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455/01

GEOLOGY GL5

THEMATIC UNIT 1

QUATERNARY GEOLOGY

P.M. TUESDAY, 20 June 2006

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 corries/cwms (a glacial landform) of part of Snowdonia, North Wales. **Figure 1b** shows the interpretation of ice flow direction in the corries/cwms, based on field measurements.

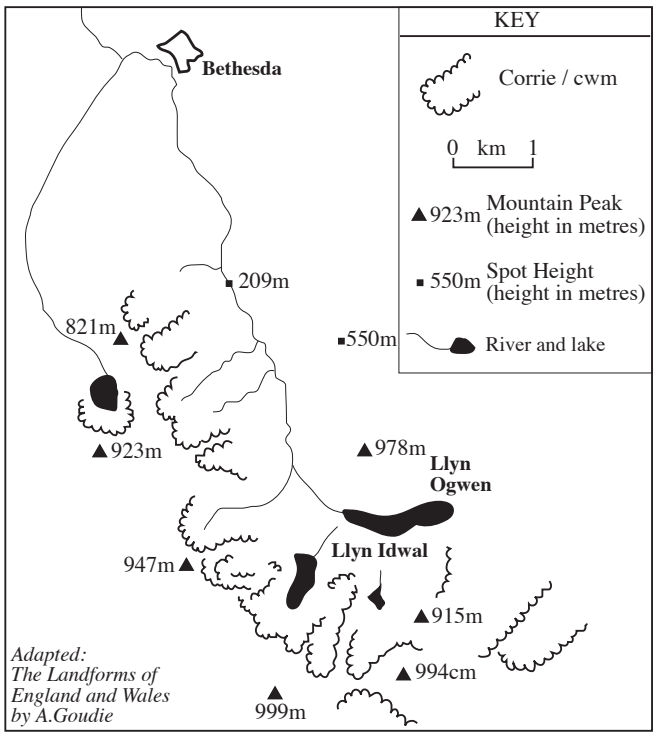

Figure 1a

Direction	Number of measurements
0 – 30°C	2
30 – 60°C	0
60 – 90°C	9
90 – 120°C	0
120 – 150°C	0
150 – 180°C	0
180 – 210°C	0
210 – 240°C	0
240 – 270°C	0
270 – 300°C	2
300 – 330°C	0
330 – 0°C	3

Figure 1b

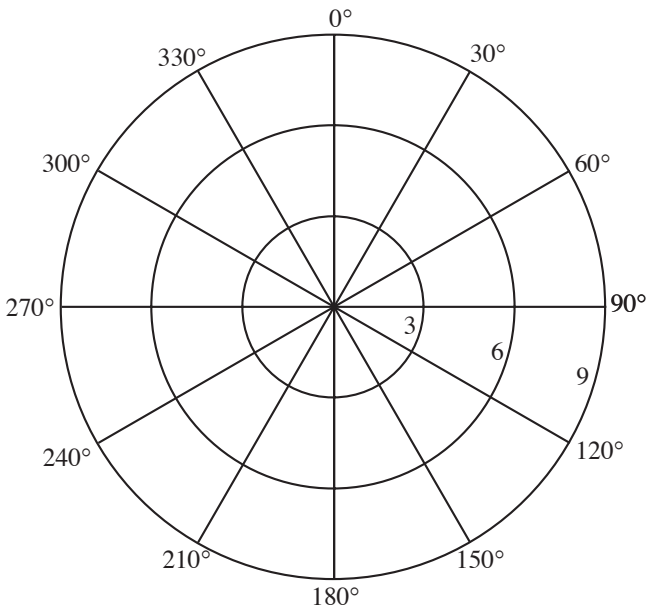

Figure 1c

(a) (i) Using the data in **Figure 1b**, complete the rose diagram (**Figure 1c)** to show directions of ice movement. [2]

(ii) Describe the directions of ice movement indicated by the data in **Figures 1a** and **1b** and plotted on the rose diagram in **Figure 1c**. [2]

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(iii) Explain how **one** named type of field evidence may provide the data on the direction of ice movement. [3]

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(b) (i) **Figure 1a** suggests that ice accumulated particularly on northeast-facing slopes. Account for the accumulation of more ice on slopes facing in this direction. [2]

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(ii) The southwest-facing slope near the 550 metre spot height shows evidence of periglacial activity. Describe and explain **one** process that is likely to have occurred at this location. [3]

