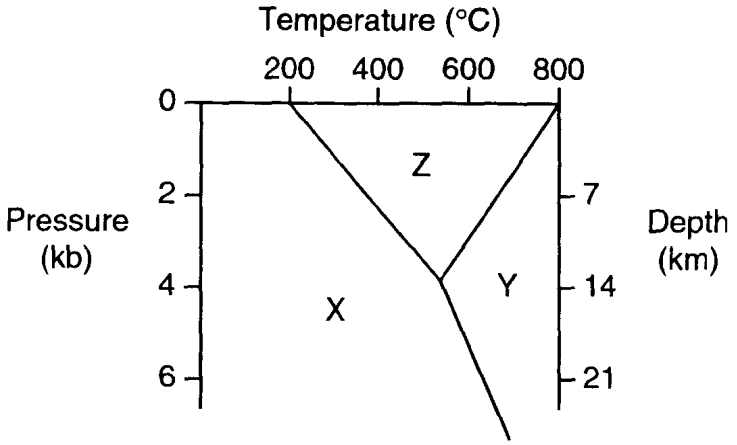
..... **[2]**

(c) The graph below shows the pressure and temperature stability fields of the Al_2SiO_5 polymorphs, lettered X, Y and Z.



(i) Name the three Al_2SiO_5 minerals that occur in the stability fields.

X .....……..... Y .....……..... Z .....……..... **[2]**

(ii) State the temperature and pressure of the point where all three minerals are stable.

.....… **[2]**

(iii) Define the term polymorph

.....…….

.....…….

.....…….

.....…….**[2]**

(d) Explain why pure limestones do not develop Al_2SiO_5 polymorphs during metamorphism.

.....……..

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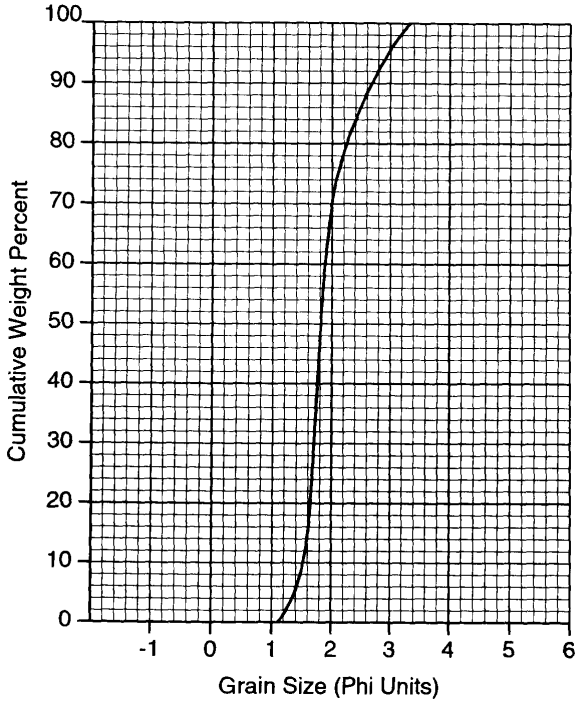
.....……..

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

[Total 17]

3. (a) The graph below shows data obtained from sieve analysis of a sediment



The coefficient of sorting (p) can be measured from the cumulative frequency graph above.
Use the equation : $p = \frac{\Phi_{84} - \Phi_{16}}{2}$

where Φ_{84} is the grain size at the cumulative weight of 84% of the sample and Φ_{16} is the grain size at the cumulative weight of 16% of the sample.

If the coefficient of sorting is < 0.50 the sediment is well sorted.
If the coefficient of sorting is between 0.50 and 1.00 the sediment is moderately sorted.
If the coefficient of sorting is > 1.00 the sediment is poorly sorted.

(i) Define the term *sorting*.

.....

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

(ii) Calculate the coefficient of sorting for the sediment shown on the graph.

