Candidate Name	Centre Number	Candidate Number

WELSH JOINT EDUCATION COMMITTEE
General Certificate of Education
Advanced Subsidiary/Advanced

CYD-BWYLLGOR ADDYSG CYMRU
Tystysgrif Addysg Gyffredinol
Uwch Gyfrannol/Uwch

453/01

GEOLOGY - GL3

GEOLOGY AND THE HUMAN ENVIRONMENT

P.M. THURSDAY, 24 May 2007

(1 hour 15 minutes)

For Examiner's Use only.

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

ADDITIONAL MATERIALS

In addition to this examination paper, you may require a calculator.

INSTRUCTIONS TO CANDIDATES

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions from Section **A** and **one** from Section **B**.

Write your answer in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

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

Candidates are reminded that marking will take into account the use of examples and the quality of communication used in answers, especially in the structured essay.

No certificate will be awarded to a candidate detected in any unfair practice during the examination.

SECTION A

Answer **both** *questions,* **1** *and* **2**, *on the lines provided in the question.*

1. **Figure 1a** shows the site of the former Aberfan coal-waste tips (South Wales), one of which (tip No.7) suffered a major landslide and associated debris flow in 1966.
Figure 1b is a geological section through tip No.7 and the underlying geology prior to the landslide.

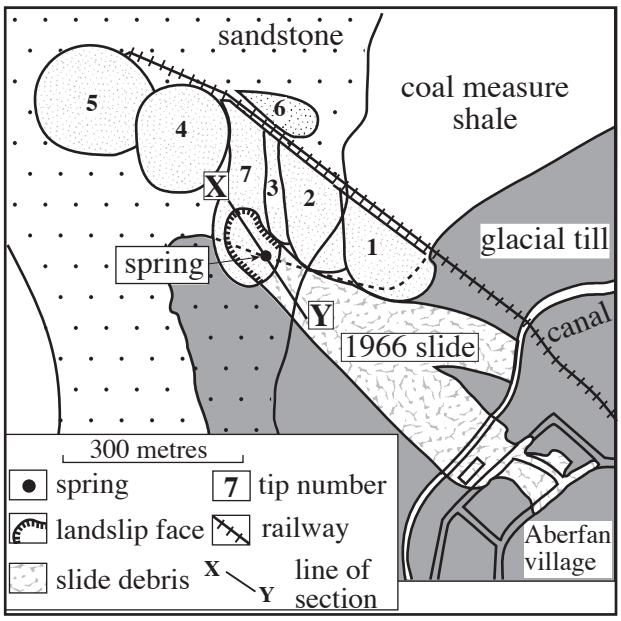

Figure 1a

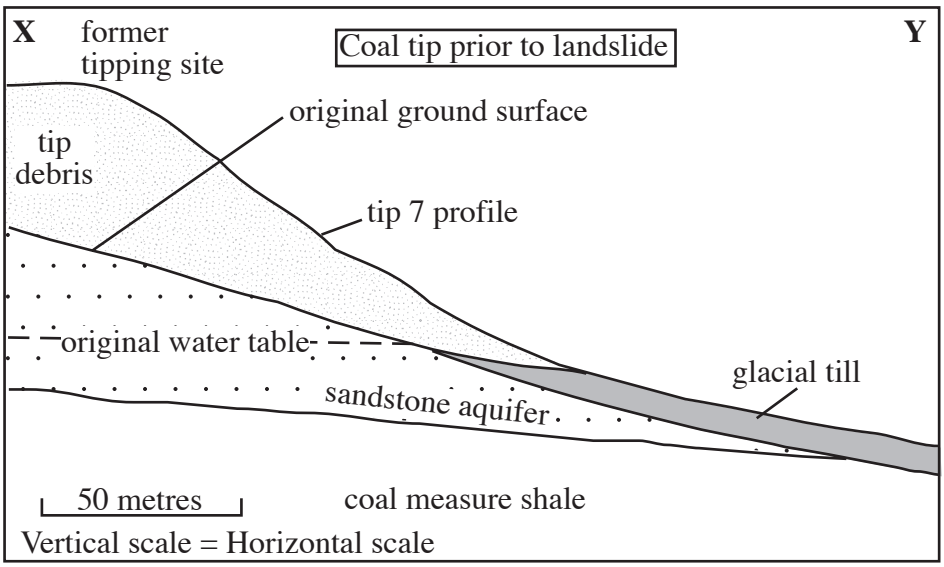

Figure 1b

Source: Figures adapted from *Foundations of Engineering Geology (2nd edition)*, Waltham T. (2002) - Spon Press

(a) On the geological section (**Figure 1b**), mark with a labelled arrow (**← S**) the location of the spring **beneath** tip No.7. Account for the presence of a spring at this location. [2]

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(b) Draw a line on **Figure 1b** to show the probable surface of failure associated with the landslide. [1]

(c) (i) State **two** geological factors that may have been responsible for causing tip No.7 to fail. [2]

1. .....