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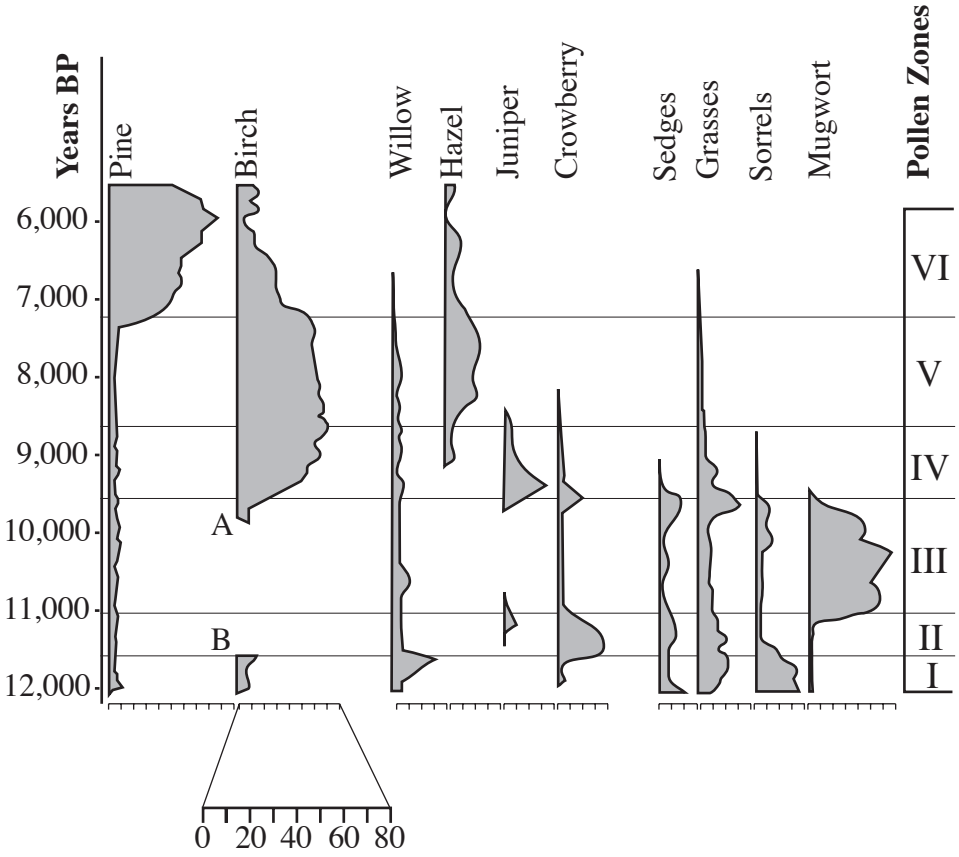
Total 12 marks

2. **Figure 2a** is a pollen diagram from lake sediments in the Cairngorms, northern Scotland.



Horizontal scale in increments of 10% of total land pollen

Adapted from: Cairngorms, A landscape fashioned by geology: SNH

Figure 2a

(a) (i) Complete the pollen diagram between points **A** and **B** by plotting on **Figure 2a** the pollen results for **Birch** given in **Figure 2b**. [2]

Years BP	% of total land pollen for Birch
10,500	10
11,000	11
11,500	32

Figure 2b

(ii) Describe the changes in the occurrence of Pine shown in **Figure 2a**. [2]

.....

.....

.....

(iii) Describe the changes in the vegetation between pollen zones III and IV indicated on **Figure 2a**. [3]

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(b) No pollen older than 12,000 years BP is found in these sediments. Suggest **two** reasons that might account for the absence of pollen from before that date. [2]

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(c) Evaluate the use of pollen as an indicator of climatic fluctuations in the Quaternary. [4]

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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. Using examples that you have studied, explain how **three** of the following may influence topography.

- Dipping strata
- Folds
- Faults
- Joints
- Igneous bodies [25]

4. Turbidite sequences are well represented in the rock record and many are thought to have been deposited by turbidity currents in oceans.

(a) Explain the origin and characteristics of turbidity currents.

(b) Explain how **two** sedimentary structures were formed by the processes occurring in a turbidity current. [25]

5. Explain how changing quantities of continental ice can affect sea levels. Describe how the Quaternary record provides evidence of such sea-level changes. [25]

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455/02

GEOLOGY GL5

THEMATIC UNIT 2

GEOLOGY OF NATURAL RESOURCES

P.M. TUESDAY, 20 June 2006

For Examiner's Use only.

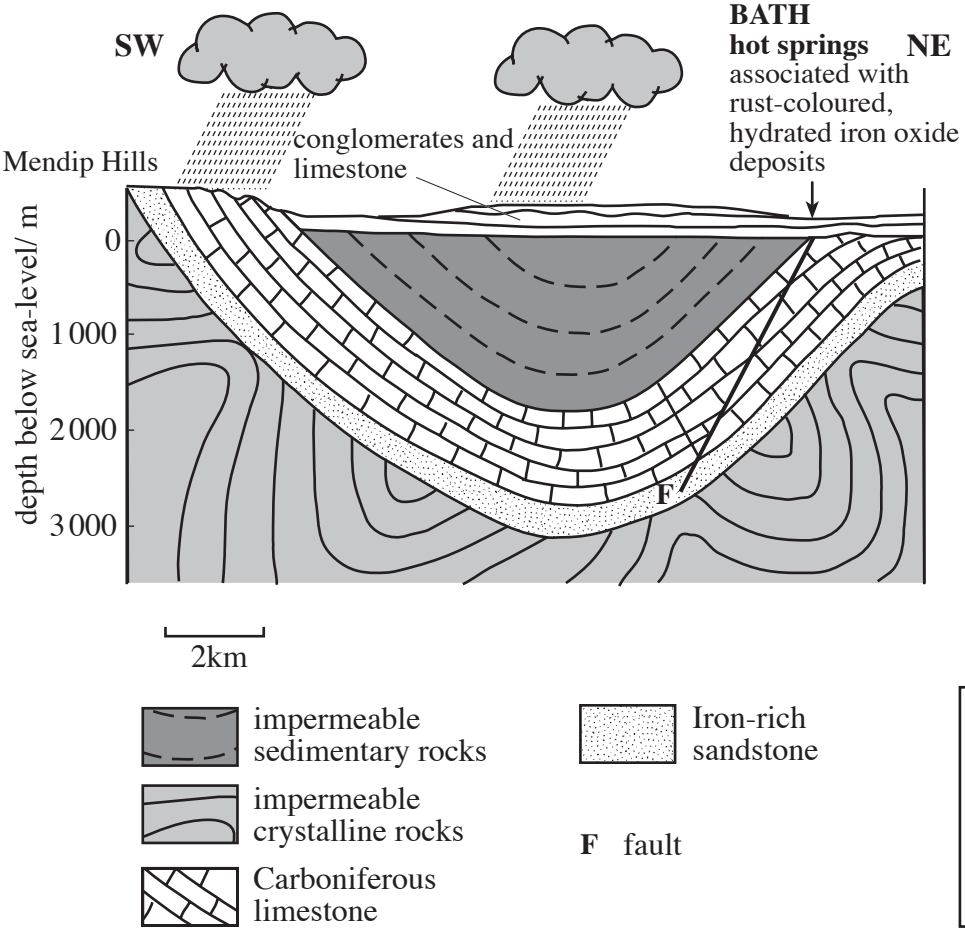
Section A	**1**	
	2	
Section B	**3**	
	4	
	5	
	Total 50	