[1]

(iii) State the degree of sorting of the sediment

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

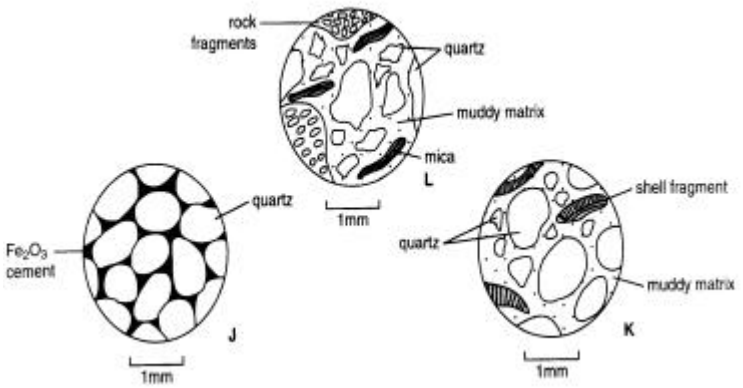
(iv) Name an environment in which this sediment might have been formed and explain your answer.

.....

.....

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

(b) Below are thin section drawings J, K and L.



(i) With reference to the thin section drawings J and K above, state the degree of sorting.

J: ..... **K** .....**[1]**

(ii) With reference to the thin section drawings J and L above, describe the grain shape.

K: ..... **L:** .....**[2]**

(iii) Using the evidence provided, name and describe the depositional environments of :

J .....

.....

.....

..... **[3]**

K .....

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.....**[3]**

L .....

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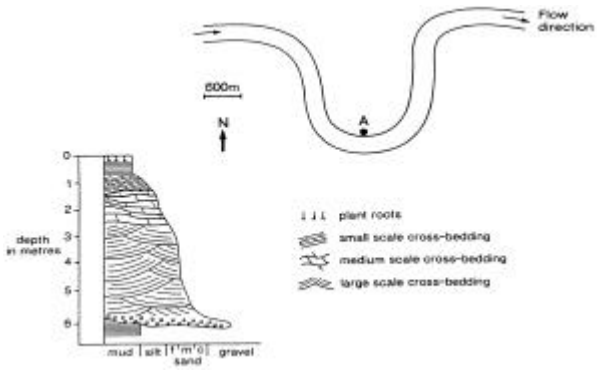
.....**[3]**

[Total 17]

4 The map below shows part of a meandering river.
Data from the borehole at A is shown as a graphic log.



(a) Mark clearly on the map:
(i) an area characterised by erosion
(ii) an area where deposition occurs **[2]**

(b) **(i)** Explain with the aid of a diagram how the cross-bedding shown in the graphic log may have formed.

.....

.....

.....

.....**[3]**

(ii) The pebbles in the gravel form an imbricate structure. Explain how this is formed

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.....

.....

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

(iii) Describe the changes in energy recorded in the graphic log from 6 m depth to 0 m. Give evidence from the log to support your answer

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.....**[3]**

(c) Describe the environment in which the mud was deposited.

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

(d) Explain how Walther's law may be used to interpret this sequence of sedimentary rocks.

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..... **[3]**

[Total: 15]

5 *In this question, 2 marks are available for the quality of written communication.*

(a) Describe and explain the sedimentary deposits which occur in clear, shallow seas. **[12]**

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(b) Describe and explain how the mineral composition and silica percentage are used to classify the igneous rocks. **[11]**

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[quality of written communication: 2]
[Total: 25]

Oxford Cambridge and RSA Examinations

Advanced GCE

GEOLOGY

Petrology **2835**

Mark Scheme

TOTAL MARK 90

1 **(a)** **(i)** liquidus [1]
(ii) solidus [1]
(iii) eutectic [1] **[3]**

(b) **(i)** begin 1480 – 1500 °C, end 1230 – 1260 °C [1+1] **[2]**
(ii) anorthite [1] **[1]**
(iii) 77 – 80% An; 20 – 23% Di [1] **[1]**

(c) F solid/crystals / crystal mush and liquid because below liquidus above solidus [1]
G solid because below solidus [1] **[2]**

