Candidate Name	Centre Number	Candidate Number
		2

GCE A level

455/01

GEOLOGY - GL5

THEMATIC UNIT 1

QUATERNARY GEOLOGY

A.M. FRIDAY, 13 June 2008

For Examiner's Use only.

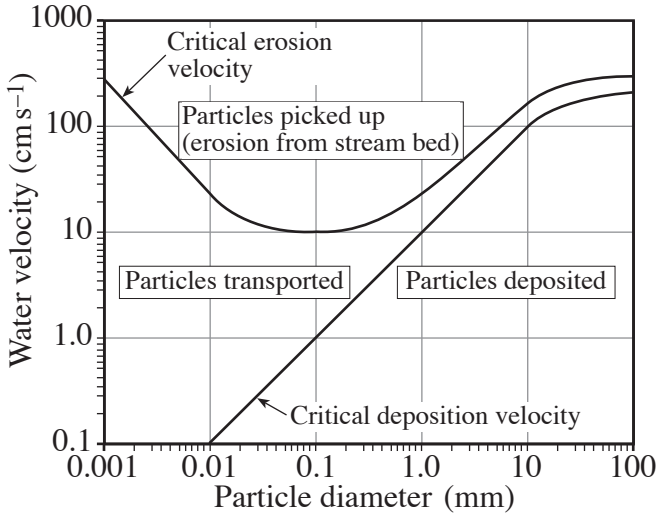
Section A	**1**	
	2	
Section B	**3**	
	4	
	5	
	Total 50	

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** is a graph (the Hjulstrom graph) showing the velocity required by a current of water to pick up, transport and deposit sedimentary particles of varying sizes.



A particle 1 mm in diameter will only be picked up when the water velocity reaches 20 cm s^{-1} and deposited when the velocity is reduced to 10 cm s^{-1}. The graph assumes the particles are spherical and all have a similar density.

Figure 1a

Refer to **Figure 1a**.

(a) (i) For a particle of diameter 0.1 mm, state the [2]

- minimum velocity required to pick up (erode) the particle, ... cm s^{-1}
- maximum velocity at which the particle will be deposited. ..... cm s^{-1}

(ii) Explain why there is a difference between the minimum erosion velocity and the maximum deposition velocity for the particle. [2]

.....

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(b) Explain why the critical erosion velocity increases for particles smaller than 0.1 mm. [2]

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(c) **Figure 1b** is a sketch of a Quaternary sediment that has been interpreted as being part of a fluvioglacial deposit.

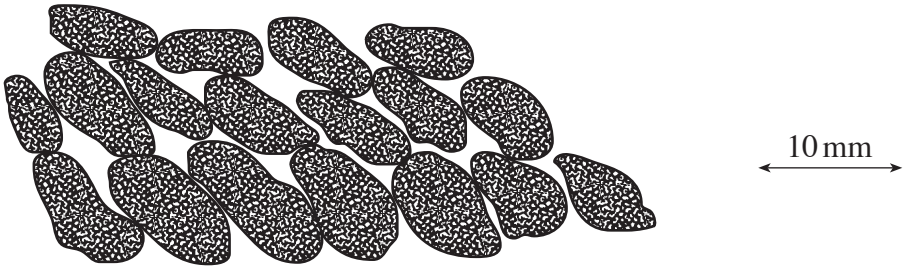

Figure 1b

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

(i) Give the maximum velocity at which the water was travelling to have deposited this sediment. [1]

.....

(ii) Describe and explain the sorting of particles shown in **Figure 1b**. [3]

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(d) *"This sediment has been interpreted as being of fluvioglacial rather than glacial origin."* Evaluate this statement. [3]

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Total 13 marks

2. **Figure 2a** is a simplified map showing the drainage patterns and geology of part of southern England.

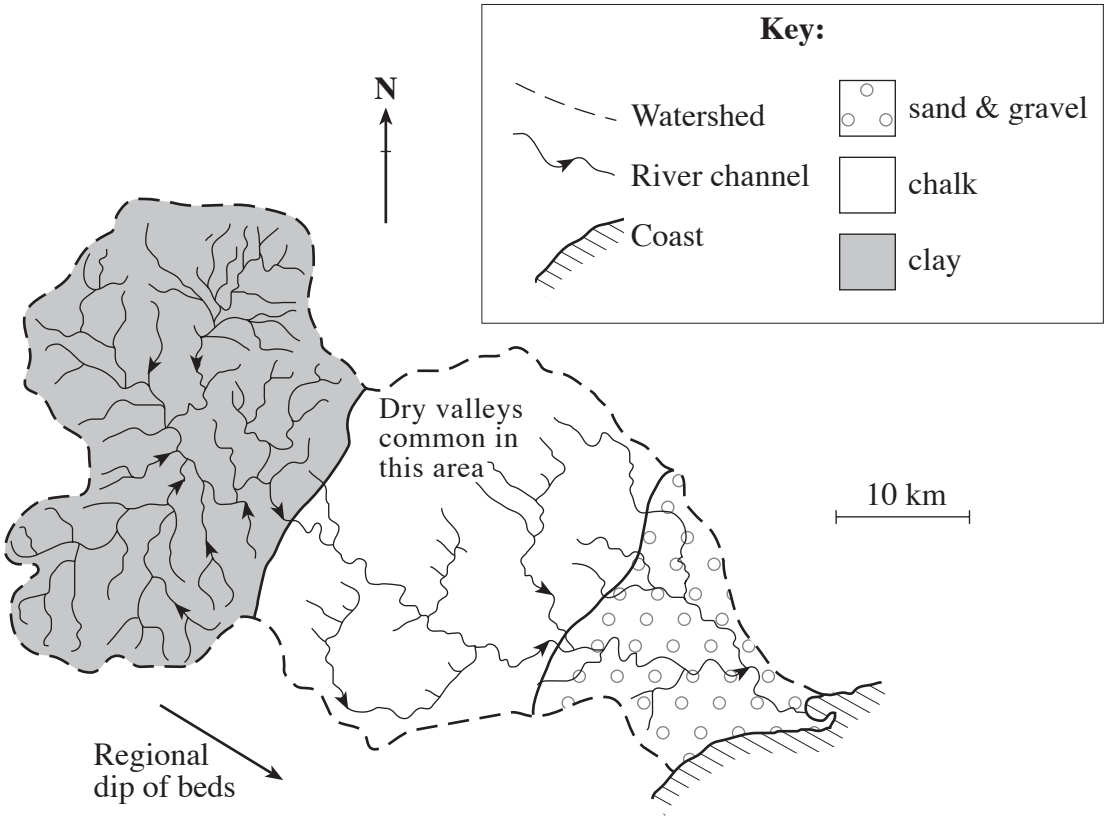

Figure 2a

(a) Refer to **Figure 2a**.

