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, 25 May 2006

(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.

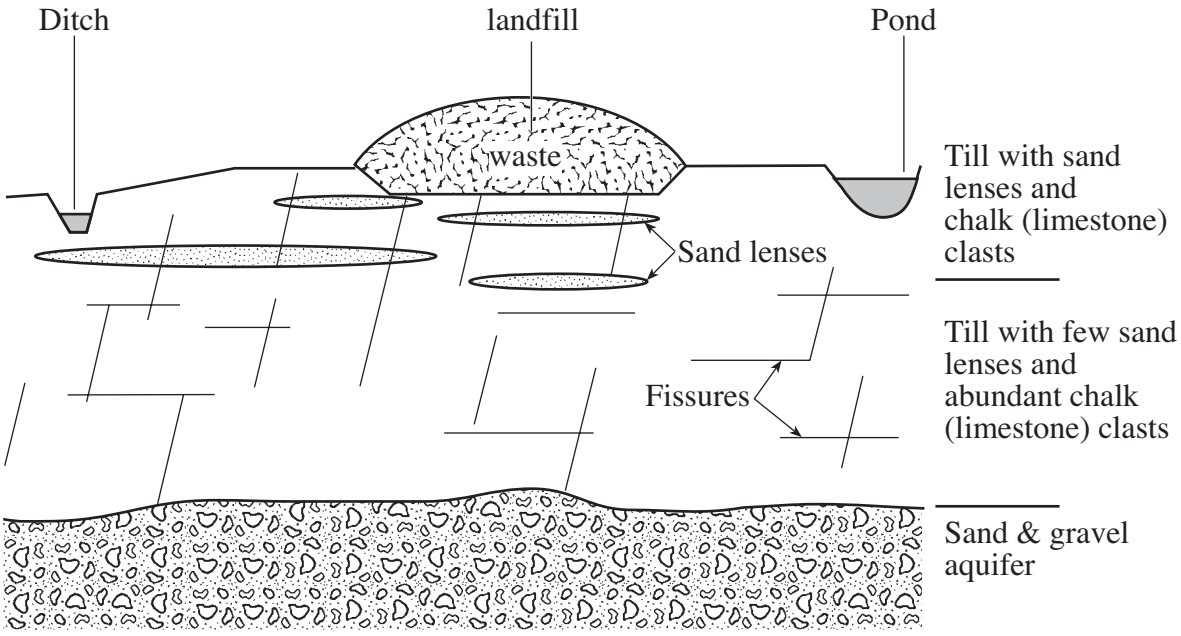
SECTION A

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

1. **Table 1** gives the background to a proposed development to dispose of domestic waste at Hardwick Air Field in Norfolk. **Figure 1** is a cross section showing the geology of the proposed waste disposal site.

In 1991 Norfolk County Council applied for planning permission to build a 10 m high waste hill (landfill) to dispose of 1·5 million m³ of domestic waste. Normally an expensive ***containment liner*** *is required to prevent ground water contamination by the acidic* ***leachate****. Critical to their proposal was that the area was underlain by till (a superficial deposit rich in clay) which would act as a natural barrier to the* ***leachate*** *generated within the decomposing waste. The proposal was rejected as it was considered that the till did not provide* ***an effective enough barrier to the movement of acidic leachate.***
Modified from:- *Environmental Geology* – Bennett & Doyle 1997: John Wiley & Sons

Table 1



not to scale

Figure 1

Refer to **Table 1** and **Figure 1**

(a) (i) State **two** reasons why leachate needs to be contained. [2]

1. .....

2. .....

(ii) State **one** substance (other than leachate), produced from the decomposing waste, that can be controlled by good engineering practice. Explain how this might be achieved at this site.
(You may annotate **Figure 1a**.) [2]

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(b) Describe the typical features of a "*containment liner*" [2]

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(c) (i) Draw a continuous line on **Figure 1a** to show a possible route for migrating leachate from the landfill to the sand and gravel aquifer. [1]

(ii) Explain why the till might not provide "*an effective enough barrier to the movement of acidic leachate*." [3]

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(d) Using your knowledge, explain why a landfill site would be unsuitable for the disposal of highly radioactive waste. [2]

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Total 12 marks

2. Between 1962 – 1965, waste water was injected into a deep well near Denver.
Figure 2a shows the relationship between the frequency of local, minor earthquake events and the rate of injection of waste water.

