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Uwch

455/01

GEOLOGY GL5

THEMATIC UNIT 1

QUATERNARY GEOLOGY

P.M. TUESDAY, 19 June 2007

For Examiner's Use only.

Section A	**1**	
	2	
Section B	**3**	
	4	
	5	
	Total 50	

Answer **both** *questions in Section A (25 marks) and* **one** *question in Section B (25 marks).*

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SECTION A

Answer **both** *questions in the spaces provided.*
This section should take approximately half an hour to complete.

1. **Figure 1a** is a relief map of the Great Bahama Bank and Andros Island.
Figure 1b shows the distribution of carbonate sediments around Andros Island.

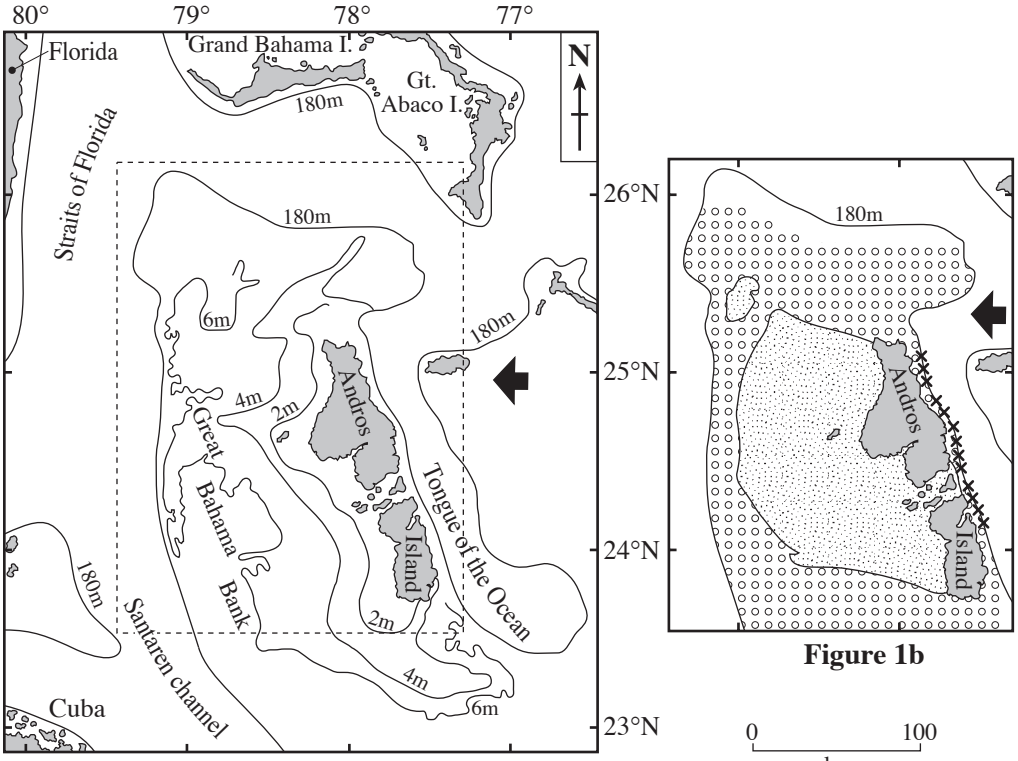

Figure 1a

Figure 1b

Key

- Carbonate muds
- Cross bedded, oolitic carbonate sediments
- Coral reef
- Dominant wind direction
- 4m Submarine contours
- ---------- Area representing **Figure 1b**

Refer to **Figures 1a** and **1b**.

(a) (i) Describe the distribution of carbonate mud sediment. [2]

.....

.....

.....

(ii) Explain why carbonate muds are being deposited in these locations. [2]

.....

.....

.....

(b) Explain why coral reef development is confined to the east coast of Andros Island. [2]

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(c) (i) Cross-bedded, oolitic carbonate sediment is being deposited in the sea around Andros Island.
Oolites (or ooids) are formed by the accretion of carbonate in concentric layers around a nucleus such as a shell fragment or a sand grain. They are typically 1mm in diameter.
Draw, to scale, a labelled diagram of an oolite (ooid). [2]

(ii) Using **Figures 1a** and **1b**, explain how the sedimentary environment around Andros Island leads to the formation and deposition of cross-bedded oolitic carbonate sediment. [4]

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Total 12 marks

Turn over.

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2. **Figure 2a** is a Quaternary landform map of the Cadair Idris area in Wales.
Figure 2b is a cross-section along the line **X-Y** on **Figure 2a**.