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. *(a)* **Figure 1** is a simplified geological section through the aquifer around Bath, from which hot springs emerge at temperatures of 40 °C to 50 °C.



Source: S268 Block 5 Part 1 *The Open University 1995*

Figure 1

Refer to **Figure 1**.

(a) (i) State what is meant by the term **aquifer**. [1]

.....

.....

(ii) Clearly label **Figure 1** to show the position of a major aquifer. [1]

(b) The average geothermal gradient is 25 °C km^{-1}. Calculate the temperature of rock at a depth of 3000 m below sea level.
Show your working. [2]

Temperature ..... °C

(c) (i) Using arrows (⟶ ⟶), show, on **Figure 1**, the probable pathway for the flow of groundwater which results in hot springs at Bath. [2]

(ii) Explain how the following geological factors have contributed to the hot springs at Bath:

1. rock type;

2. geological structure. [5]

Rock type .....

.....

.....

.....

Geological structure .....

.....

.....

.....

(d) Explain the formation of the hydrated iron oxide deposits associated with the hot springs. [2]

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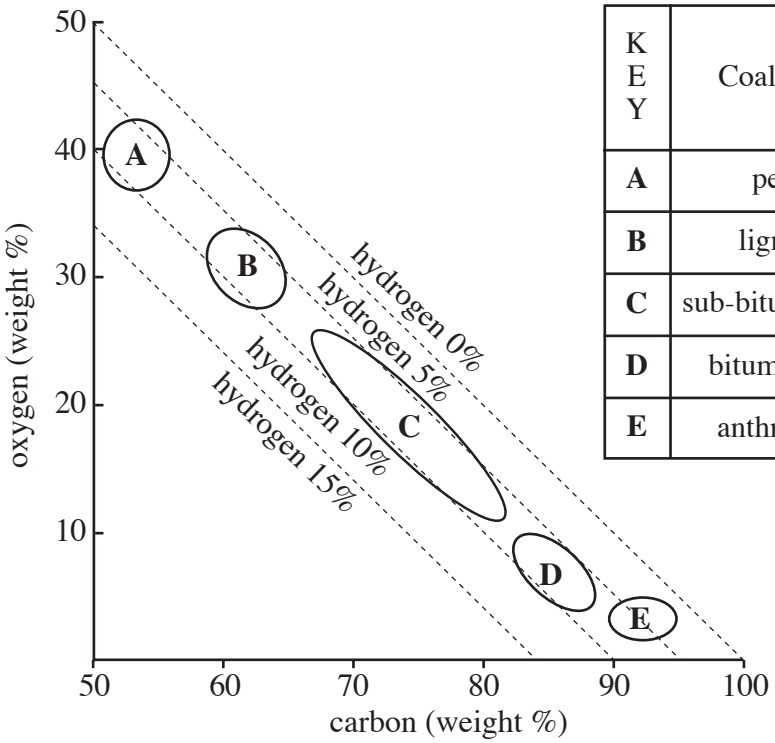
Total 13 marks

2. **Figure 2a** shows the relationship between three of the chemical elements (carbon, hydrogen and oxygen) of the coal rank series.



KEY	Coal type	Volatile content (weight %)	Increase in rank	(Box **X**) Increase in density
A	peat	55	↓	
B	lignite	45		
C	sub-bituminous	45		
D	bituminous	35		
E	anthracite	10		

Source:
S268 Block 4
The Open University 1995

Figure 2a

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

(i) With an increase in rank, state which chemical element shows :

1. a reduction in percentage;

2. least change in percentage.

[2]

1. Reduction in percentage .....

2. Least change .....

(ii) Draw an arrow in the box labelled **X** to show how the density of coal is related to its rank. Explain your answer. [2]

.....

.....