(d) **(i)** rapid cooling at edges against cold country rock gives small crystals [1]
slow cooling at centre gives large crystals where better insulated [1] **[2]**

(ii) olivine crystals are early formed as high on Reaction Series [1]
crystals dense so sink to base of intrusion and forms cumulate layer [1] **[2]**

(iii) early plagioclase in chilled margin Ca rich [1]
later plagioclase towards centre Na rich [1]
early pyroxene Mg rich/later pyroxene towards centre Fe rich [1] **[3]**

[Total: 16]

2 **(a)** **(i)** thermal / contact [1] **[1]**

(ii) A = metaquartzite [1]
B = hornfels [1]
C = spotted slate [1]
D = hornfels [1] **[4]**

(iii) sedimentary features of sandstone- fragmental/granular recrystallised to crystalline metaquartzite by heat
grains and cement become sugary texture when recrystallised
quartz sand grains undergo partial melting at edges of grains which recrystallise to form interlocking mosaic (any 2) **[2]**

(b) clay minerals are unstable at higher temperatures so new minerals stable at higher temperature form [1]
ions of K / Ca / Na available as minerals breakdown to form new minerals [1] **[2]**

(c) **(i)** X = kyanite
Y = sillimanite
Z = Andalusite [all 3 for 2 marks, 2 correct for 1 mark] **[2]**

(ii) pressure = 4 kb and temperature 525° [1+1] **[2]**

(iii) different crystal forms have the same mineral composition [1+1] **[2]**

(d) only calcite so new minerals cant grow [1]
no impurities / no Al / no Si [1] **[2]**

[Total: 17]

3 **(a)** **(i)** degree to which particles are the same size / spread of grain size about mean / variation in grain size [1] **[1]**

(ii) $\frac{2.4 - 1.6}{2} = 0.4$ [1] **[1]**

(iii) well sorted [1] **[1]**

(iv) aeolian / beach [1]
these are mature environments where high energy has sorted the sediment - removing fines / breaking down coarse [1] **[2]**

(b) **(i)** J = well sorted and K = poorly sorted [1] **[1]**

(ii) K = sub angular – sub rounded [1]
L = angular – sub angular [1] **[2]**

(iii) J aeolian / high energy [1]
all quartz
no fossils
iron oxide cement
well rounded / sorted [1 mark for each to max 2] **[3]**

K marine fairly low energy / close to shore [1]
mud matrix
marine shells / fossils
poorly sorted so low energy / close to river mouth [1 mark for each to max 2] **[3]**

L rapid deposition / flash floods / turbidity currents [1]
angular fragments so less transport
mud matrix
rock fragments
mica so in water [1 mark for each to max 2] **[3]**

[Total: 17]

4 **(a)** **(i)** anywhere on the outside of a meander bend [1] **[1]**

(ii) anywhere on the inside of a meander bend [1] **[1]**

(b) **(i)** cross-bedding in the channel/on bank on inside of meander bend/as point bar deposit
sand deposited on slope of the side or base of the channel so at angle
larger scale crossbedding represents higher level of energy
as channel migrates new sets of cross beds are formed
[1 mark for each to max 2]
diagram of point bar [1] **[3]**

(ii) imbricate structure formed by strong currents in a river which cause the pebbles to line up parallel to the current [1+1] **[2]**

(iii) very low energy at the base to form fine grainrd mud
very high energy / flood to form conglomerate – large pebble size
high energy for large scale cross bedding
decreasing energy up to mud/small cross bedding
colonised by plants at top so land / no energy [1 mark for each to max 3] **[3]**

(c) the mud was deposited on the flood plain not in the channel / overbank deposit when the river floods and the suspended load is deposited as the floodwater retreats or dries up [1+1] **[2]**

(d) all three sediments, gravel, sand and mud
are laid down at the same time
each sediment is laid down laterally away from the others
as the river channel moves, the vertical sequence will be the same as the horizontal sequence [1 mark for each to max 3] **[Total: 15]**