(i) Describe **two** differences between the drainage patterns in the area of clay and the area of chalk. [2]

1. .....

.....

2. .....

.....

(ii) Explain how the lithology has controlled the different drainage patterns in the clay and chalk areas. [3]

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(b) **Annotate Figure 2b** to show how the relief of part of the chalk area on **Figure 2a** may be related to the geological structure and the river drainage patterns. [3]

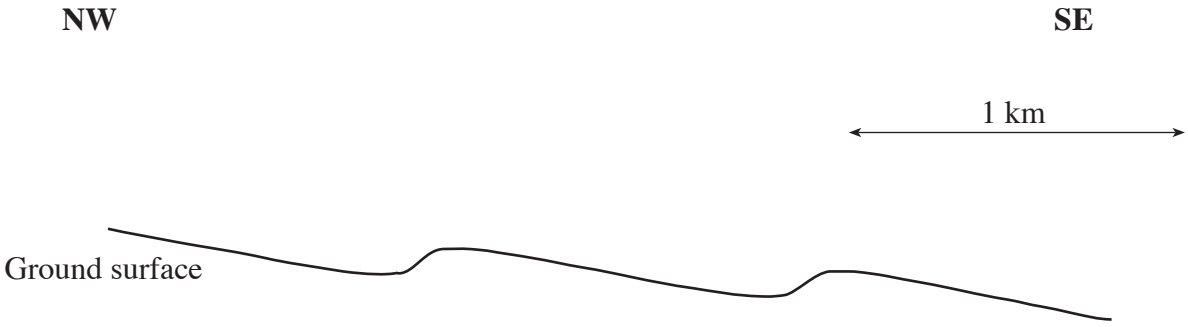

Figure 2b

(c) *"There are dry valleys in the chalk area that are thought to have been formed when the area was experiencing periglacial conditions."*
Evaluate this statement with reference to the processes that would create dry valleys. [4]

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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. *"There is a link between continental ice sheets and sea level."*
Evaluate this statement with reference to the geological evidence for sea level change. [25]

4. *(a)* Explain the link between sedimentary processes and products in modern turbidity current environments.

(b) Evaluate the use of sole structures in determining current directions in ancient turbidite deposits. [25]

5. *(a)* Explain how fossils can be used to provide evidence for Quaternary climatic fluctuations in Britain.

(b) Evaluate the use of Radiocarbon (^{14}C) dating in determining the duration and rate of these fluctuations. [25]

Examiner only

Turn over.

Examiner only

Examiner only

Turn over.

Examiner only

Candidate Name	Centre Number	Candidate Number
		2

GCE A level

455/02

GEOLOGY - GL5

THEMATIC UNIT 2

GEOLOGY OF NATURAL RESOURCES

A.M. FRIDAY, 13 June 2008

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 location of granites and hydrothermal mineral veins in West Cornwall.

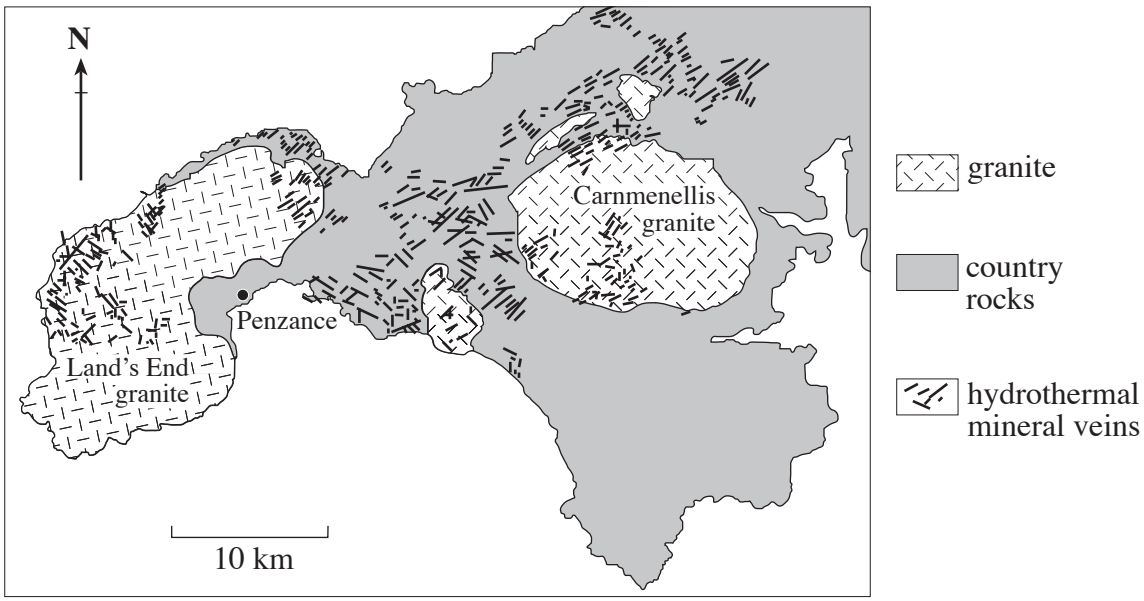

Figure 1a

(a) (i) State the 2 main trends of the hydrothermal mineral veins in **Figure 1a**. [2]

.....

.....

(ii) Describe the location and distribution of hydrothermal mineral veins in **Figure 1a**. [2]

.....

.....

(iii) Suggest an explanation for the trends of the hydrothermal mineral veins. [1]

.....

.....

Figure 1b is a suggested model for the origin of the hydrothermal mineral veins. Ore minerals found in the veins include cassiterite (containing tin), chalcopyrite (containing copper), galena (containing lead) and sphalerite (containing zinc).