(b) Using your knowledge, explain how you would distinguish between the following coals in hand specimen.

(i) Peat and Lignite. [2]

.....

.....

.....

(ii) Bituminous coal and Anthracite. [2]

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(c) Discuss the relationship between coal formation and the formation of natural gas. [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. With reference to the quarrying **or** mining of one or more geological raw materials, explain how the environment can be protected and the effects of pollution limited. [25]

4. *(a)* Describe the formation of **one named** bulk mineral deposit and assess its economic importance in the construction industry.

(b) Explain the **processing** steps by which **one named** element or compound of industrial value is derived from a geological raw material. [25]

5. Evaluate the use of **two** of the following techniques in the exploration of mineral and/or energy resources:

(i) geological mapping;

(ii) geochemical prospecting;

(iii) satellite remote sensing;

(iv) seismic reflection. [25]

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455/03

GEOLOGY GL5

THEMATIC UNIT 3

GEOLOGICAL EVOLUTION OF BRITAIN

P.M. TUESDAY, 20 June 2006

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 cross-section between Moreton-in-Marsh and the Mendip Hills. The Inferior Oolite (a division of the Jurassic) is divided into the Lower, Middle and Upper Inferior Oolite. **Figure 1b** shows simplified sedimentary logs of the Inferior Oolite and underlying rocks at the four locations shown. **Figure 1c** is a field sketch of a quarry at Vallis Vale in the Mendip Hills.

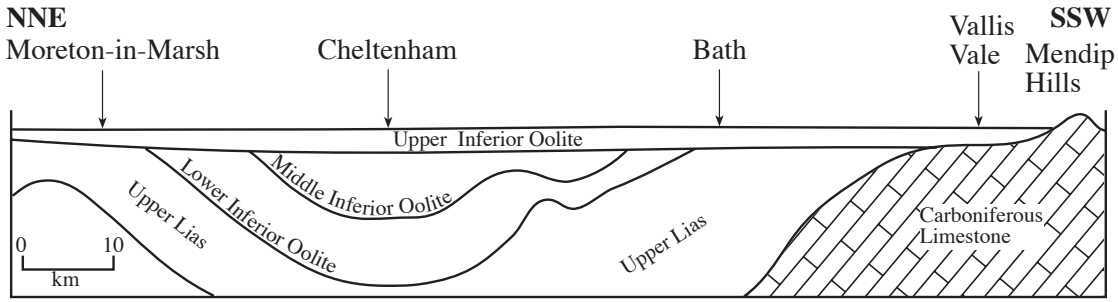

Figure 1a

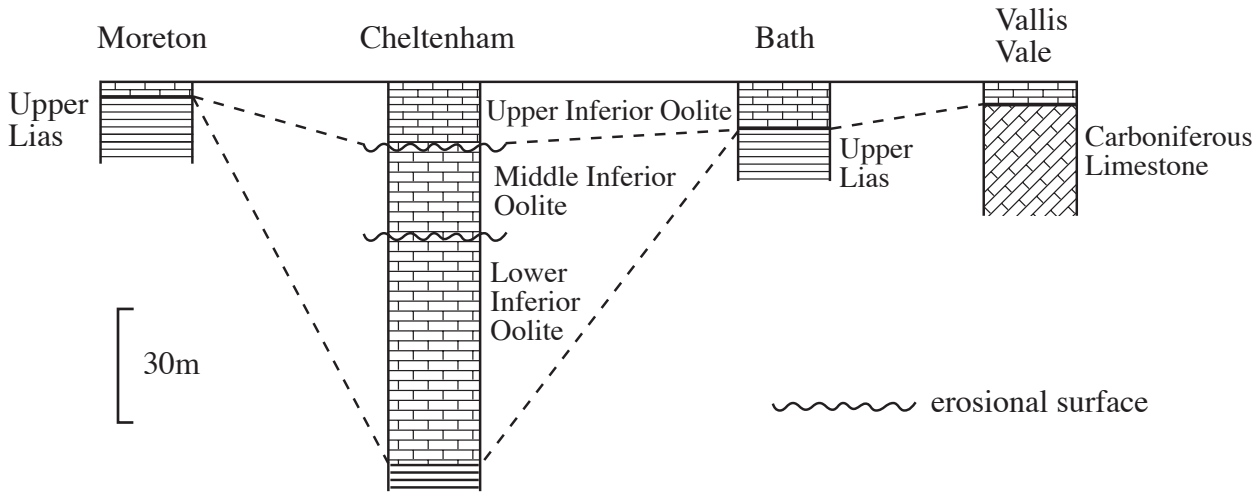

Figure 1b

Upper Inferior Oolite - yellow, oolitic limestone with worn and broken brachiopods. Horizontal bedding with conglomerate at the base. The conglomerate lies on a bored surface covered with bivalves.

Carboniferous Limestone - beds dipping at 40° North. Grey, massively bedded, shelly limestone with colonial corals in position of growth.