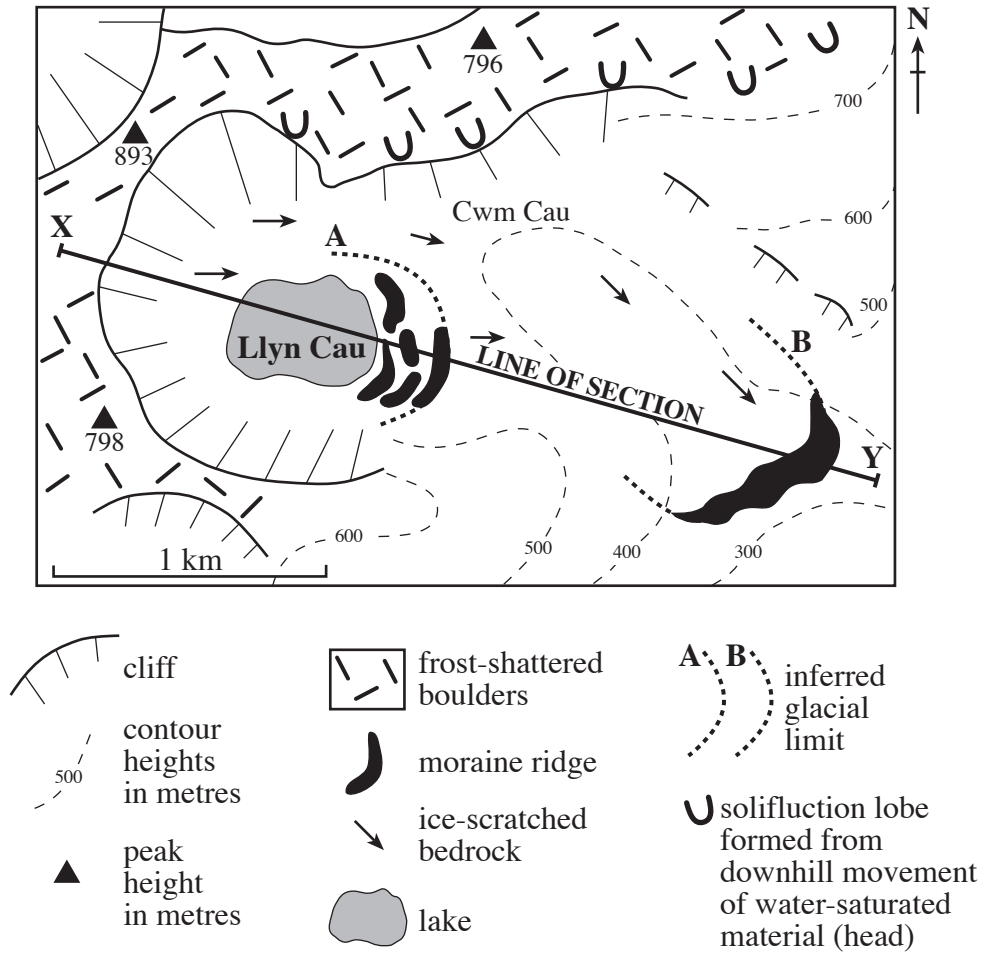

Figure 2a

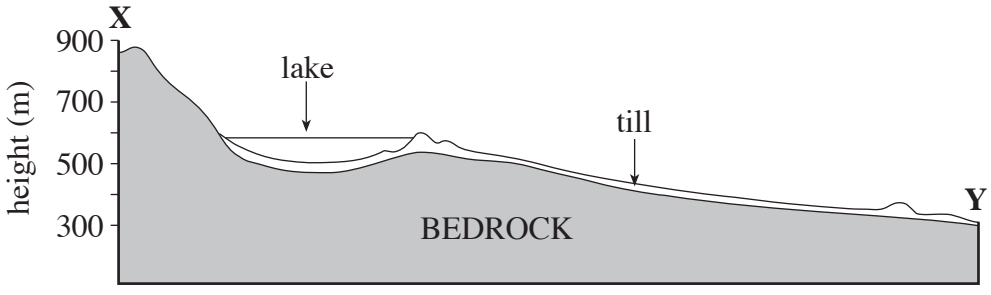

Figure 2b

(a) State **two** pieces of evidence from **Figure 2a** which indicate that this area has been glaciated. [2]

1. .....

2. .....

(b) Use **Figures 2a** and **2b**.

(i) Give a geological reason for the presence of the lake (Llyn Cau). [2]

.....

.....

.....

(ii) Suggest reasons for the presence of two different glacier limits in Cwm Cau (labelled **A** and **B**). [2]

.....

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.....

(c) Solifluction lobes can develop in periglacial conditions. Use **Figure 2a**.

(i) Describe the distribution of solifluction lobes in the Cadair Idris area. [3]

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(ii) Explain the distribution of solifluction lobes in the Cadair Idris area. [2]

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(d) The Cadair Idris area has been interpreted as experiencing glacial and periglacial conditions at the same time. Evaluate this interpretation. [2]

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Total 13 marks

SECTION B

Answer **one** *question from this section.*

Write your answer in the remaining pages of this booklet.

3. *(a)* Explain how Milankovitch Cycles are thought to cause climatic fluctuations in the Quaternary.

(b) Discuss the importance of the distribution of continents and mountain belts in influencing global climate in the Quaternary. [25]

4. *(a)* Explain how fossils can provide evidence for Quaternary climatic fluctuations.

(b) Evaluate the use of radiocarbon (^{14}C) dating in determining the duration of Quaternary climatic fluctuations. [25]

5. *"The geological structure and lithology of an area controls the drainage patterns of water both above and below the surface."*
Evaluate this statement with reference to examples you have studied. [25]

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455/02

GEOLOGY GL5

THEMATIC UNIT 2

GEOLOGY OF NATURAL RESOURCES

P.M. TUESDAY, 19 June 2007

For Examiner's Use only.

Section A	**1**	
	2	
Section B	**3**	
	4	
	5	
	Total 50	

Answer **both** *questions in Section A (25 marks) and* **one** *question in Section B (25 marks).*

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SECTION A

Answer **both** *questions in the spaces provided.*
This section should take approximately half an hour to complete.

1. **Figures 1a** and **1b** show details of an evaporite deposit formed by the evaporation of seawater in a shallow lagoon. The minerals have been formed by precipitation from solution.

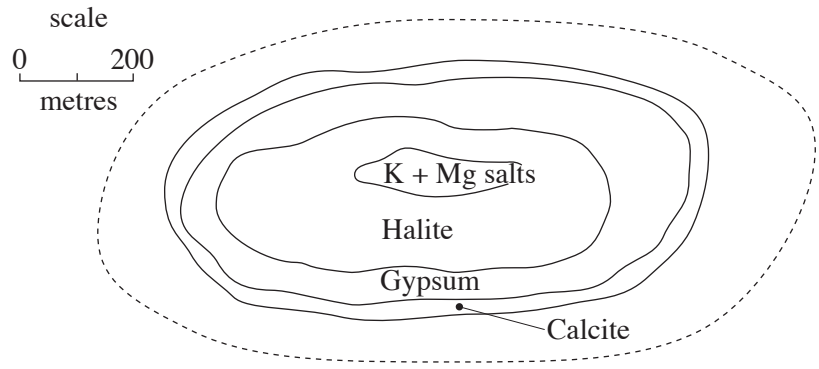

Figure 1a

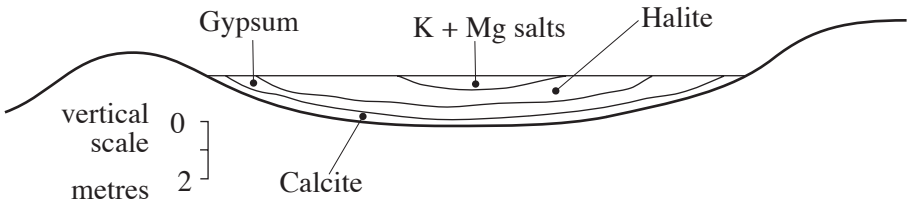

Figure 1b

(a) (i) Using **Figures 1a** and **1b**, describe the shape and structure of the evaporite deposit.[2]

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% of seawater evaporated	Minerals precipitated
50-60	Calcite ($CaCO_3$)
75-80	Gypsum ($CaSO_4.2H_2O$)
85-90	Halite (NaCl)
95-98	Salts of potassium and magnesium (K+Mg)

Table 1

(ii) State which one of the four evaporite minerals shown in **Figures 1a**, **1b** and **Table 1** is the least soluble. Give one reason to support your answer. [2]

Name of mineral .....

Reason .....

(iii) Seawater on average contains 35 parts per thousand (3.5%) of minerals dissolved as ions in solution. Suggest a source for these ions. [1]

.....

(b) **Figure 1c** shows a typical environment where evaporite sequences form.