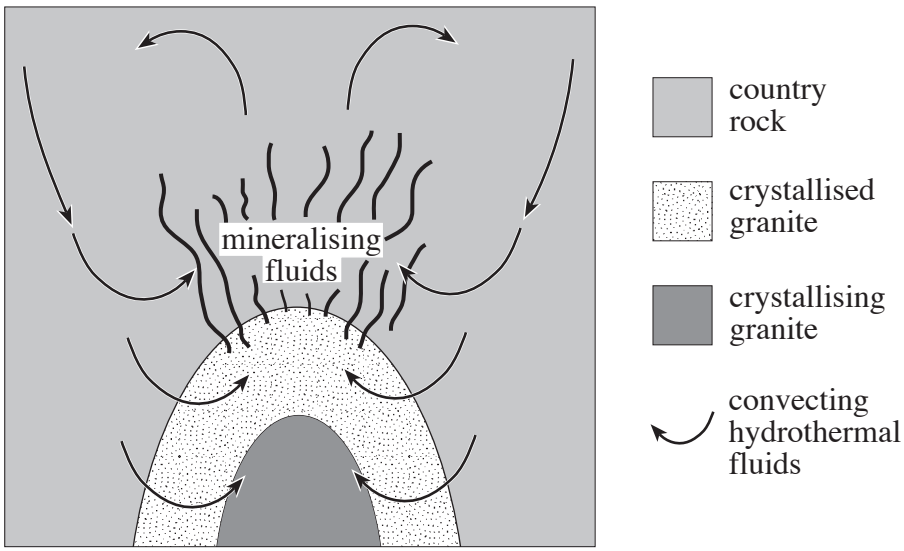

Figure 1b

(b) (i) Suggest **two** possible sources for the metals dissolved in the hydrothermal fluids. [2]

Source 1 .....

Source 2 .....

(ii) Using **Figure 1b** suggest **one** possible source of the water forming the hydrothermal fluids. [1]

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(iii) Explain why there is a convective circulation of hydrothermal fluids. [2]

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(c) Mining of the ores has shown that they are arranged in zones around the granites as shown in **Figure 1c**.

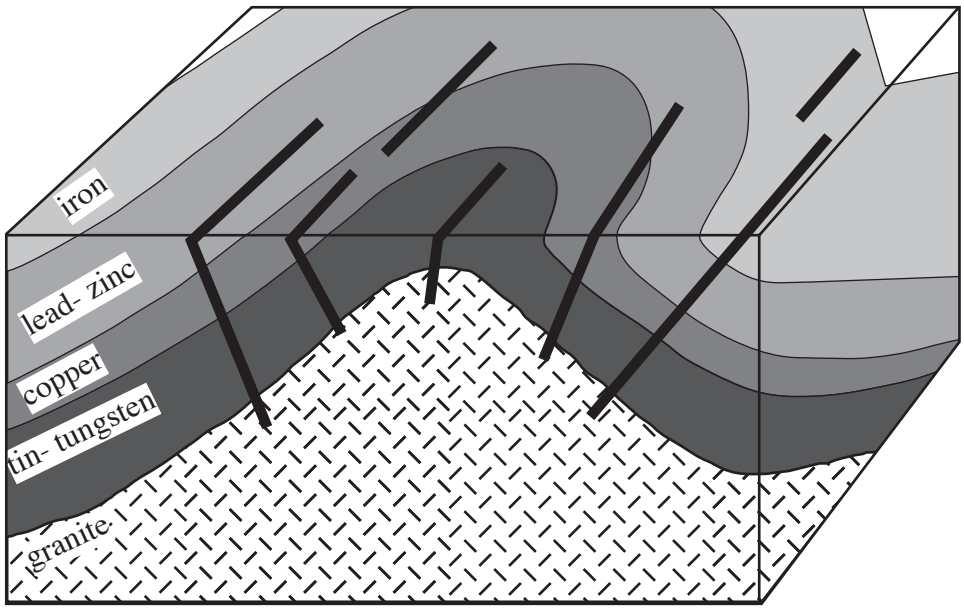

Figure 1c

Account for the arrangement of mineral rich zones around the granite intrusion. [3]

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Total 13 marks

2. **Figure 2a** shows a simplified cross section through the Brent oil and gas field in the northern North Sea.

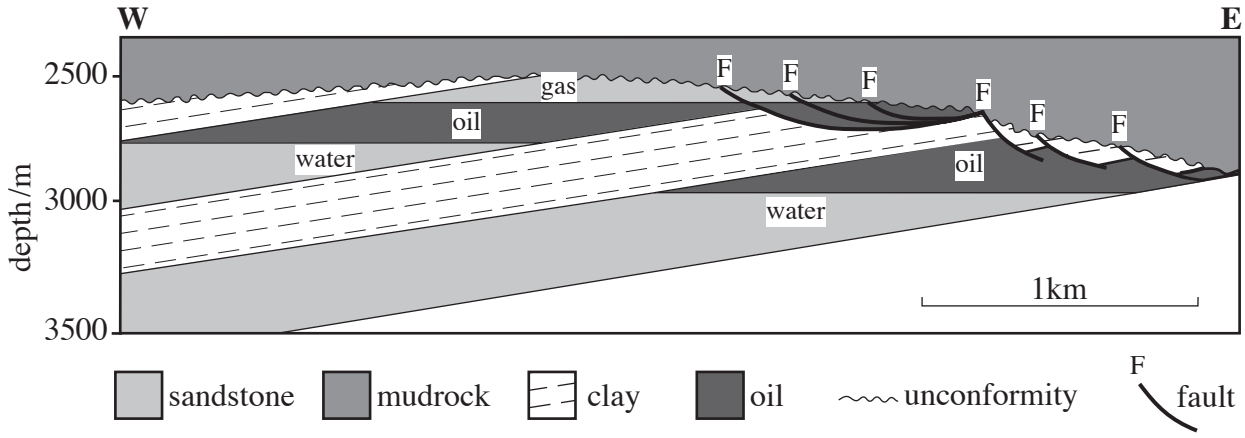

Figure 2a

(a) (i) Name **two** types of trap on **Figure 2a** that have allowed oil and gas to accumulate in the sandstone reservoir rocks. [2]

.....

.....

(ii) Suggest **two** possible migration routes for the oil from the clay source rock to the sandstone reservoirs. [2]

.....

.....

(iii) Describe and explain **one** characteristic of the sandstone that would make it a suitable reservoir rock. [3]

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(b) **Figure 2b** shows the relationship between depth of burial, temperature and the formation of hydrocarbon products.