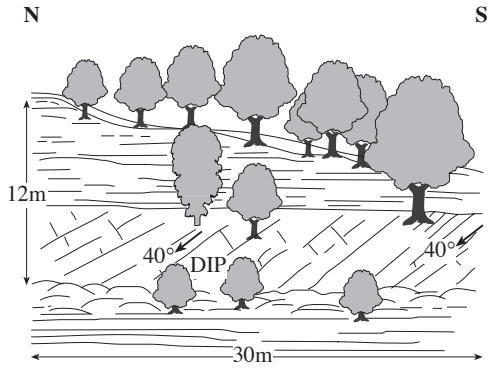

Figure 1c

(a) Using **Figure 1a** and **Figure 1c**, name the type of boundary between the **Upper Inferior Oolite** and the underlying beds. Give **one** reason for your answer. [2]

Type of boundary .....

Reason .....

.....

(b) Refer to **Figure 1b**.

(i) Measure the thickness of the **Inferior Oolite** sediments at Cheltenham and Vallis Vale. [1]

Cheltenham ..... m Vallis Vale ..... m

(ii) Give **two** possible reasons for the difference in thickness between these two locations. [2]

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(c) (i) Using evidence from **Figure 1c**, describe **two** characteristics of the environment of deposition of the **Upper Inferior Oolite** at Vallis Vale. [4]

Characteristic .....

Evidence .....

.....

Characteristic .....

Evidence .....

.....

(ii) Contrast the environment of deposition of the **Carboniferous Limestone** and the **Upper Inferior Oolite** at Vallis Vale as shown in **Figure 1c**. [3]

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Total 12 marks

Turn over.

2. *(a)* **Figure 2a** shows North America and Europe fitted together prior to the opening of the North Atlantic and also shows their apparent polar wandering curves.

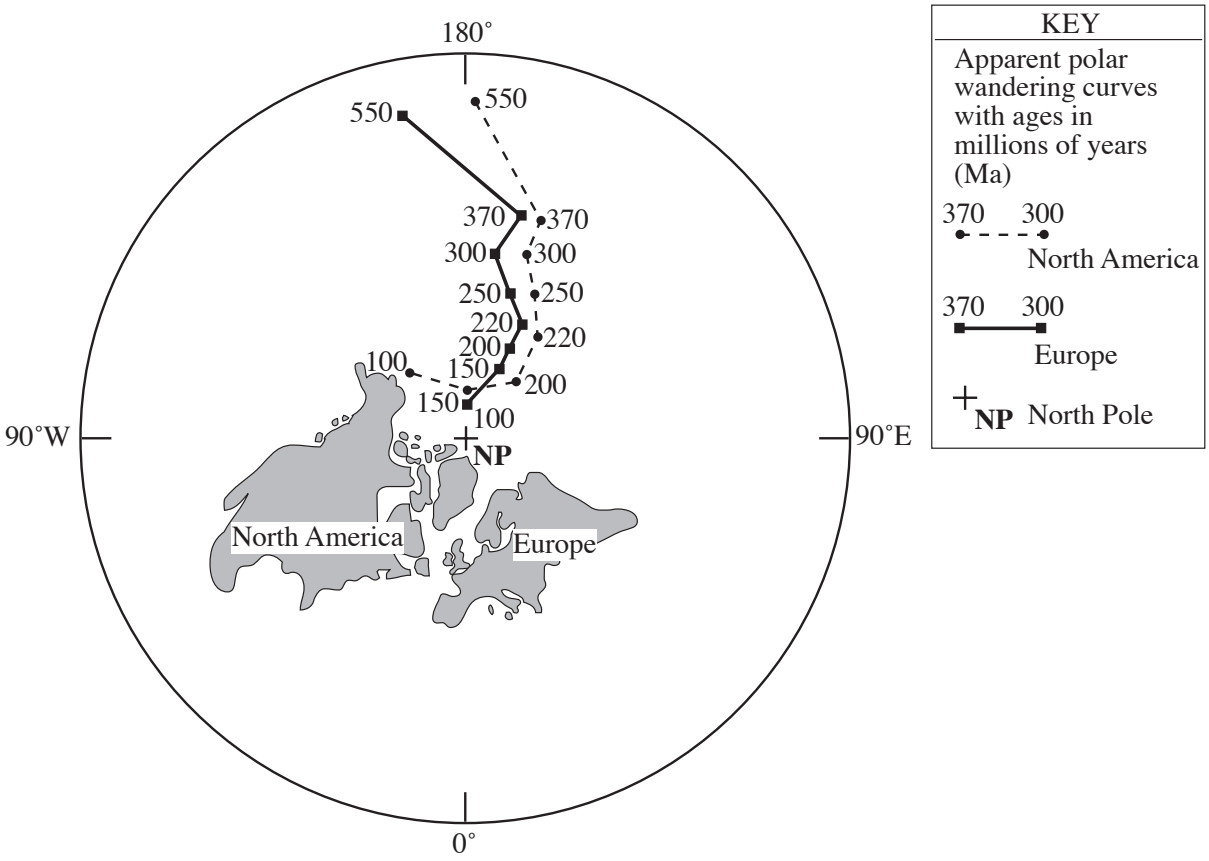

Figure 2a

(i) Apparent polar wandering curves can be used to identify continental movements. Complete the table below using **Figure 2a**, to suggest whether North America and Europe were joined or separated at particular times. Also suggest a time for the opening of the North Atlantic using **Figure 2a**. [3]

Age	North America and Europe joined or separated
Prior to 370 Ma the apparent polar wandering curves for North America and Europe follow different paths.	.....
After 370 Ma the apparent polar wandering curves for North America and Europe follow similar paths until the opening of the North Atlantic.	.....
..... Ma	The North Atlantic opened.