2. .....

(ii) Give an explanation of the possible role played by **one** of the geological factors you have identified in *(c)* (i). [2]

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(d) Explain how appropriate action could have reduced the risk of mass movement prior to the failure of tip No.7. [3]

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(e) Explain **one** environmental problem (other than waste tipping) associated with the extraction of rock or minerals from a mine you have studied. [2]

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Total 12 marks

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2. **Table 2a** shows data on the relationships between Richter magnitude, seismic energy and the frequency of occurrence of earthquakes.

Richter magnitude	Seismic energy released (metric tons TNT equivalent)	Approximate frequency of occurrence
<2	<1	8,000 per day
2.0	1	1,000 per day
3.0	32	49,000 per year
4.0	1,000	6,200 per year
5.0	32,000	800 per year
6.0	1 million	120 per year
7.0	•	18 per year
8.0	1 billion	1 per year
>9.0	32 billion	1 per 20 years

Adapted from the U.S. Geological Survey

Table 2a

Refer to **Table 2a**.

(a) Describe the general relationships between Richter magnitude, seismic energy released and frequency of occurrence of earthquakes. [2]

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(b) (i) Estimate the seismic energy (in equivalent metric tons of TNT) released in a **magnitude 7** earthquake. Mark on **Table 2a**. [1]

(ii) Explain why large magnitude earthquakes are infrequent. [2]

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(c) **Figure 2a** is a seismogram of an earthquake **(B)**. **Figure 2b** is a diagram that calculates earthquake magnitude using data from a seismogram.