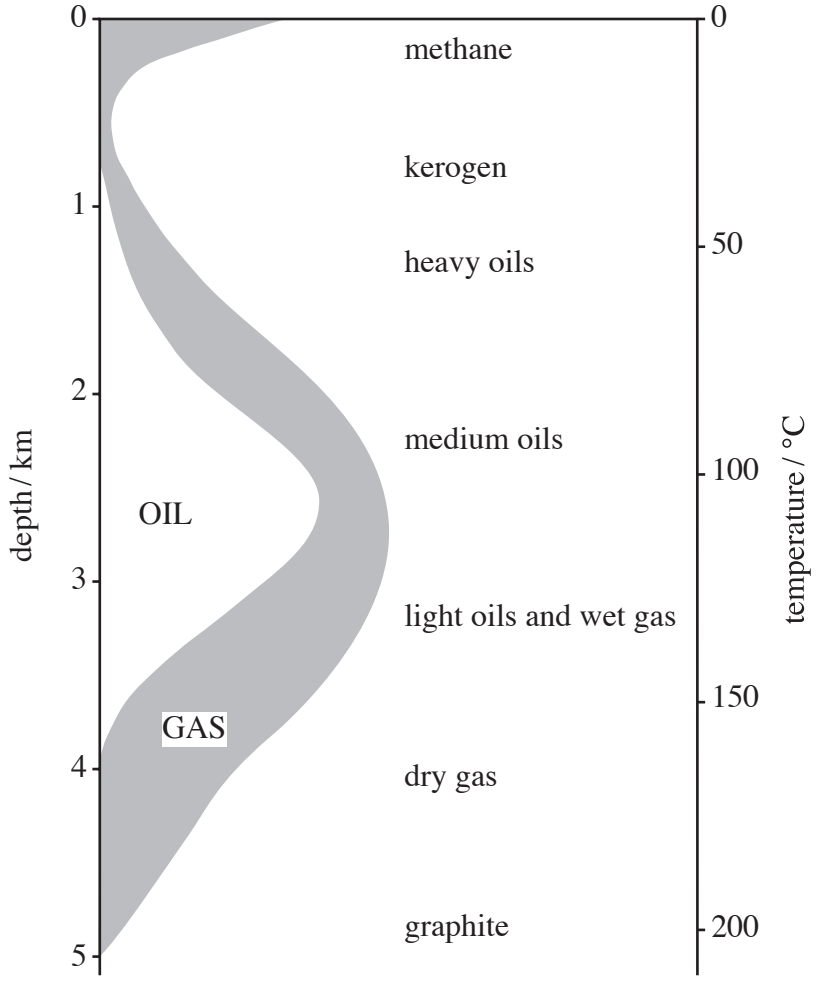

Figure 2b

(i) State the depth and temperature of peak oil formation. [2]

Depth ..... km

Temperature ..... °C

(ii) Suggest why there is no oil formed below 4 km depth and no gas beyond 5 km depth. [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. *(a)* Describe the method of extraction of **one** type of geological raw material (mineral or rock).

(b) Evaluate the potential environmental problems caused by the extraction of this named raw material and explain the ways in which these problems can be minimised. [25]

4. Evaluate the use of **two** of the following techniques in the exploration for mineral and energy resources:

Drilling and downhole logging;

Geophysical surveying;

Geochemical prospecting;

Geological mapping;

Satellite remote sensing. [25]

5. *(a)* Evaluate the suitability of the physical properties of **one** useful mineral **or** rock type in relation to its industrial application.

(b) Use a flow diagram to describe the processing steps by which **one** element **or** compound of industrial value is derived from its geological raw material. [25]

Examiner only

Examiner only

Turn over.

Examiner only

Examiner only

Candidate Name	Centre Number	Candidate Number
		2

GCE A level

455/03

GEOLOGY - GL5

THEMATIC UNIT 3

GEOLOGICAL EVOLUTION OF BRITAIN

A.M. FRIDAY, 13 June 2008

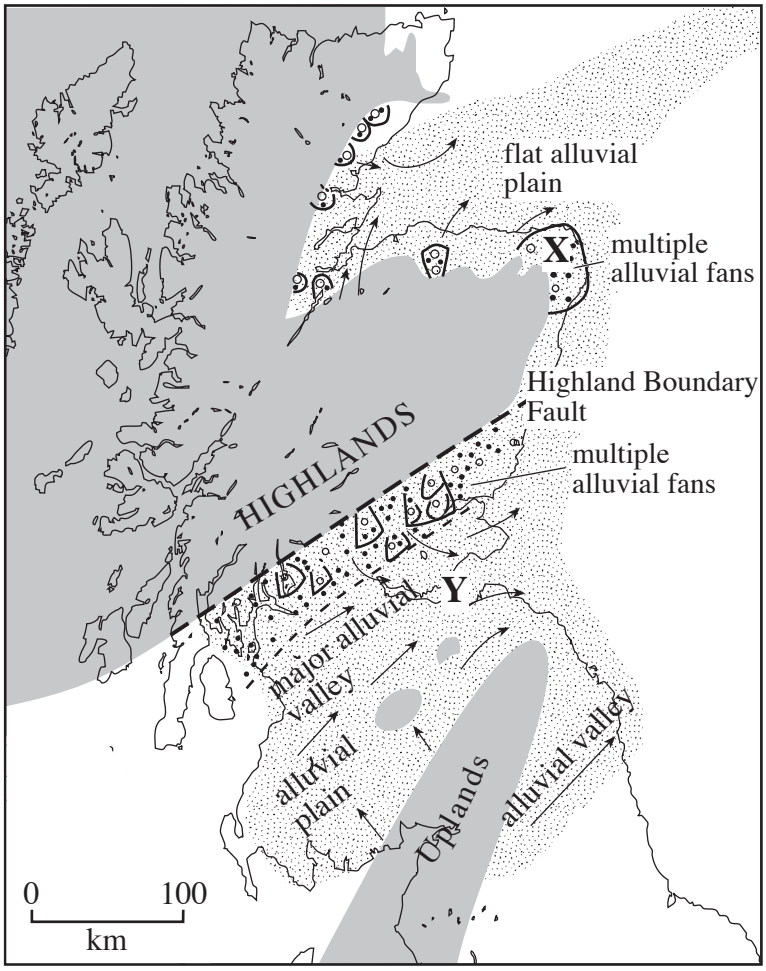
For Examiner's Use only.		
Section A	1	
	2	
Section B	3	
	4	
	5	
	Total 50	

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** is a palaeogeographic map of Northern Britain during the Devonian Period. **Figures 1b** and **1c** are graphic logs recorded at localities **X** and **Y** on **Figure 1a**.