(ii) Explain why the curves are termed **apparent** polar wandering curves. [2]

.....

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(b) **Figure 2b** shows the angle of inclination (dip) of a freely suspended magnetised needle at various latitudes on the Earth's surface. **Figure 2c** is a log of sedimentary red beds from the Devonian of southwest England.

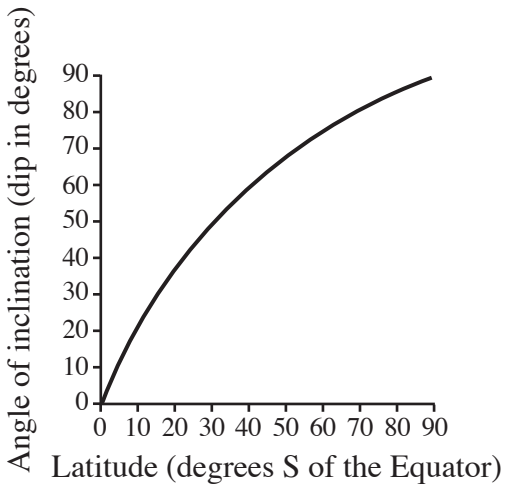

Figure 2b

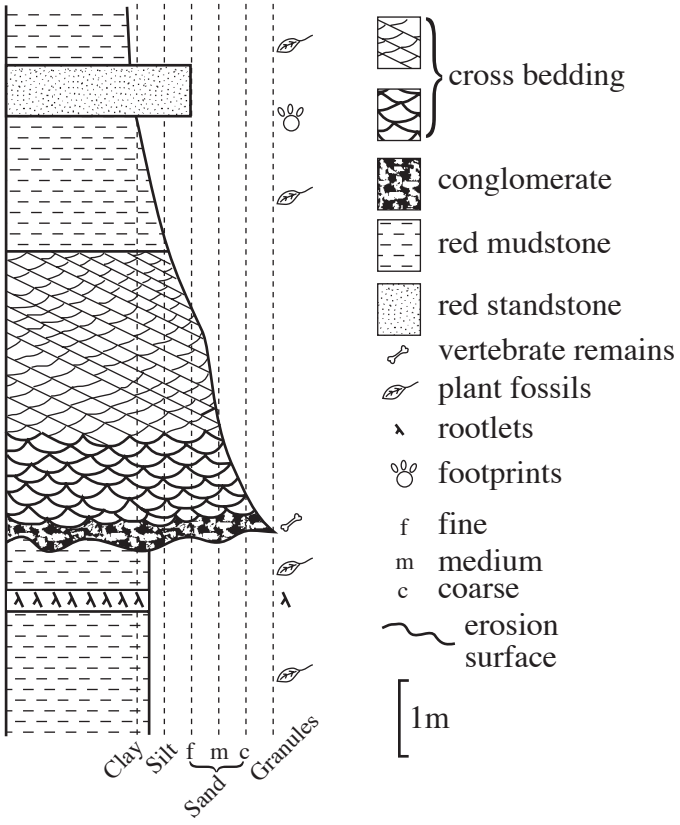

Figure 2c

(i) A palaeomagnetic inclination of 35º has been recorded from the Devonian rocks of Britain.
Use **Figure 2b** to determine the latitude of Britain during the Devonian. [1]

..... º South

(ii) The environment of deposition of the Devonian sedimentary rocks in **Figure 2c** has been interpreted as fluvial. Describe **three** characteristics of the log which support this interpretation. [3]

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(iii) *'Sedimentary rocks and palaeomagnetic data are reliable indicators of palaeolatitude.'*
Evaluate this statement with reference to **Figure 2b** and the Devonian log shown in **Figure 2c**. [4]

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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. Describe major differences in the geology of the Caledonian and Variscan orogenic belts in the British Isles. Include in your answer a discussion of location, age, structural styles and trends, plutonic and metamorphic rocks. [25]

4. *(a)* Explain how a study of the mineralogy, texture, sedimentary structures and fossil content of sedimentary rocks can be used to interpret the variation in palaeoclimate in Britain during the Permo-Triassic.

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

5. *'The geology of Britain can contribute to an increased understanding of plate movements within and beyond the British area.'* Evaluate this statement with reference to Cenozoic igneous rocks and Alpine structures. [25]

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455/04

GEOLOGY GL5

THEMATIC UNIT 4

GEOLOGY OF THE LITHOSPHERE

P.M. TUESDAY, 20 June 2006

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 simplified section of a destructive plate margin showing the foci of earthquakes that have occurred in recent months.