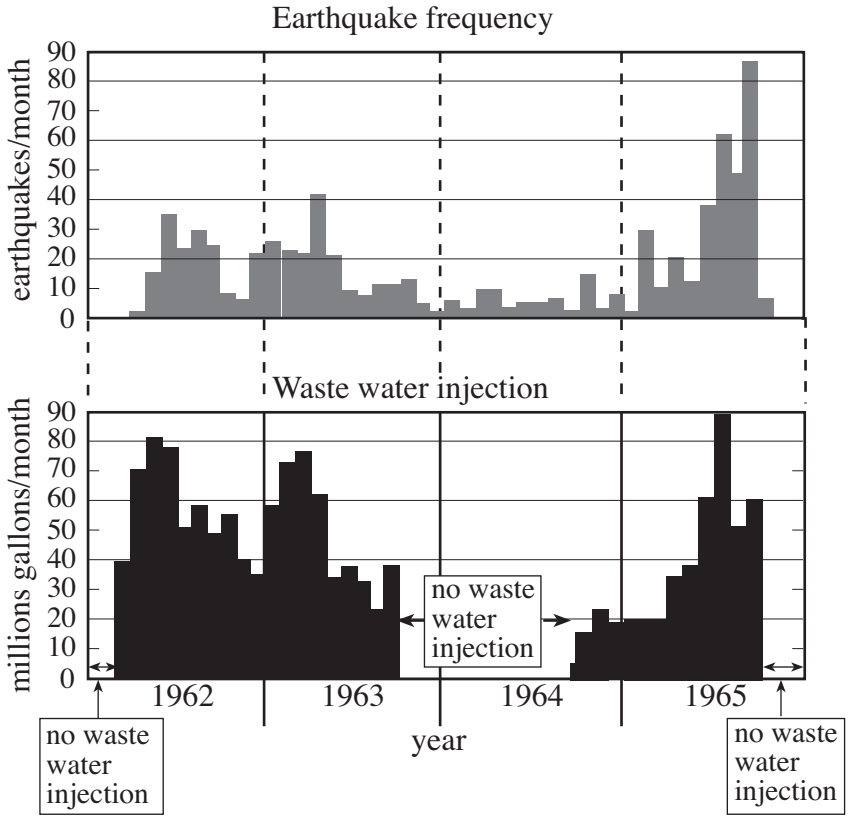

Figure 2a

Modified from:- *Environmental Geology* Bennett & Doyle 1997: John Wiley & Sons

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

(i) Describe the correlation between earthquake frequency and waste water injection between 1962 and 1965. [2]

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(ii) Explain how waste water injection might have triggered the minor earthquake events. [3]

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(b) **Figure 2b** shows a suggested method of controlling major earthquakes along the San Andreas Fault system by triggering minor earthquakes along the fault zone.

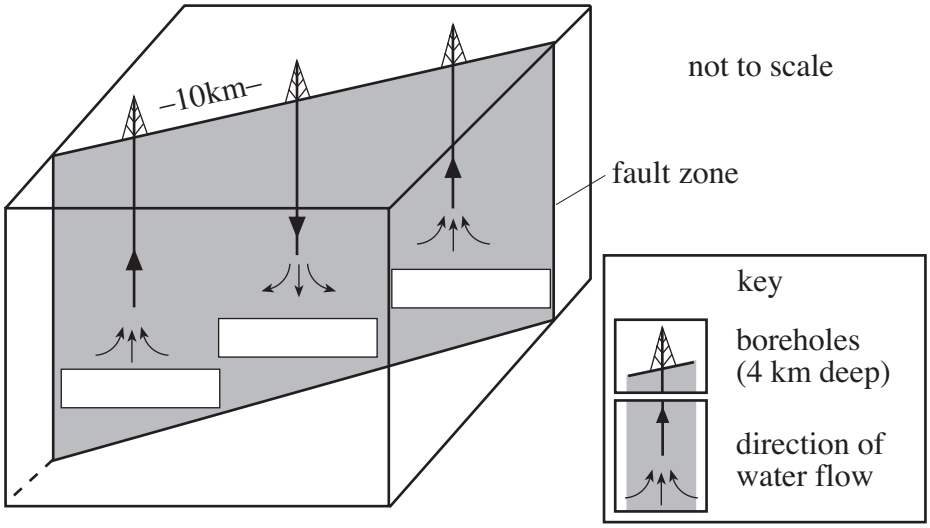

Figure 2b

(i) On **Figure 2b**, indicate in which area(s) of the fault zone minor earthquakes are likely to be triggered.
Write ***earthquake*** in the box(es) below the appropriate borehole(s). [1]

(ii) Explain how this method might be used to reduce the risk from major earthquakes. [2]

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(c) Explain the use of **one** method to predict earthquakes. [3]

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(d) Explain why many scientists maintain that the most effective way to reduce earthquake risk is to depend upon well constructed buildings rather than to attempt to predict or control earthquakes. [2]

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Total 13 marks

Turn over.

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 **two** techniques used in geological site investigations prior to major engineering activities. [10]

(b) Explain the geological hazards that might result when engineering activities associated with the construction of a dam and reservoir fail to take account of geological factors. [15]

OR,

4. *(a)* Using one or more case studies, describe the possible effects of each of the following:

(i) volcanic gas emissions;

(ii) seismic activity associated with the underground movement of magma. [12]

(b) Explain how a study of volcanic gases and seismic activity might be used in the prediction of volcanic events. [8]

(c) Outline the social and economic **disadvantages** of attempting to predict volcanic eruptions. [5]

OR,

5. *(a)* Describe how the extraction of rock and minerals during mining operations can lead to surface and groundwater pollution. [10]

(*b*) Explain how the extraction of groundwater can cause

(i) surface subsidence,

(ii) groundwater contamination. [15]

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Turn over.

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