5 **(a)** need for lack of clastic material in order for chemically formed rocks / areas where no terriginous sediment
evaporites form in a sequence controlled by solubility - K salts, halite, anhydrite, gypsum, dolomite, calcite
Salinity of sea increased by high rate of evaporation in lagoon / barred basin / restricted circulation **[max 5]**

limestones
oolites where there are strong tides / currents shown by broken fossil fragments and concentric structure
micrite where low energy carbonate muds occur with whole fossils
reef limestones / fossiliferous often high energy **[max 5]**

diagrams included for each part **[max 2]**
[max 12]

(b) Mineral composition

quartz - presence indicates excess silica and is an essential mineral in acidic rocks

feldspars - 2 types - plagioclase and orthoclase
plagioclase - variations in type useful for determining groups
Ca rich - basic/ultrabasic groups
Na rich - acidic
orthoclase characteristic of acidic group due to high K
Generally minerals low on Reaction Series form in acid rocks as crystallise at lower temperatures with the opposite for basic rosks

mafic minerals - olivine/pyroxene - silica poor - essential in basic/ultrabasic
hornblende/biotite - more silica and hydrous - characterise intermediate/acidic groups **[max 7]**

silica percentage

broad criteria based on chemical analysis of whole rock samples so chemical composition of little use with specimens - can't be determined in the field except as a generalisations by colour. Lighter is acid, darker basic
ultrabasic <45%, basic 45 - 52%, intermediate 52 - 66%, acidic >66% **[max 4]**

[max 11]

Quality of Written Communication

2 marks	Answers are structured clearly and logically, so that the candidate communicates effectively, uses a wide range of specialist terms with precision and spelling, punctuation and grammar are accurate.
1 mark	There are shortcomings in the structure of the answer, however, the candidate is able to communicate knowledge and ideas adequately, a limited range of specialist terms are used appropriately and spelling, punctuation and grammar are generally accurate with few errors.
0 marks	There are severe shortcomings in the organisation and presentation of the answer, leading to a failure to communicate knowledge and ideas. There are significant errors in the use of language, spelling, punctuation and grammar which makes the candidate's meaning uncertain.

[quality of written communication max 2]

[Total: 25]

Oxford Cambridge and RSA Examinations

Advanced GCE

GEOLOGY

Geological Skills **2836/01**

Specimen Paper

Additional materials:
Answer paper

TIME 1 hour 15 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces provided on the answer booklet.
Write all your answers on the separate answer paper provided.
If you use more than one sheet of paper, fasten the sheets together.
Answer **all** questions.

INFORMATION FOR CANDIDATES

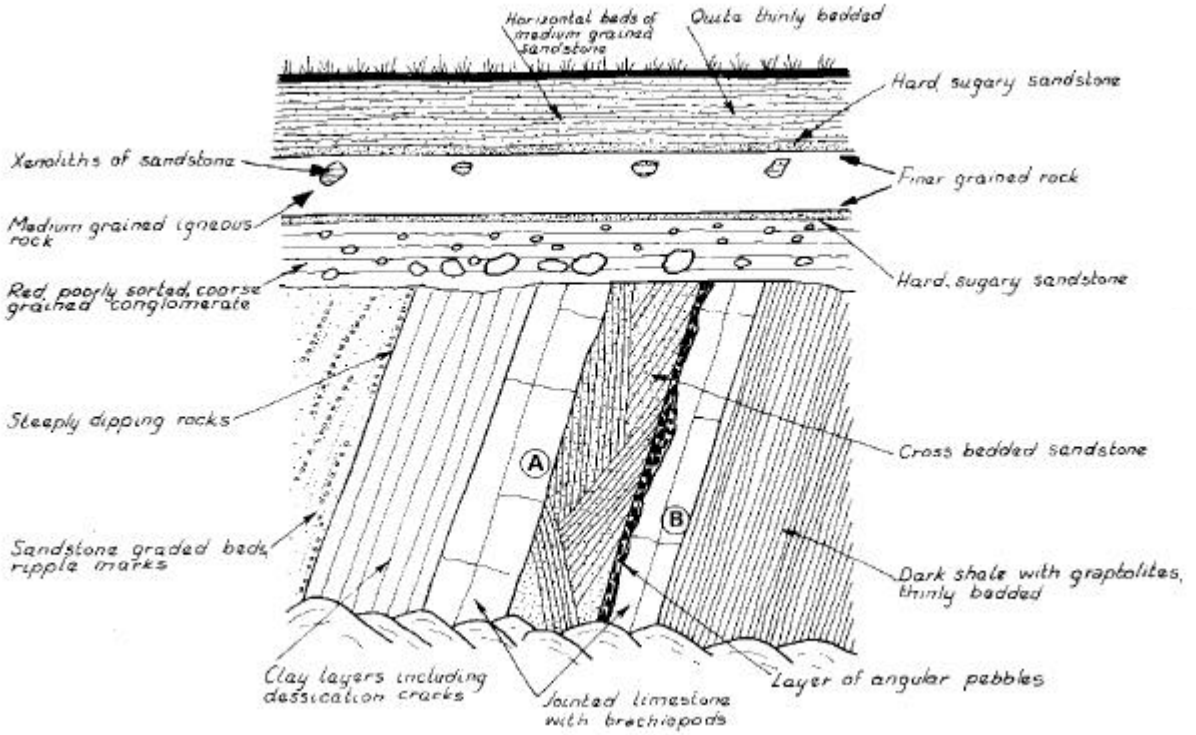
The number of marks is given in brackets [ ] at the end of each question or part question.