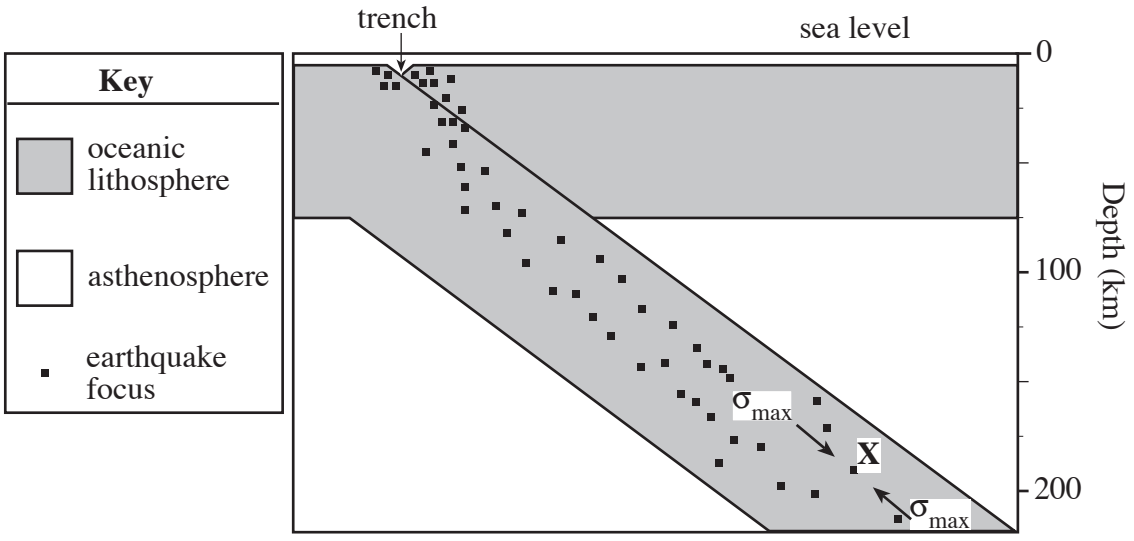

Figure 1a

(a) Describe the **distribution** of the earthquakes in **Figure 1a**. [3]

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.....

.....

(b) (i) The plate bends as it begins to subduct. This may result in tensional forces on the outside of the bend.

Label **one** earthquake focus (T ⟶) in the subducting plate which may be due to tensional forces. [1]

(ii) At depth, the earthquakes are more likely to be due to forces **within** the subducting plate.

Two arrows (σ_{max} ⟶ ⟵ σ_{max}) in the subducting plate show the likely directions of the maximum principal stresses which resulted in the earthquake at **X**.

Suggest why the forces labelled σ_{max} are acting in this way. [2]

.....

.....

Figure 1b shows the variation of temperature with depth close to the destructive plate boundary.

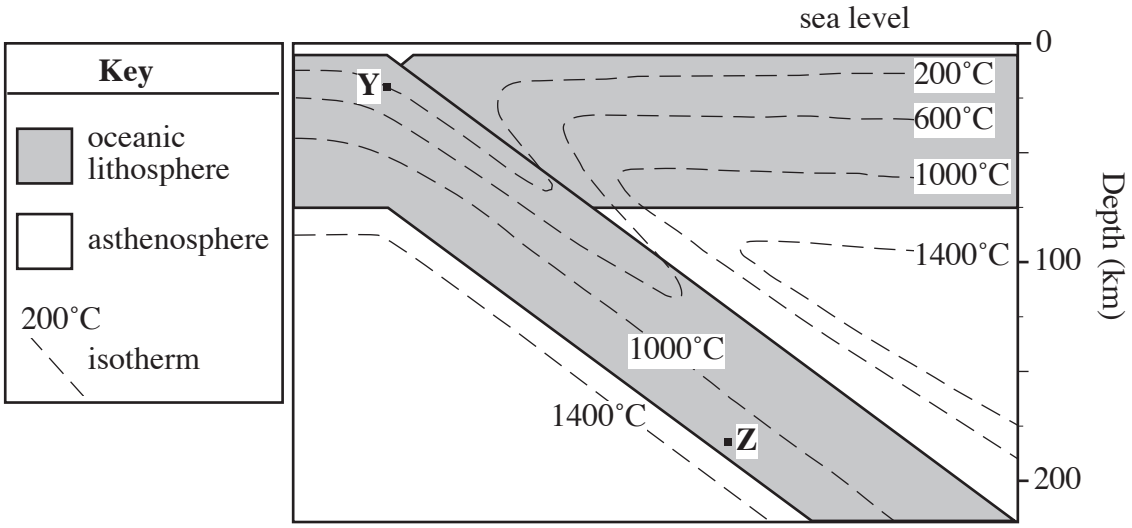

Figure 1b

(c) Refer to **Figure 1b**.

(i) Complete the table below by stating the depths and temperatures at the earthquake foci **Y** and **Z**. [2]

Focus	Depth (km)	Temperature (°C)
Y		
Z		

(ii) State and account for the range of temperatures found at a depth of 100 km. [3]

Temperature ranges from ..... ºC to ..... ºC.

Account: .....

.....

.....

(iii) Seismic waves travel faster in the subducting plate than they do in the asthenosphere. Suggest reasons to explain this. [3]

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Total 14 marks

2. **Figure 2a** shows a cross section from the Swiss to the Po basins from the NW to the SE of the Alps and **Figure 2b** shows a cross section of the North Sea basin.