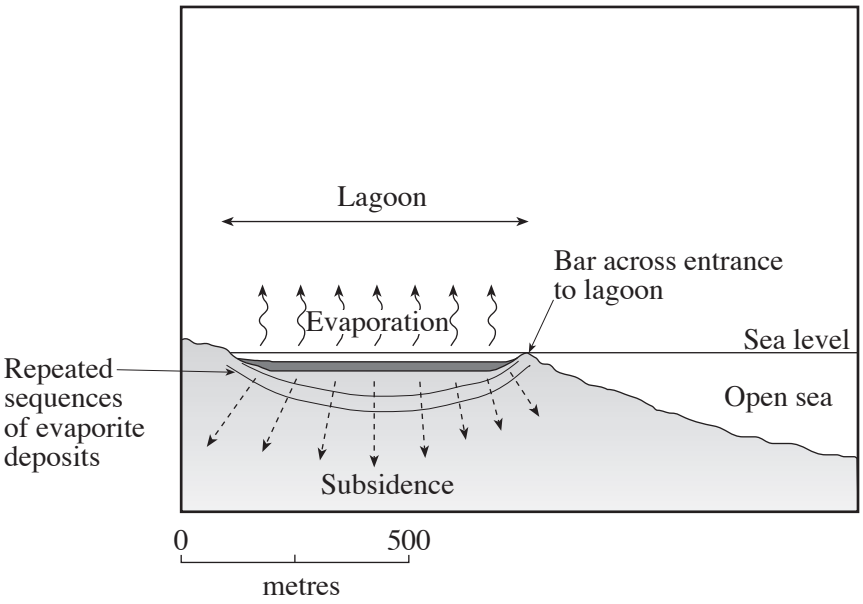

Figure 1c

(i) Suggest **one** way in which the lagoon could become replenished. [1]

.....

.....

(ii) Evaporite sequences found in Cheshire are 200 metres thick in places. If 3 metres depth of seawater produces 5 centimetres thickness of evaporite minerals, calculate the depth of seawater needed to produce evaporites 200 metres thick. Show your working. [2]

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.....

(iii) Suggest how it is possible for thick sequences of evaporites to form in shallow water environments as shown in **Figure 1c**. [2]

.....

.....

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(c) Suggest why it is unlikely that thick sequences of evaporites will form in the present day Atlantic Ocean around the shores of the UK. [3]

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Total 13 marks

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2. **Figure 2a** shows a cross section of the geology below London.
The Chalk is an important aquifer which supplies the city with a significant amount of fresh water.

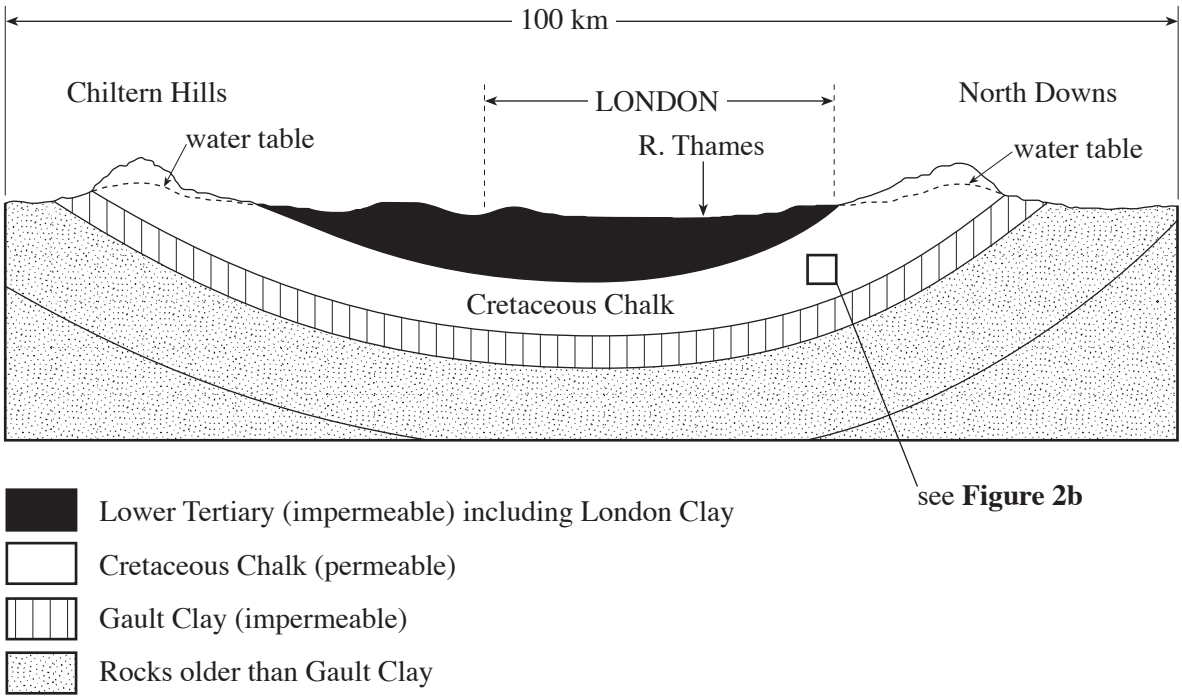

Figure 2a

(a) (i) Label onto **Figure 2a**:

- one location where a spring might occur ⟶ **S**;
- the location of a borehole that would produce an artesian well ⟶ **A**. [2]

(ii) Using only **Figure 2a**, describe the geological factors that have led to the Chalk becoming an aquifer. [2]

.....

.....

.....

Figures 2b and **2c** show details of the internal structure of the Chalk.

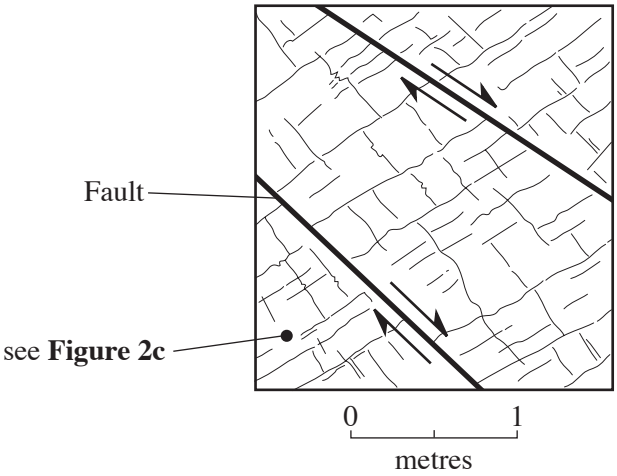

Figure 2b

Figure 2c
Electron microscope view of chalk

(b) Using **Figures 2b** and **2c** only, explain why the Chalk has both high porosity and permeability. [3]

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(c) **Figure 2d** shows a section through a well in the Chalk during pumping.