Key

uplands area
current directions
alluvial deposits
sandstones

Figure 1a

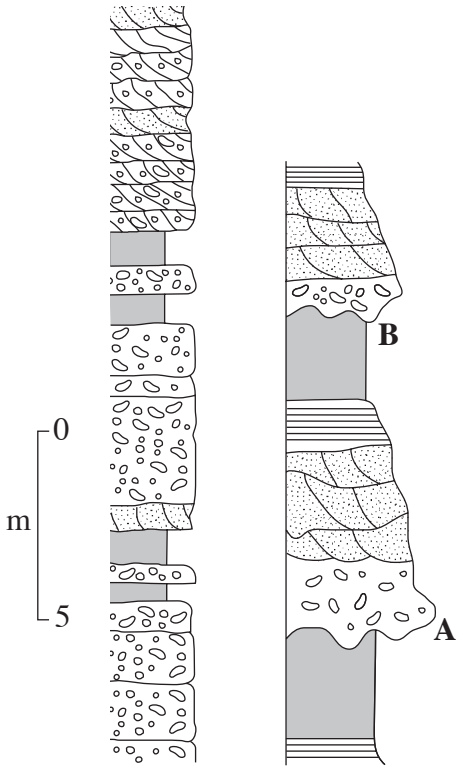


Figure 1b (X) **Figure 1c (Y)**

Key

mudstone
laminated siltstone
cross-bedded sandstone
poorly sorted conglomerate

(a) Alluvial fans as shown in **Figure 1a** are produced when rivers flowing out of a mountainous area deposit their load on a flat plain.

(i) Describe the location of the alluvial fans on **Figure 1a**. [3]

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.....

.....

(ii) Explain how **one** piece of evidence from the sediments in **Figure 1b** could be used to confirm their origin as an alluvial fan deposit. [3]

Evidence .....

Explanation .....

.....

.....

.....

(iii) Use a labelled diagram to show how **one** piece of field evidence might be used to confirm the current directions shown in **Figure 1a**. [2]

(b) (i) Describe the pattern of grain size variation between **A** and **B** in **Figure 1c**. [1]

.....

(ii) Suggest how the variation in grain size and types of sedimentary structures in **Figure 1c** indicate changes in current velocity. [3]

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(iii) State the likely environment of deposition of the sediments in **Figure 1c**. [1]

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Total 13 marks

2. **Figures 2a** and **2b** show the igneous features of the Tertiary Igneous Province of northwest Britain. **Figure 2c** shows the geology of part of the Isle of Skye.