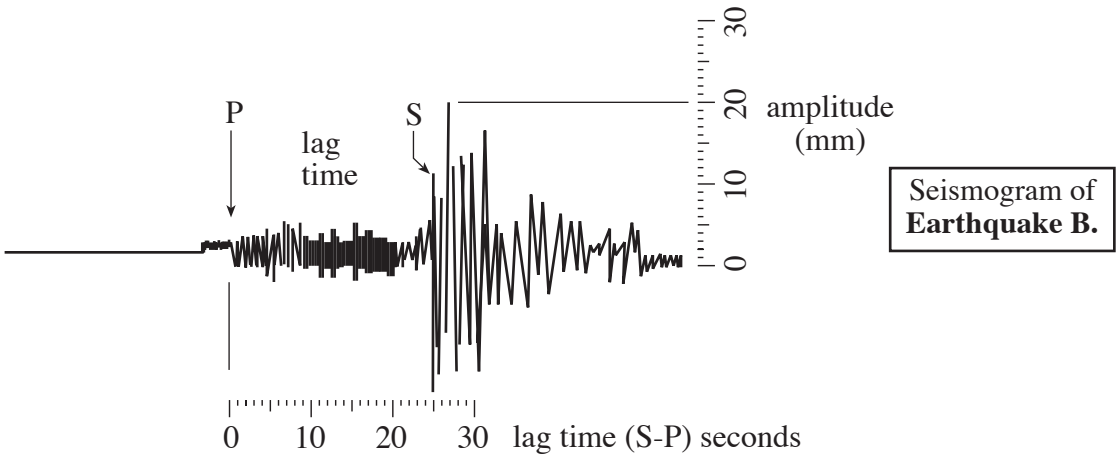

Figure 2a

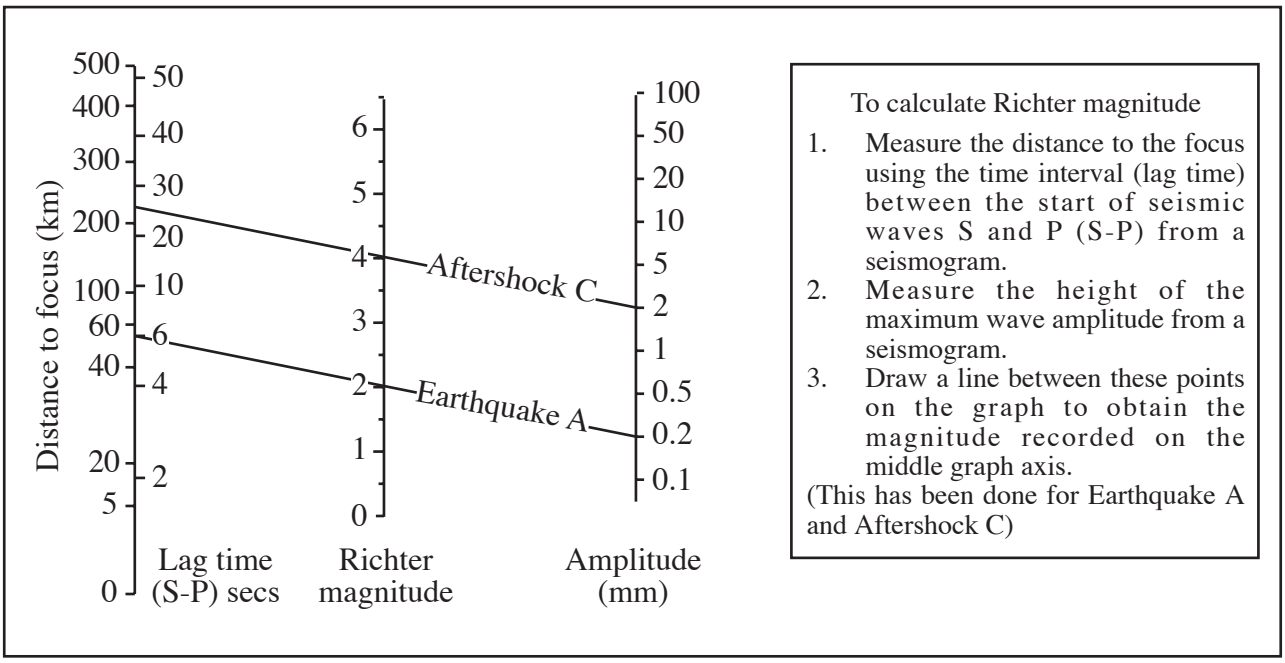

Figure 2b

(i) Complete **Table 2b** below by measuring the lag time and amplitude for the seismogram in **Figure 2a** (**Earthquake B**) and establishing the Richter magnitude using **Figure 2b**. (This method is illustrated in **Figure 2b** for another earthquake, **A**, and an aftershock event, **C**). [3]

Name	Distance to focus (km)	lag time (S-P) seconds	Amplitude (mm)	Richter magnitude
Earthquake A	50	6	0.2	2
Earthquake B	225	•	•	•
Aftershock C			2	4

Table 2b

(ii) Using **Table 2a** and **Table 2b**, calculate how many times bigger **Earthquake B** is than **Aftershock C** in terms of:

1. the energy released ..... times [1]

2. the maximum amplitude ..... times [1]

(d) Using your knowledge, explain how a major earthquake might be predicted by monitoring minor changes in **seismic activity** prior to the earthquake event. [3]

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Total 13 marks

SECTION B

Answer **one** *question from this Section on the following pages.*

You are advised to make use of examples where possible in your answer.

EITHER,

3. *(a)* Describe the properties of rock that control porosity and permeability in aquifers. [10]

(b) Explain how geologically related problems may result from interference with the hydrological system. [15]

OR,

4. *(a)* Using one or more case studies, describe how **one** of the following volcanic phenomena can be hazardous.

(i) Lahars.

(ii) Volcanic gas.

(iii) Blast/explosion. [10]

(b) Explain how the risk to life and property associated with a major volcanic event largely depends upon the extent to which an eruption can be predicted or its effect minimised. [15]

OR,

5. *(a)* Compare the changes in radon gas emissions before and after an earthquake with the changes in groundwater levels (identified in wells) over the same period of time. Explain your answer. [10]

(b) Account for the presence of high radon gas concentrations in some buildings located in particular areas of the British Isles.

You should consider

- the sources, and pathways of the gas to the surface,
- the surface geology in high risk areas,
- the risk involved in high concentrations. [15]

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Turn over.

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