You will be awarded marks for the quality of your written communication in question 4.

The questions in this paper are synoptic in nature. In your answer to each question you are encouraged to show your knowledge and understanding of different areas of Geology and apply these and the geological skills you have learned, to the situations in the questions.
Total mark for this paper is 60.

Answer **all** questions

1 The field sketch below shows a cliff face 22 m high.



(a) Name the igneous feature shown on the field sketch and describe **three** pieces of evidence to justify your answer.

.....

.....

.....

.....

.....

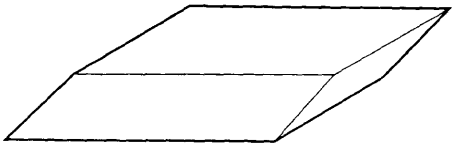
.....**[4]**

(b) Within the limestone **B** there are a number of minerals in veins.

Mineral 1
Clear, cubic crystals with a yellow tinge, a hardness of 4 and 4 cleavages

Mineral 2
Silvery grey, cubic crystals and a specific gravity of 7.5

Mineral 3
White, cleavage fragments as shown



Identify each of the minerals.

1. ……..…….. **2.** …….. **3**. ……..…… **[3]**

(c) The steeply dipping rocks may be upside down. Explain how **three** of the features on the sketch could have been used in order to determine the way-up of the rocks.

.....…….

.....…….

.....…….

.....…….

.....…….

.....……**[3]**

(d) Limestone **A** contains fragments of brachiopods, crinoid stem sections and broken colonial corals in a carbonate cement. Draw a labelled cross sectional view of this limestone to show the fossils. State the likely energy levels in which the limestone formed.

……

[4]

(e) Interpret the changing environmental conditions shown by the sequence of steeply dipping beds.

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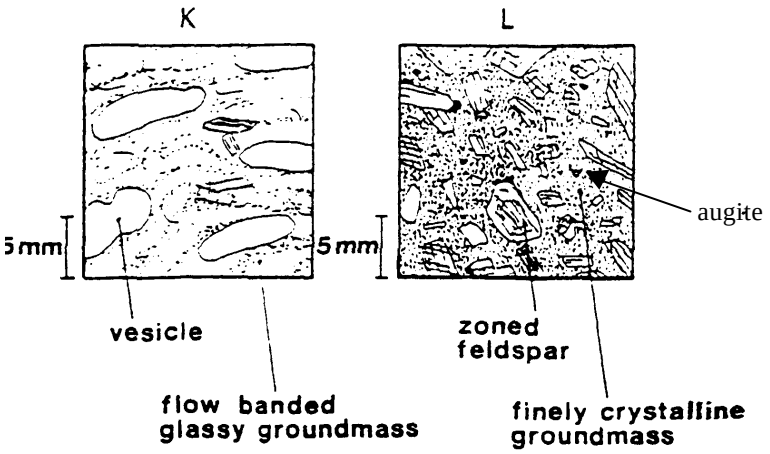
..... **[4]**