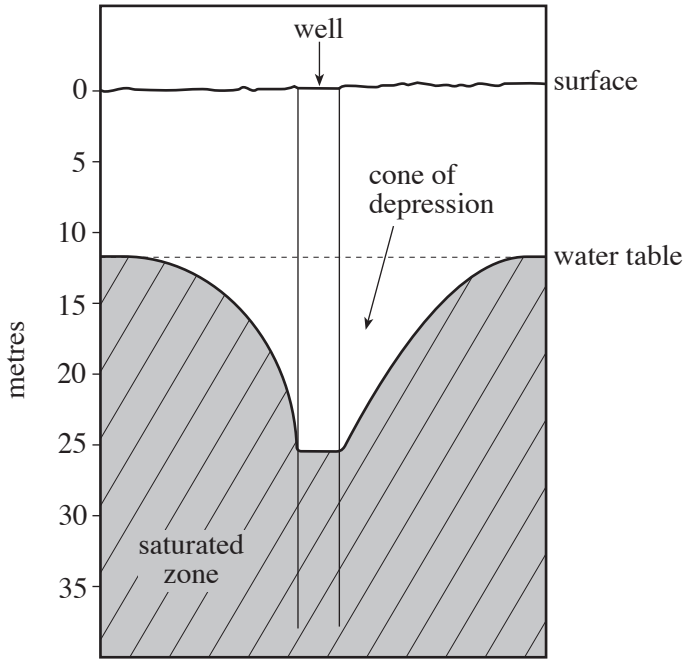

Figure 2d

(i) Calculate the maximum amount of the lowering of the water table that has taken place due to pumping. Show your working. [2]

.....

.....

(ii) Suggest why groundwater extracted from aquifers is often of better quality than water obtained from surface reservoirs. [3]

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Total 12 marks

SECTION B

Answer **one** *question from this section.*

Write your answer in the remaining pages of this booklet.

3. *"Igneous processes are the most important processes in the formation of epigenetic and syngenetic mineral deposits."*
Evaluate this statement and illustrate your answer with reference to examples you have studied. [25]

4. *(a)* Evaluate the relative importance of the geological factors that favour the formation and accumulation of large scale oil and gas deposits.

(b) Evaluate the importance of anticlinal traps in the formation of large scale oil and gas deposits. [25]

5. Evaluate the role of geophysical and geochemical techniques in the search for energy and mineral deposits. [25]

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455/03

GEOLOGY GL5

THEMATIC UNIT 3

GEOLOGICAL EVOLUTION OF BRITAIN

P.M. TUESDAY, 19 June 2007

For Examiner's Use only.

Section A	**1**	
	2	
Section B	**3**	
	4	
	5	
	Total 50	

Answer **both** *questions in Section A (25 marks) and* **one** *question in Section B (25 marks).*

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SECTION A

Answer **both** *questions in the spaces provided.*
This section should take approximately half an hour to complete.

1. **Figure 1a** is a map showing some of the Variscan structures present in south west England and south Wales. The locations (**1**, **2** and **3**) of three field sketches are also shown.

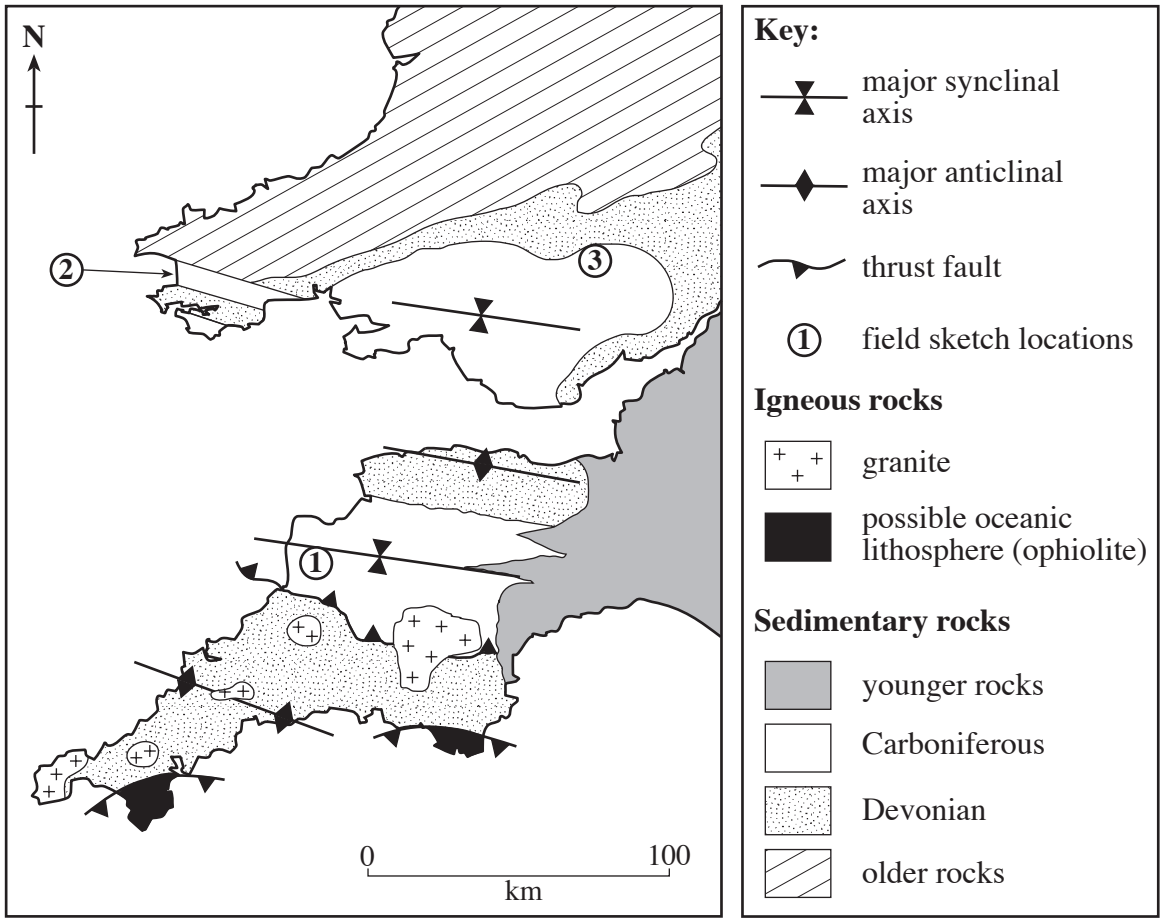


Figure 1a

(a) Using **Figure 1a**,

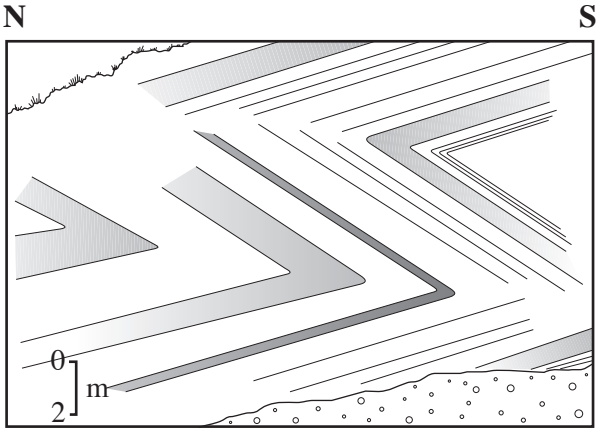
(i) state the regional trend of the major fold axes, [1]

.....