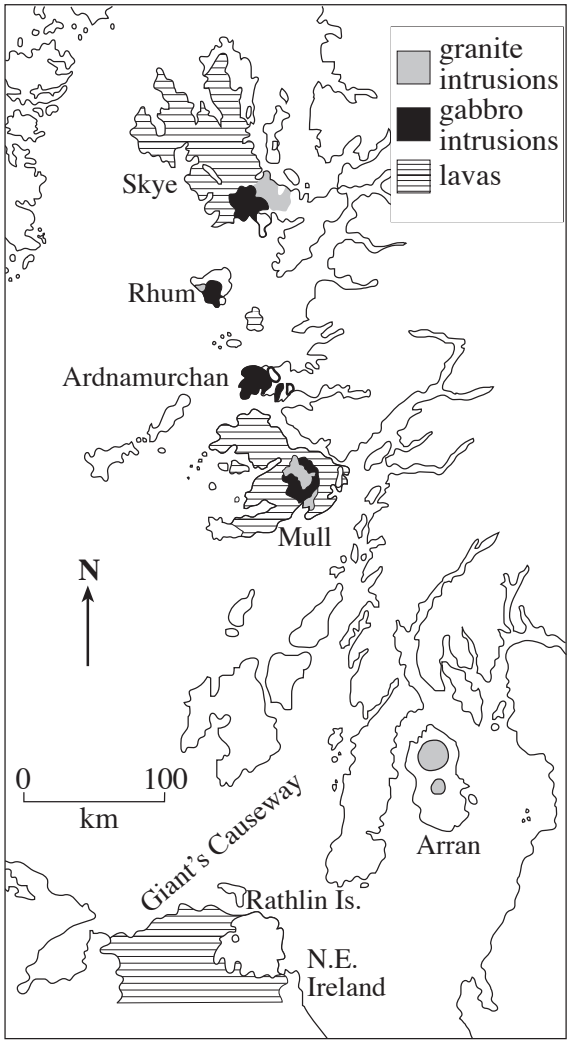

Figure 2a

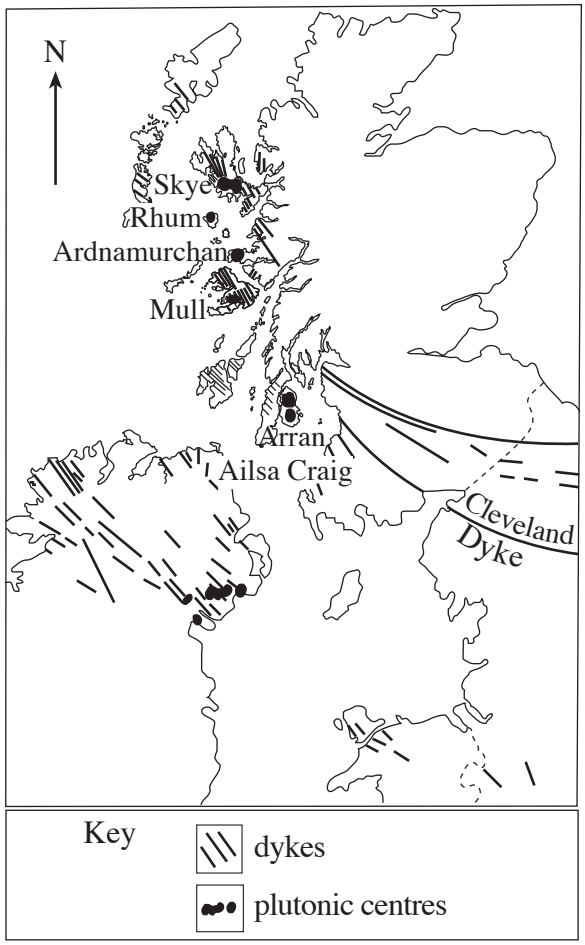

Figure 2b

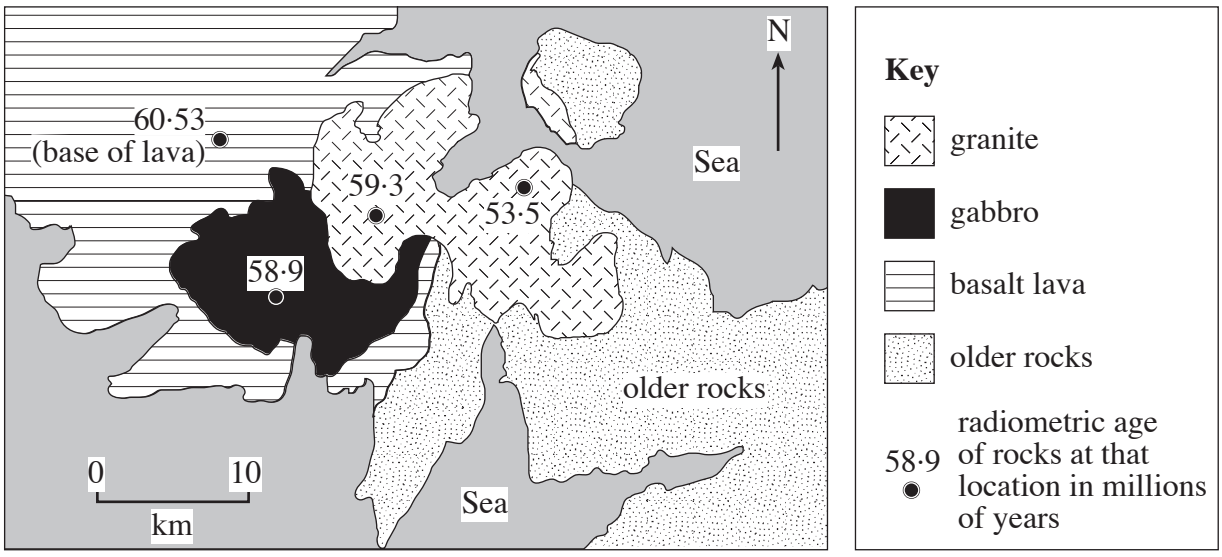

Figure 2c

(a) Refer to **Figures 2a** and **2b**.

(i) Over 98% of the Tertiary lavas that erupted were basalts and are now found tens of kilometres away from their point of eruption. Explain the wide geographical extent of the lava flows. [1]

.....

(ii) Describe the distribution and trend of the plutonic centres and dykes. [3]

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(b) **Figure 2c** is a simplified geological map of the central part of the Isle of Skye showing the field relationships and radiometric dates of the basalt lavas, granite intrusion and gabbro intrusion.

(i) From the radiometric dates, calculate the length of time taken to erupt the lavas on Skye. [1]

.....

(ii) Consider the map evidence and radiometric dates of the granite and gabbro. Stating your reasons, suggest the relative ages of the granite and gabbro intrusions. [3]

.....

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.....

(iii) With the majority of the lava being composed of basalt, gabbro would be the rock expected to form the plutonic centres. Suggest **one** reason for the presence of the granitic rocks in the plutonic centres. [1]

.....

(c) Explain the origin of the Tertiary igneous activity shown in **Figures 2a**, **2b** and **2c** in terms of plate tectonics. [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. *"During the early Palaeozoic the northern and southern parts of Britain were on different continents separated by the Iapetus Ocean."* Describe and evaluate the geological evidence which supports this statement. [25]

4. *"The effects of three major orogenies (Caledonian, Variscan and Alpine) can be demonstrated in Britain."* Describe and evaluate the geological evidence which supports this statement. [25]

5. Palaeomagnetic evidence suggests that Britain drifted north across the Equator in the Late Palaeozoic (Carboniferous and Permian).

(a) Describe the effects of drifting through the respective climatic zones on the sediments and fossils during the Late Palaeozoic.

(b) Evaluate the reliability of the palaeomagnetic evidence. [25]

Examiner only

Turn over.

Examiner only

Examiner only

Examiner only

Candidate Name	Centre Number	Candidate Number
		2

GCE A level

455/04

GEOLOGY GL5

THEMATIC UNIT 4

GEOLOGY OF THE LITHOSPHERE

A.M. FRIDAY, 13 June 2008

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** is a block diagram showing a section of an orogenic belt.

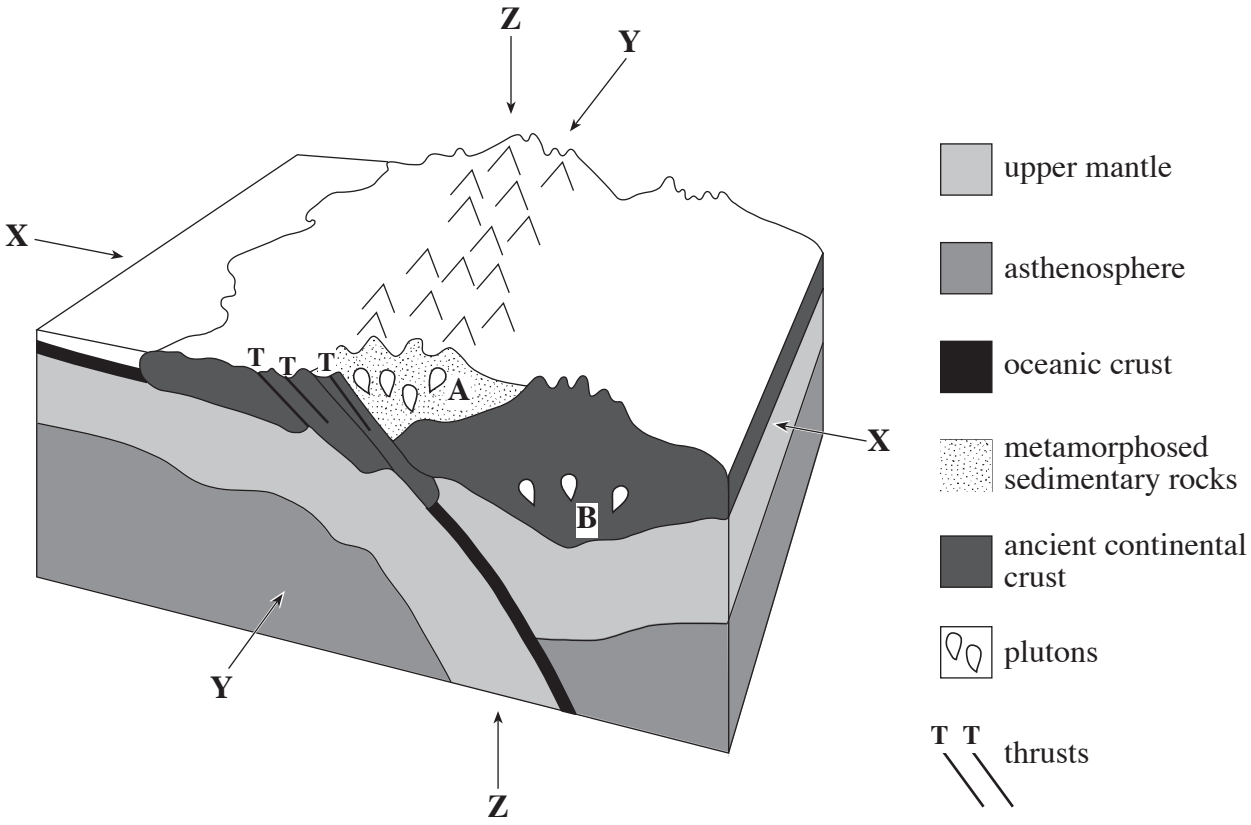

Figure 1a

(a) **X**, **Y** and **Z** show the directions of the three principal stresses which were responsible for the formation of the orogenic belt. Complete the table below to match the stresses (σ_{min}, σ_{int}, σ_{max}) with their correct directions. [2]

Direction	Principal stress
X	
Y	
Z	

(b) Plutons at **A** on **Figure 1a** form due to the partial melting of metamorphosed sedimentary rocks. The pressure-temperature conditions are shown in **Figure 1b**.