[Total: 18]

2 Sketches of rock thin sections **K** and **L** are shown below. Both rocks were collected at volcanoes.



(a) **(i)** Describe the evidence for each of the rocks having a volcanic origin.

K.....

.....

L .....

…… **[2]**

(ii) Explain which type of volcano and volcanic activity is most likely to have formed each of the rocks?

K .....

……

……

L .....

……

…… **[4]**

(b) Describe and explain how the zoned feldspars in specimen **L** may have formed.

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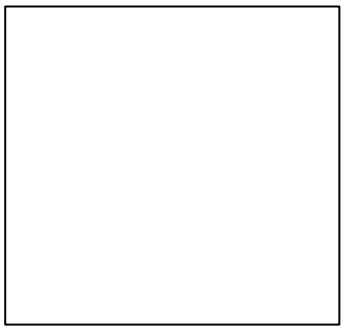
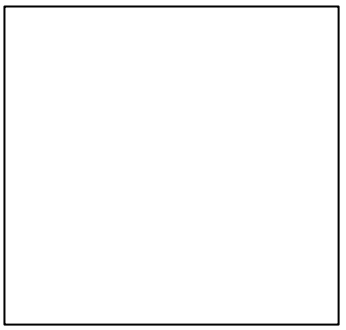
..... **[2]**

(c) **(i)** Draw scaled labelled diagrams to illustrate the differences between a poorly sorted breccia and a well sorted sandstone





[4]

(ii) Which of the rocks that you have drawn will be most suitable as an aquifer? Explain your answer.

.....

.....

.....

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

(d) Explain how rocks that contain no fossils or bedded structures can be dated.

.....