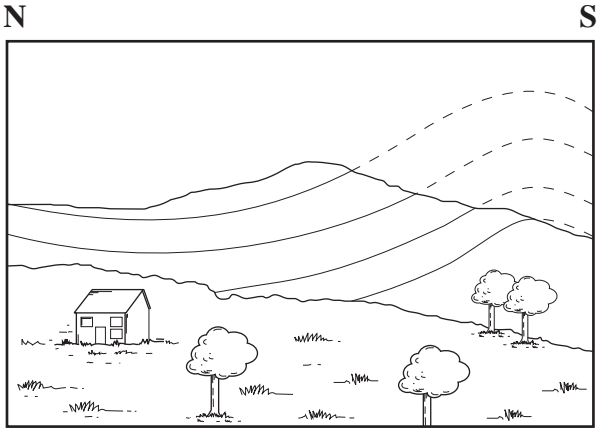
(ii) state the directions of the greatest compressional stresses (σ max) which produced the structures. [1]

.....

(b) Field sketches at locations **1** and **3** are shown in **Figure 1b**.



Field sketch location 1



Field sketch location 3

Figure 1b

(i) Complete **Table 1a** by adding appropriate descriptions of the folds shown in the field sketch at location **1**. [3]

Fold description at location 1	
shape of the fold hinge	
apparent angle of dip of the axial plane	
interlimb angle	

Table 1a

(ii) Describe **two** differences between the folds at locations **1** and **3**. [2]

1. .....

.....

2. .....

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(c) A field sketch of the structures at location **2** is shown in **Figure 1c**.

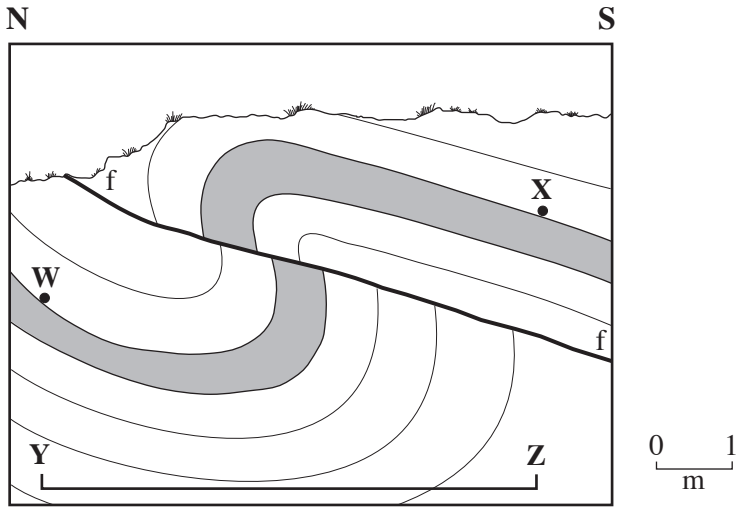

Figure 1c

Calculate the amount of crustal shortening produced at location **2** using the formula below and enter the result in **Table 1b**. The distance **W** to **X** is 10 m measured along the bedding plane. Show your working. [2]

$$\% \text{ crustal shortening} = \frac{\underline{\text{distance along bed from } \mathbf{W} \text{ to } \mathbf{X}} - \underline{\text{distance } \mathbf{Y} \text{ to } \mathbf{Z}}}{\text{distance along bed from } \mathbf{W} \text{ to } \mathbf{X}} \times 100$$

Location	**1**	**2**	**3**
crustal shortening	60%		2%
cleavage	strong	weak	none

Table 1b
Showing crustal shortening and cleavage at each location

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(d) *'South Wales and the south west of England were close to the site of a probable destructive plate margin during the Variscan Orogeny.'*
Evaluate this statement using **Figure 1a**, **Table 1a** and **Table 1b**. [5]

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Total 14 marks

2. **Figure 2a** is a simplified geological map showing the Palaeozoic (Ordovician and Silurian) rocks of the Southern Uplands of Scotland. Numbers **1-3** show the locations of the three borehole logs drawn below the map in **Figure 2b**. **Figure 2c** shows the details of turbidite units from borehole **2**.