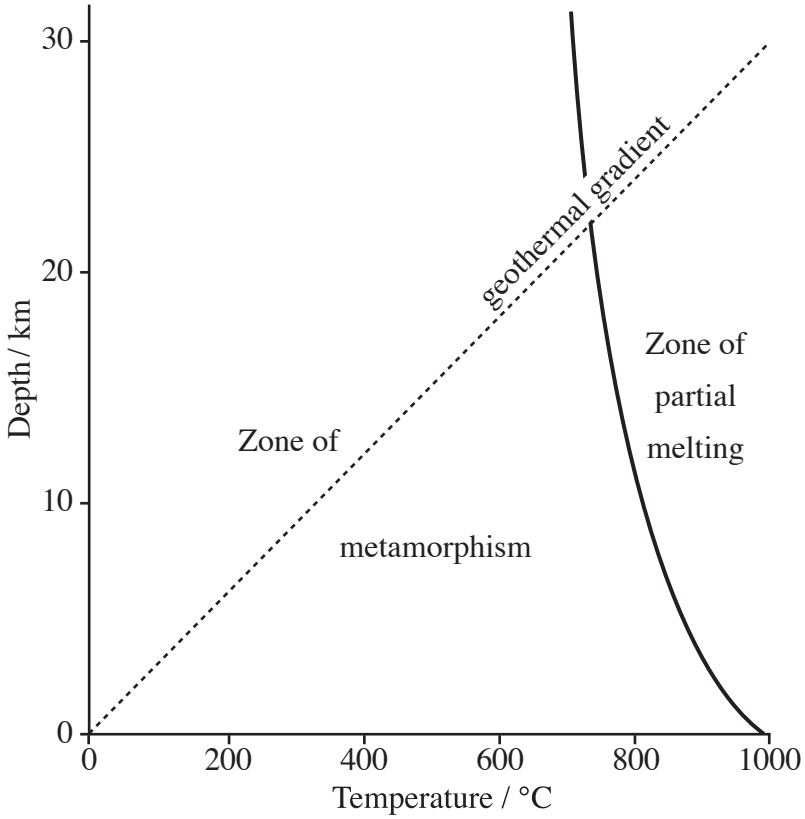

Figure 1b

Using **Figure 1b**, calculate the geothermal gradient in region **A**.
Show your working. [2]

Geothermal gradient ..... °C/km

(c) The plutons at **B** on **Figure 1a** are linked to the partial melting of subducted oceanic crust. The pressure-temperature conditions are shown in **Figure 1c**.

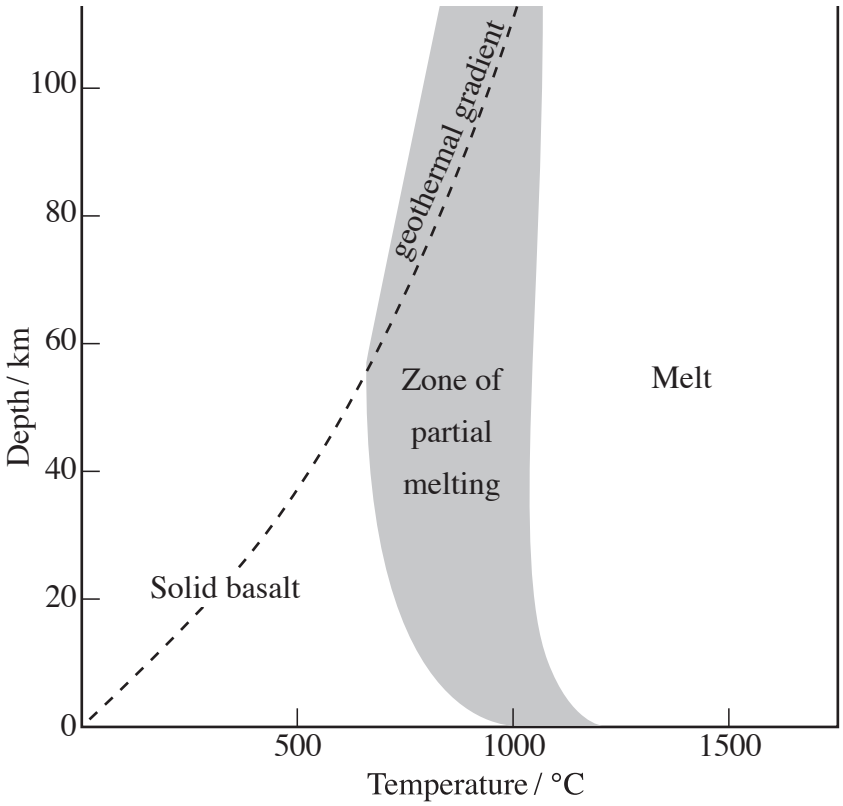

Figure 1c

(i) Given the geothermal gradient shown in **Figure 1c**, state the temperature and depth at which ocean crust would be expected to start melting. [2]

Temperature ..... °C

Depth ..... km

(ii) Suggest why the basalt being subducted is likely to be wet (have a high water content). [1]

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.....

(d) Account for the fact that the plutons at **A** in **Figure 1a** have an overall granitic composition. [2]

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(e) The plutons at **B** in **Figure 1a** are likely to range in composition from andesitic to granitic. Suggest reasons for the variation in the compositions of the plutons. [4]

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Total 13 marks

2. **Figures 2a** and **2b** show sketch cross-sections of the faulting parallel to the ridge axis at a fast and a slow spreading ridge system.