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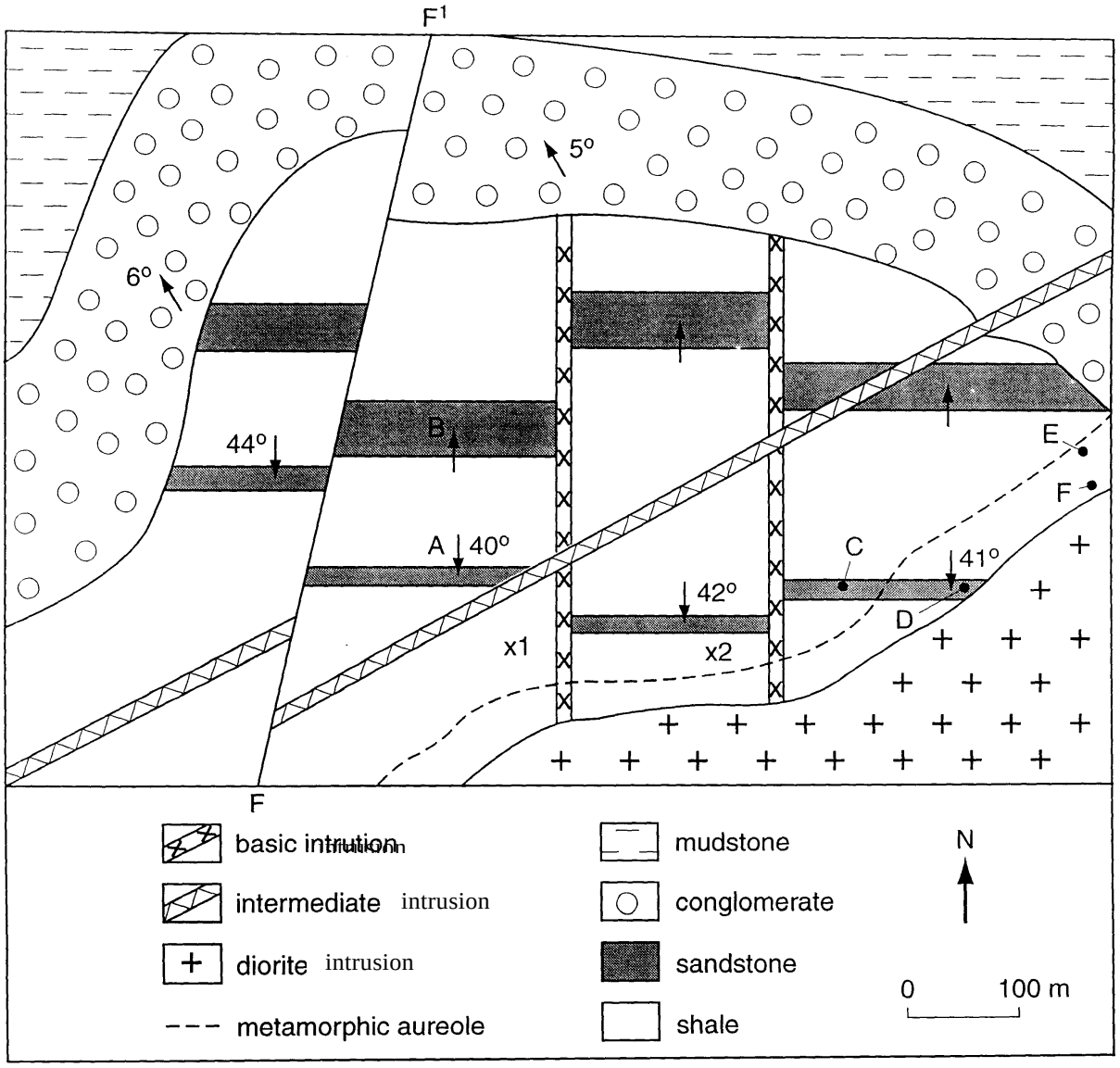
..... **[2]**

[Total: 16]

3 Use the map below to answer the questions that follow.



Localities A, B, C, D, E and F are marked

Map

(a) Describe the differences in the rocks found in the following positions:

(i) **C** and **D**

.....

.....

.....

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

(ii) **E** and **F**

.....

.....

.....

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

(b) Explain why the sandstone varies in width from north to south on the map

.....

.....

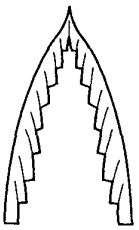
.....

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

(c) The fossils shown below are of different ages and were found in different shale units on the map.

(i) Use the letters **G** and **H** to mark on the map possible localities where each fossil could be found. **[1]**

Fossil G



Fossil H

(ii) Explain the localities you have chosen in relation to the age of the shale and the fossils.

.....

.....

.....

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

(iii) Why are these fossils commonly used as zone fossils.

.....

.....

.....

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

(d) Indicate using the letter **P** one place on the map where photograph A could have been taken. **[1]**

[Total: 12]

4 *In this question 2 mark is available for the quality of written communication.*

(a) Write in continuous prose a detailed geological history of the area shown on the map beginning with the oldest event. The descriptions of events should use technical terms and should explain the age relationships between the rocks and structures.

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.....**[7]**

(b) Write in continuous prose a detailed, description of the geology shown on photograph **A**.

Photograph A

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.... **[5]**

[quality of written communication 2]

[Total: 14]

Oxford Cambridge and RSA Examinations

Advanced GCE

GEOLOGY

Geological Skills **2836/01**

Mark Scheme

TOTAL MARKS 60

Section A

1 **(a)** sill [1]
xenoliths of sandstone that have fallen down into the sill [1]
2 baked margins of altered sandstone - above and below [1]
fine grained rock as chilled margins - top and bottom [1] **[4]**

(b) 1: fluorite [1]
2: galena [1]
3: calcite [1] **[3]**

(c) cross bedding - u shaped down / beds cut off by next cross set [1]
desiccation cracks - V shape up infilling of cracks
graded beds - coarse at bottom, fine at top
uneven erosive base to breccia bed with breccia above
[1 mark for each to max 3] **[3]**