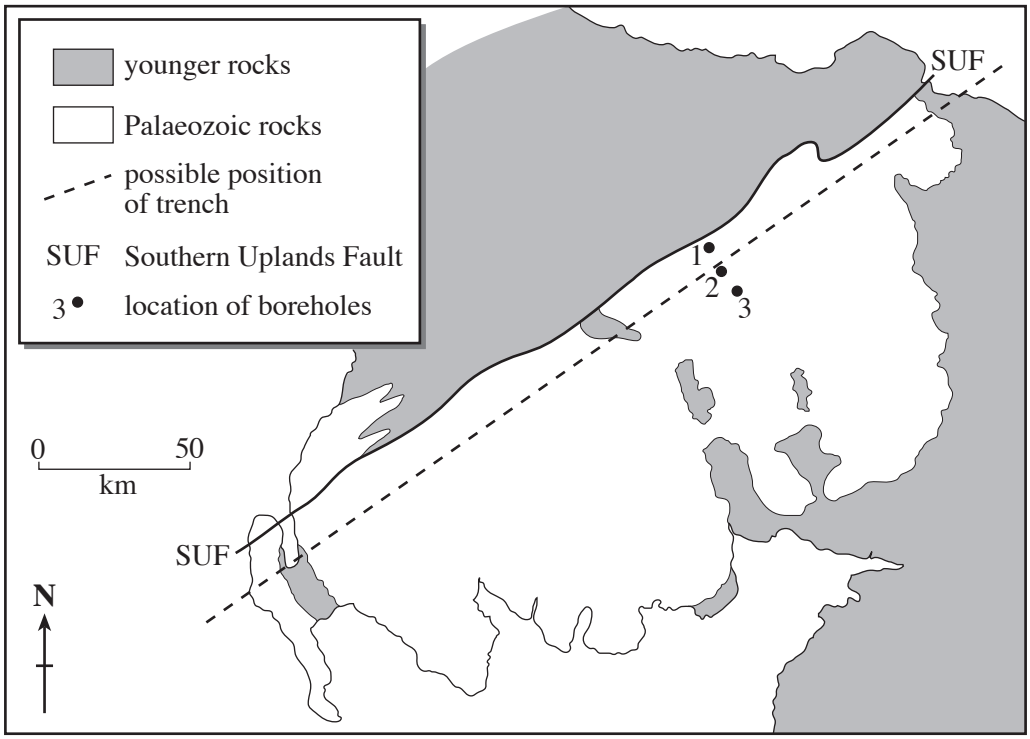


Figure 2a

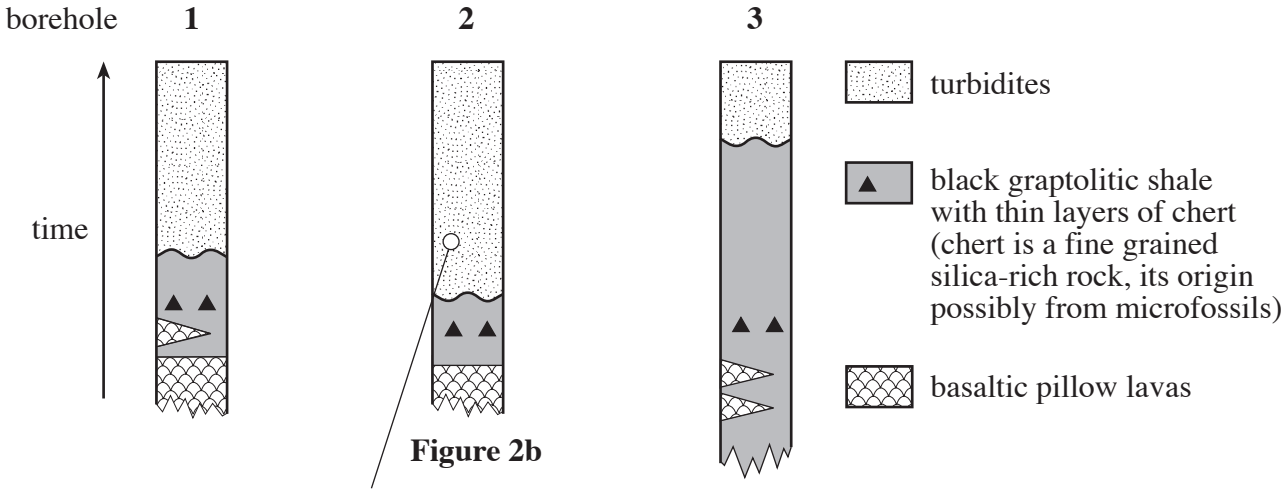
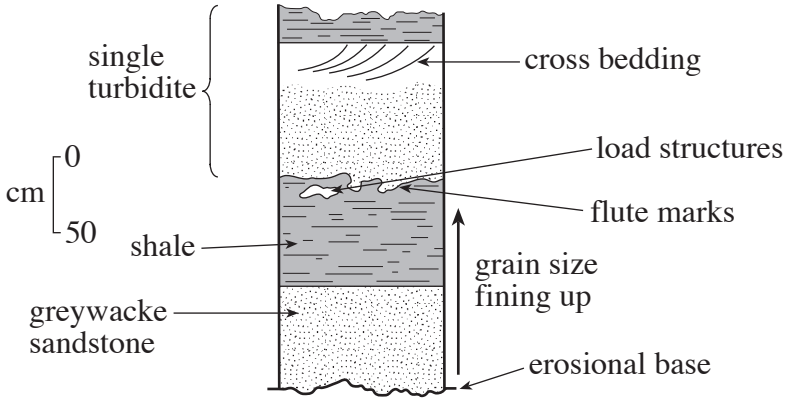


Figure 2b



adapted from:
Hunter and Easterbrook
Geological History
of the British Isles
(Open University)

Figure 2c

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Refer to Figure 2c.

(a) (i) Name **one** sedimentary structure present in a single turbidite unit which can be used to determine the direction of current flow. [1]

.....

(ii) Explain the origin of the fining upwards grain size within the single turbidite. [3]

.....

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Refer to Figure 2b.

(b) (i) Describe the likely environment of deposition of the black graptolitic shale with thin layers of chert present in all three boreholes. State the evidence for your conclusions. [3]

.....

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.....

(ii) Explain the possible significance of the basaltic pillow lavas in the boreholes. [2]

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Refer to Figures 2a and 2b.

(c) The position of a possible oceanic trench has been marked on **Figure 2a**. State the evidence from the sediments in the boreholes which could be used to support this interpretation. [2]

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Total 11 marks

Turn over.

SECTION B

Answer **one** *question from this section.*

Write your answer in the remaining pages of this booklet.

3. *(a)* Interpret the geology of the Tertiary Igneous Province of north west Britain in plate tectonic terms.

(b) Describe the evidence for rifting and subsidence in the North Sea and evaluate its relationship to plate movements in the Mesozoic and Tertiary. [25]

4. Palaeomagnetic evidence suggests that during the Late Palaeozoic (Devonian, Carboniferous and Permian), Britain drifted across the Equator.

(a) Describe the evidence from **sedimentary rocks** and **fossils** which suggests an equatorial climate in Britain in the Late Palaeozoic.

(b) Describe and evaluate the **palaeomagnetic** evidence. [25]

5. *(a)* Describe a range of techniques for collecting geological data in the field and explain how the data can be presented in a variety of forms.

(b) Evaluate the usefulness of these techniques in the interpretation of the geology of an area with which you are familiar. [25]

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Turn over.

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GEOLOGY GL5

THEMATIC UNIT 4

GEOLOGY OF THE LITHOSPHERE

P.M. TUESDAY, 19 June 2007

For Examiner's Use only.

Section A	**1**	
	2	
Section B	**3**	
	4	
	5	
	Total 50	

Answer **both** *questions in Section A (25 marks) and* **one** *question in Section B (25 marks).*

SECTION A

Answer **both** *questions in the spaces provided.*
This section should take approximately half an hour to complete.

1. **Figure 1a** shows the magnetic anomalies within a surveyed area of the oceanic lithosphere to the southwest of Iceland.