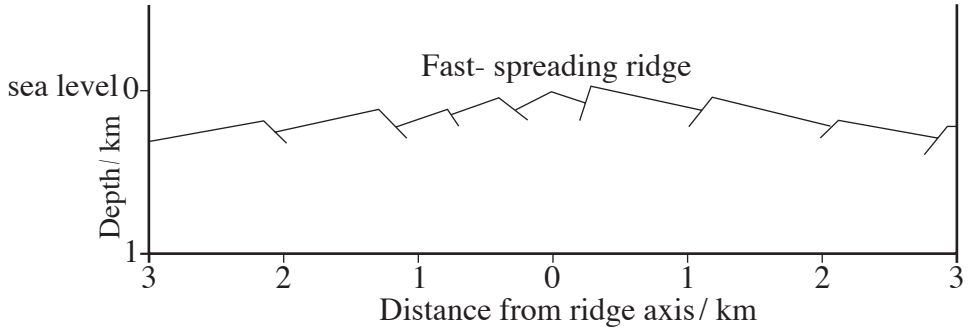

Figure 2a

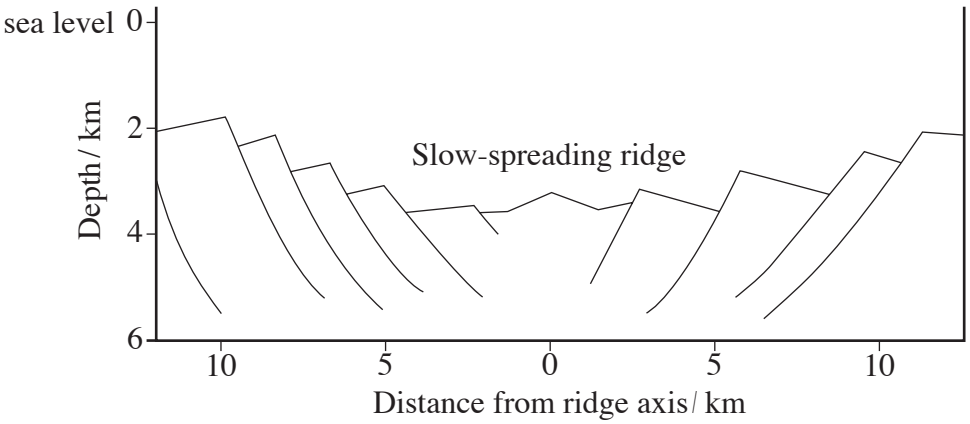

Figure 2b

(a) (i) State the type of faulting that occurs at **both** of the ridge systems. [1]

.....

(ii) Suggest what this faulting indicates about the types of stresses acting at both of the ridges. [1]

.....

(b) State and explain **one** difference between the two ridges. [2]

Difference .....

Explanation .....

.....

(c) **Figure 2c** shows a transform fault (**T-T**) at right angles to the ridge axis (**R-R**). **Figure 2d** is a map of the transform fault and the displaced ridge plus three locations marked **X**, **Y** and **Z**.

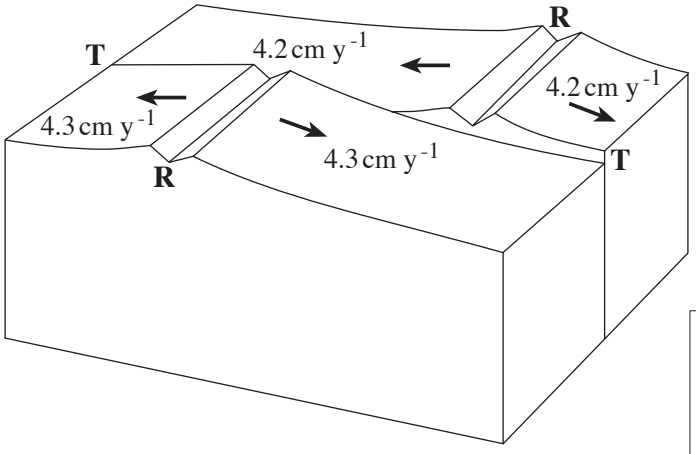

Figure 2c

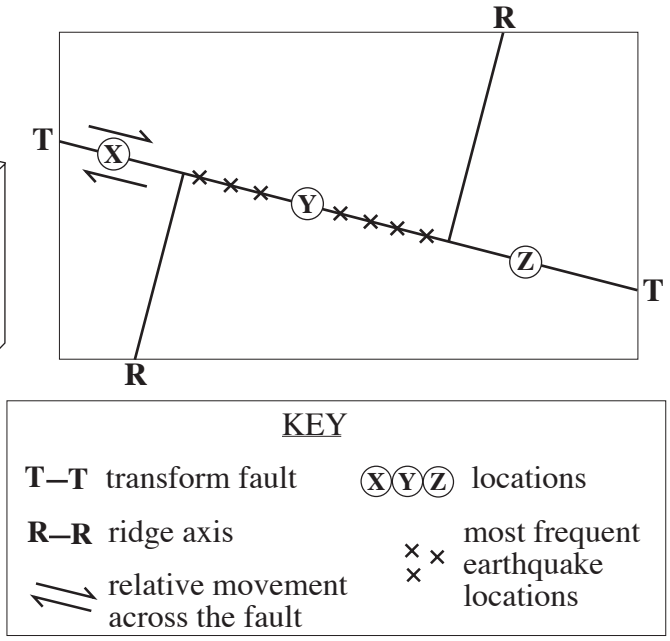

Figure 2d

(i) Using **Figures 2c** and **2d**, calculate the relative rate of movement across the transform fault **T** at locations **Y** and **Z**. Show your working. The calculation for **X** has been completed. [4]

Relative rate at **X**: $4.3 - 4.2 = 0.1\,\text{cm y}^{-1}$

Relative rate at **Y**: .....

Relative rate at **Z**: .....

(ii) Using the symbols shown in the key, on **Figure 2d** show the **relative** movement across the transform fault **T-T** at **Y** and **Z**. The **relative** movement at **X** is shown. [2]

(iii) Earthquakes are most frequent along the portion of the transform fault indicated on **Figure 2d**. Earthquakes are less frequent on the other sections of the fault. Suggest a reason(s) for this difference in frequency. [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 heat is lost through the Earth's lithosphere and evaluate the relative importance of the processes that you describe. [25]

4. *(a)* Describe how forces acting on continental lithosphere may cause brittle or ductile deformation.

(b) Evaluate the importance of the depth in the lithosphere on the types of deformation produced. [25]

5. Describe how a rate of seafloor spreading may be calculated. Evaluate the accuracy of any method(s) you describe. [25]

Examiner only

Turn over.

Examiner only

Examiner only