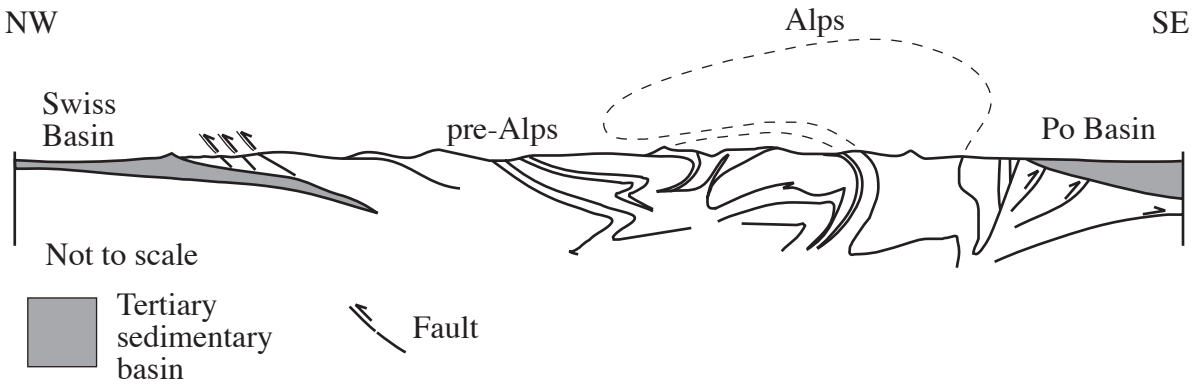

Figure 2a

(a) The Swiss and Po Basins are thought to have formed due to compressional stresses. Give **two** pieces of evidence from **Figure 2a** to support this claim. [2]

Evidence 1: .....

.....

Evidence 2: .....

.....

.....

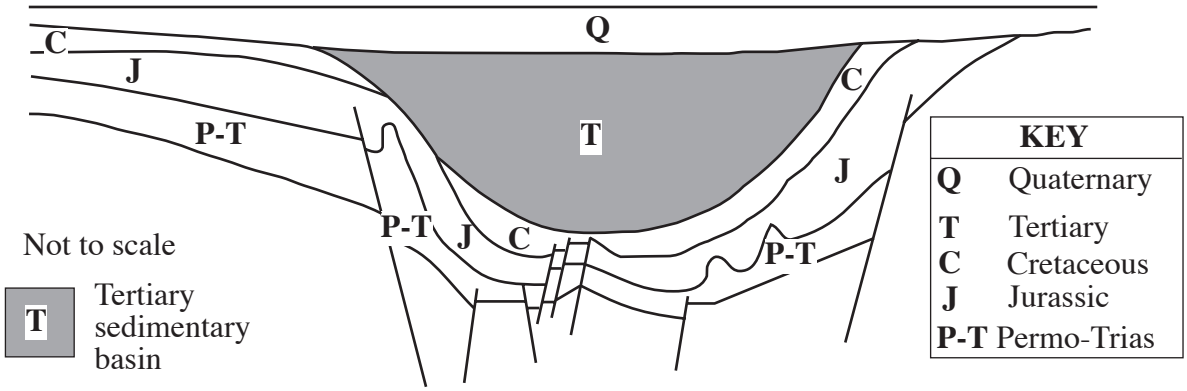

Figure 2b

(b) The North Sea basin is thought to have formed due to tensional stresses. Give **one** piece of evidence from **Figure 2b** to support this claim. [1]

.....

.....

(c) *'The faulting in the North Sea basin is **younger** than the Cretaceous and **older** than the Tertiary.'* Evaluate this statement with reference to **Figure 2b**. [3]

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.....

(d) **Figure 2c** shows the rate of sedimentation in part of the North Sea Basin for the past 65 million years.

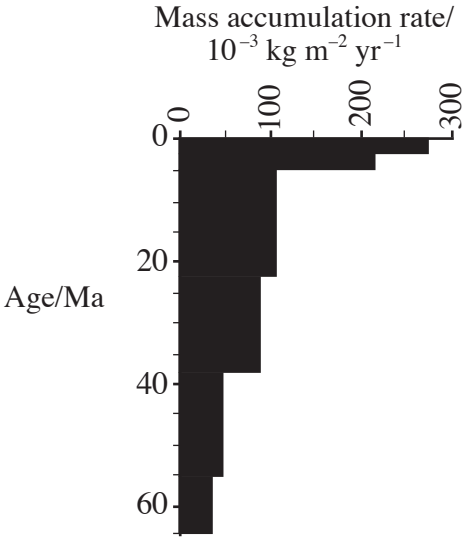

Figure 2c

Describe the rate of sedimentation as shown in **Figure 2c**. [2]

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.....

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.....

(e) Discuss the effect that the mass of sediment might have had on the development of the North Sea sedimentary basin. [3]

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.....

Total 11 marks

SECTION B

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

Write your answer in the remaining pages of this booklet.

3. Describe the formation of ocean floor magnetic anomalies. Evaluate their importance in supporting the theory of sea-floor spreading. [25]

4. *(a)* Describe the variation in surface heat flow across a spreading ocean basin and active continental margin.

(b) Discuss the importance of surface heat flow in supporting the theory of plate tectonics. [25]

5. *(a)* Describe how the orientation of principal stresses within the lithosphere affects the nature of any fault structure produced.

(b) Outline the conditions that might lead to a rock folding rather than faulting. [25]

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