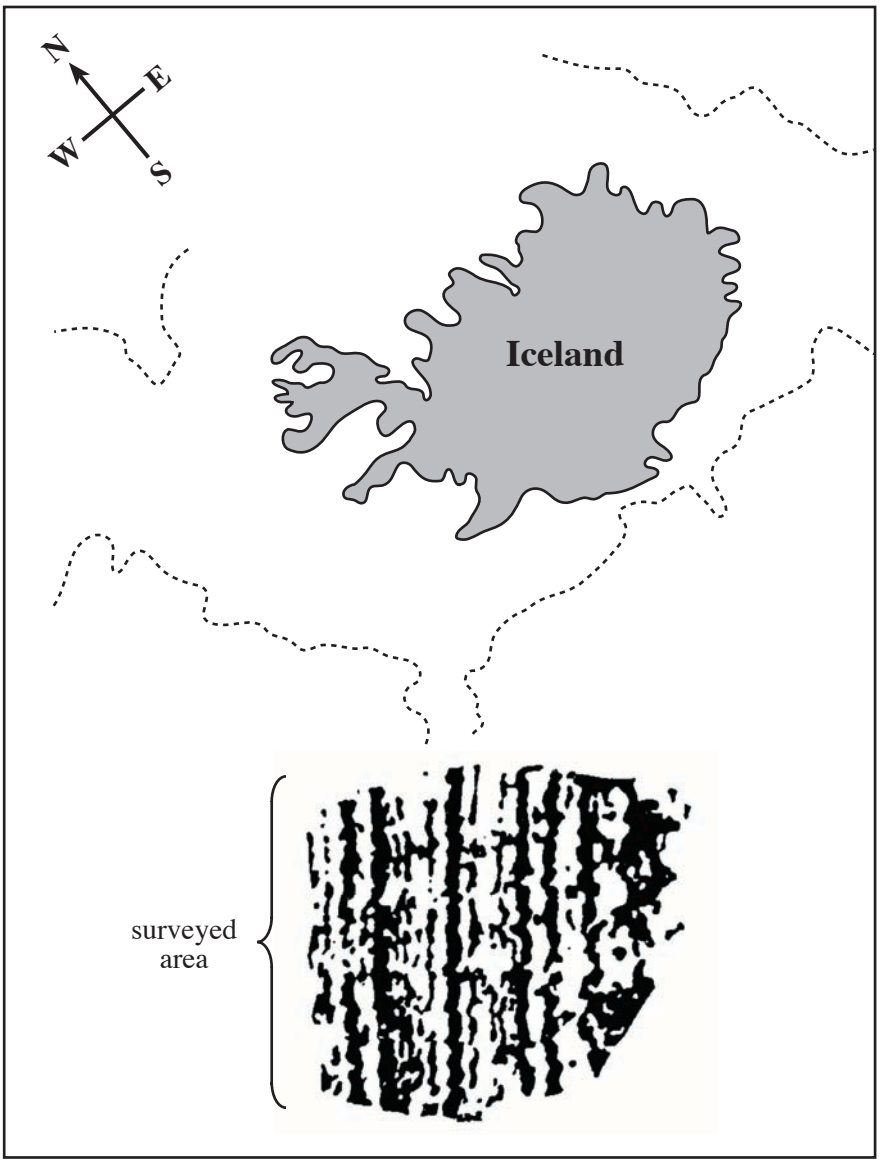

Figure 1a

(a) (i) Describe the pattern of the magnetic anomalies. [2]

.....

.....

(ii) Draw within the surveyed area on **Figure 1a** a line to show the axis of the Mid Atlantic Ridge. [2]

(iii) Give **two** reasons for your choice of position of the axis. [2]

Reason 1 .....

.....

Reason 2 .....

.....

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Figure 1b shows polarity changes for the past 5 Ma. Major periods of magnetisation are called **chrons**. Four chrons have been recognized, two normal and two reversed, and these are named.

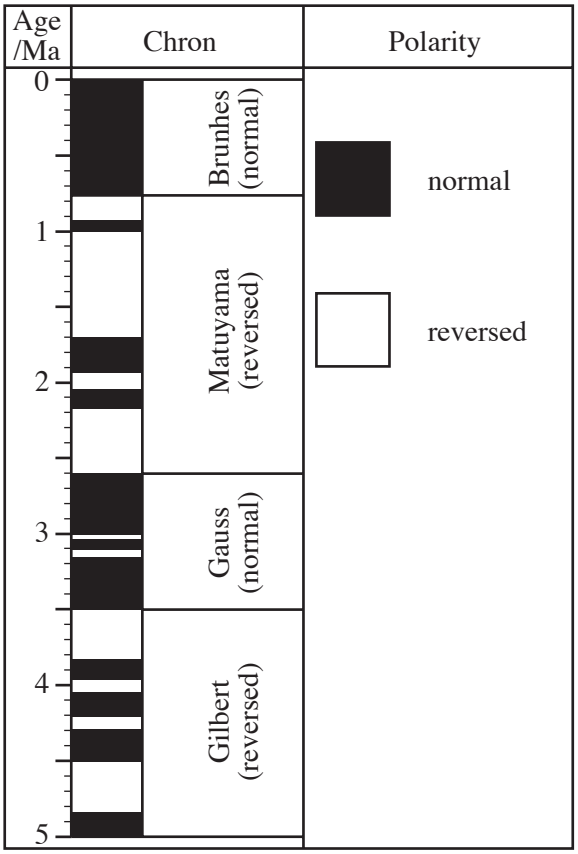

Figure 1b

(b) (i) State the name of the shortest chron shown on **Figure 1b**. [1]

.....

(ii) The Gilbert chron contains an equal number of normal and reversed episodes of magnetisation. State the **total** number of episodes in the Gilbert chron. [1]

.....

(iii) Suggest why the Gilbert chron is described as a period of reversed magnetisation when it contains equal numbers of normal and reversed magnetisations. [1]

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.....

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Figure 1c shows how the magnetic striping varies with distance from the axis of the ridge in part of the North Atlantic. The boundaries between the Gauss chron and the Matuyama chron to the east and west of the Mid-Atlantic ridge have been marked with arrows labelled $\mathbf{G_1}$ and $\mathbf{G_2}$.

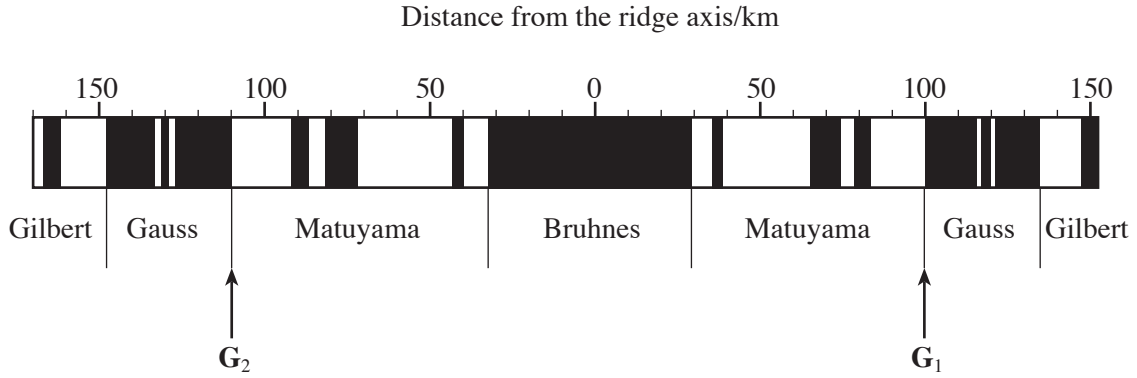

Figure 1c

(c) Refer to **Figures 1b** and **1c**.