(d) crinoidal limestone stem sections / ossicles drawn and labelled [1]
colonial coral septa / corallites drawn and labelled [1]
brachiopod fragments drawn and labelled in carbonate cement [1]
energy level high [1] **[4]**

(e) deep, quiet sea for shale with graptolites
clear, carbonate sea, shallower with brachiopods in limestone [1]
uplift, nonconformity / erosion and breccia layer formed unconformably [1]
cross bedded sandstone probably beach or shallow sea
limestone in clear, shallow sea [1]
clay layers of lagoon or estuary drying out to form dessication cracks
sandstone with graded beds and ripples, river or shallow sea [1] **[4]**
[Total: 18]

2 **(a)** **(i)** K: vesicular texture and flow banding and glassy groundmass [1]
L: fine grained groundmass [1] **[2]**

(ii) K: acid due to glassy, flow banded, explosive with infrequent eruptions, steep sides, nuee ardente makes pumice / ignimbrite with vesicular texture [1+1]
L: basic due to zoned plagioclase feldspar and augite, non explosive with frequent eruptions, gentle sides [1+1] **[4]**

(b) Ca rich core to crystal forms at high temperature
more Na rich outer layers form at lower temperatures [1]
origin due to convection currents in magma or differentiation within the magma [1]
[2]

(c) **(i)** drawings sorting and relative size [1+1]
scale [1]
labels [1] **[4]**

(ii) well sorted sandstone as higher level of porosity [1]
detail from diagram eg no cement or poorly sorted rock lower porosity [1] **[2]**

(d) radiometric dating [1]
suitable method described [1] **[2]**
[Total: 16]

3 **(a)** **(i)** C will be unchanged sandstone [1]
D will be metaquartzite/recrystallised/crystalline not clastic [1] **[2]**

(ii) **E** spotted slate/some recrystallisation [1]
F hornfels/total recrystallisation [1] **[2]**

(b) steep dip in south so narrow but shallow dip in north so wider [1+1] **[2]**

(c) **(i)** **G** in shale at edge of anticline, **H** in centre of anticline [1] **[1]**

(ii) H is pendant/uniserial/two stipes and in earlier older shale than G [1]
G must be in the younger rocks [1] **[2]**

(iii) graptolites have rapid evolutionary change
with a worldwide distribution as nektonic organisms
common and easily identified [1 mark for each to max 2] **[2]**

(d) anywhere on line of unconformity [1] **[1]**
[Total: 12]

4 **(a)** beds of shale sandstone shale laid down
beds folded into an asymmetrical anticline with an east west axis
beds cut by two north-south faults
intrusion of diorite major intrusion with associated metamorphic aureole
associated basic dykes intruded along the faults
erosion
conglomerate laid down unconformably and mudstone on top
tilted 5° northwest
intermediate intrusion crosscuts the basic intrusion
F-F1 fault cuts the intermediate dykes
erosion
correct order **[max 7]**

(b) lower rocks laid down as cross bedded units / massive beds tilted by earth movements
joints form / uplift and erosion of the older beds
poorly sorted coarse conglomerate laid down unconformably on older series tilted to right by earth movements
erosion has exposed the older beds. **[max 5]**

Quality of Written Communication

2 marks	Answers are structured clearly and logically, so that the candidate communicates effectively, uses a wide range of specialist terms with precision and spelling, punctuation and grammar are accurate.
1 mark	There are shortcomings in the structure of the answer, however, the candidate is able to communicate knowledge and ideas adequately, a limited range of specialist terms are used appropriately and spelling, punctuation and grammar are generally accurate with few errors.
0 marks	There are severe shortcomings in the organisation and presentation of the answer, leading to a failure to communicate knowledge and ideas. There are significant errors in the use of language, spelling, punctuation and grammar which makes the candidate's meaning uncertain.

[quality of written communication max 2]
[Total: 14]