(i) Calculate the rate between $\mathbf{G_1}$ and $\mathbf{G_2}$ at which the Atlantic Ocean is widening. Show your working and give your answer in centimetres per year (cm y^{-1}). [2]

Ocean widening at ..... cm y^{-1}

(ii) The plates are moving at different velocities to the east and west of the ridge axis. Suggest reason(s) to explain this. [2]

Reason(s) .....

.....

.....

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Total 13 marks

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2. **Figure 2a** is a photograph of a faulted pebble found within a conglomerate. **Figure 2b** is a drawing of the pebble together with the directions of two of the principal stresses which caused the faulting.

Figure 2a

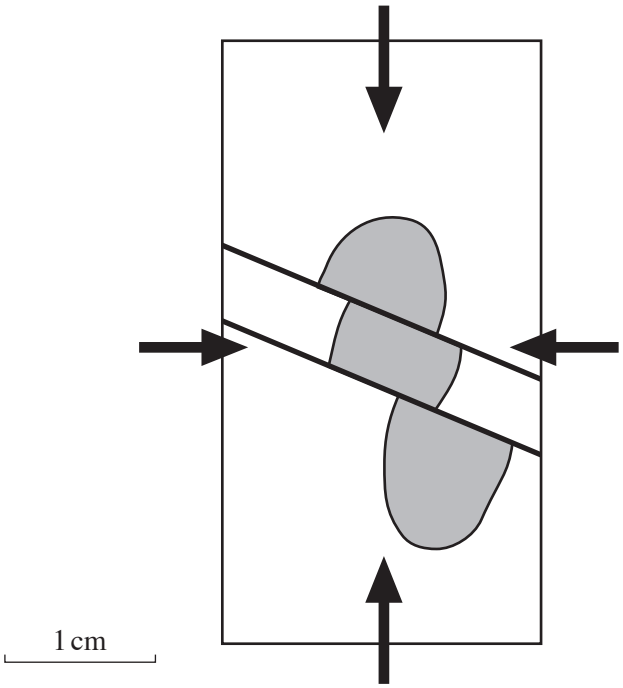

Figure 2b

(a) (i) Label the two principal stress directions (σ_{min}, σ_{int}, or σ_{max}) in **Figure 2b**. [2]

(ii) State the direction of the third principal stress which is **not** shown on **Figure 2b**. [1]

.....

(iii) Name the type of faulting that has affected the pebble.
Give a reason for your answer. [2]

.....

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Figure 2c is a cross-section showing the conglomerate between two sandstones, together with sketches of two sedimentary structures **X** and **Y** found within the sandstones.

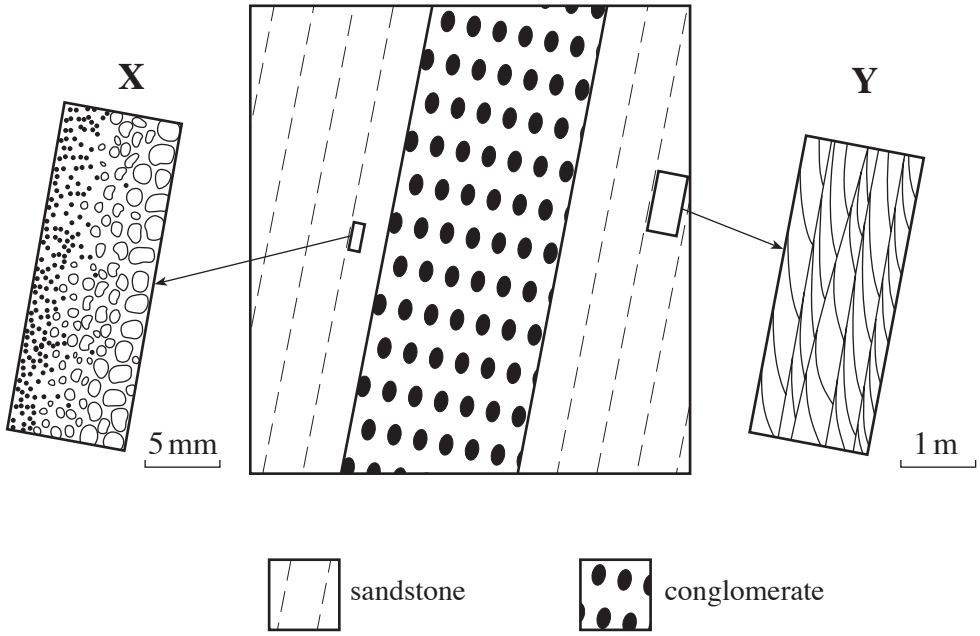

Figure 2c

(b) It has been suggested that the rocks may be upside down.
Use **Figure 2c** to evaluate this claim. [5]

(c) It has also been suggested that the cross-section might be part of a fold as shown in **Figure 2d**.

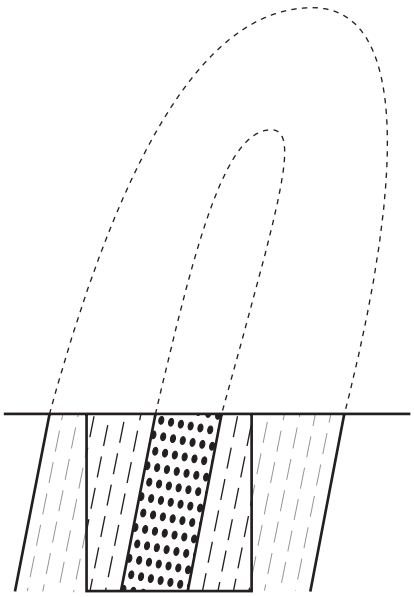

Figure 2d

Discuss whether the fold in **Figure 2d** and the faulting of the pebble in **Figure 2b** may both have been formed at the same time by the same stresses. [2]

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.....

Total 12 marks

SECTION B

Answer **one** *question from this section.*

Write your answer in the remaining pages of this booklet.

3. Describe how the use of seismic studies may contribute to an understanding of the theory of plate tectonics.
Discuss the importance of the different depths of earthquake foci to the theory. [25]

4. *(a)* Describe the J. Tuzo Wilson Cycle.

(b) Discuss how the present-day distribution of rift valleys might support the J. Tuzo Wilson theory. [25]

5. Describe how sedimentary basins may be formed.
Evaluate the importance of isostasy in the formation of sedimentary basins. [25]

Examiner only
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Turn over.

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