Candidate Name	Centre Number	Candidate Number

WELSH JOINT EDUCATION COMMITTEE
General Certificate of Education
Advanced

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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 (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.

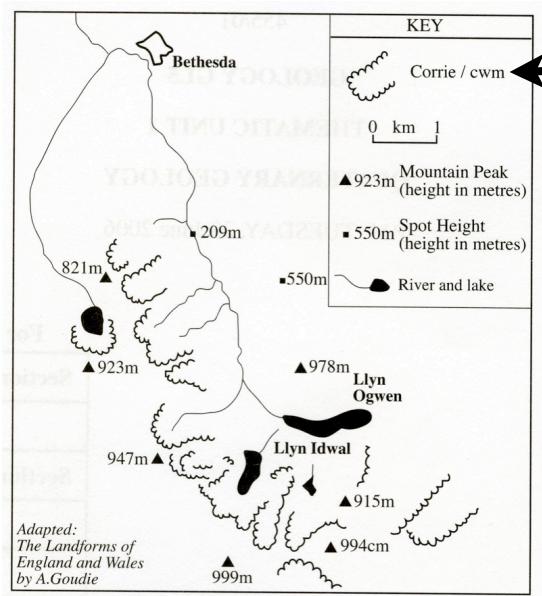

Figure 1a

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

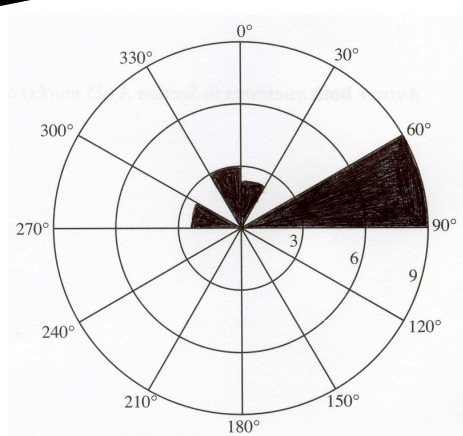

Figure 1c

Direction of corries could be used for (a)(ii)
e.g. facing towards NE

Did you spot the "deliberate mistake" !!!
Although papers are carefully edited, because of the need for security errors sometimes creep in at the printing stage.
Luckily this did not cause any problems. Should it have done, the question would have been omitted.

Two marks here.
One for marking the four directions.
One for marking the correct amounts.

(a)(i) Using the data in **Figure 1b** complete the rose diagram (**Figure 1c**) to show the direction 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 **Figure 1**c . (2)

.....main direction is 60˚-90˚ .....
..... more than 50% of readings .....
..... smaller numbers 270˚-30˚ .....

Easiest way to obtain marks with this type of question is always to quote actual data provided.

You would also get credit for alternative descriptions such as: all northerly in direction, or mostly NE to E etc.

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

..... glacial striations are scratches on rocks which show the ....
..... direction of movement of the ice as it moved over the rock .....
..... if a hand is moved along the scratch, the smoother direction ....
..... shows the actual direction in which the ice moved .....

Numerous alternatives.
This one was common but most only got 2 of the 3 marks because they didn't explain how the actual direction of the ice movement might (not) be worked out.
Those who did drumlins or crag-and-tail were usually the best at explaining how the actual direction was obtained.

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

..... the Sun's radiation is coming from the south.....
..... NE-facing slopes are in the shade.....
..... less melting of ice .....

This was the usual correct answer.
Some said that moisture-bearing winds would come from a southerly direction. This was also credited.

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

..... freeze-thaw occurs in periglacial regions due to repeated
..... heating and cooling

..... when the temperature drops below zero water freezes and expands
..... when the temperature rises the ice thaws and reduces in volume

..... the force of expansion of the ice on freezing is very great and can
..... cause rocks to fracture.

Wide variety of answers here.
Solifluction and frost-heave were two of the most common.

There was 1 mark for correctly naming and 2 marks for correctly describing a process BUT it is reasons and explanations that are asked for. Thus a high quality description and explanation that did NOT name the process would still have been awarded 3 marks.

Total 12 marks

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

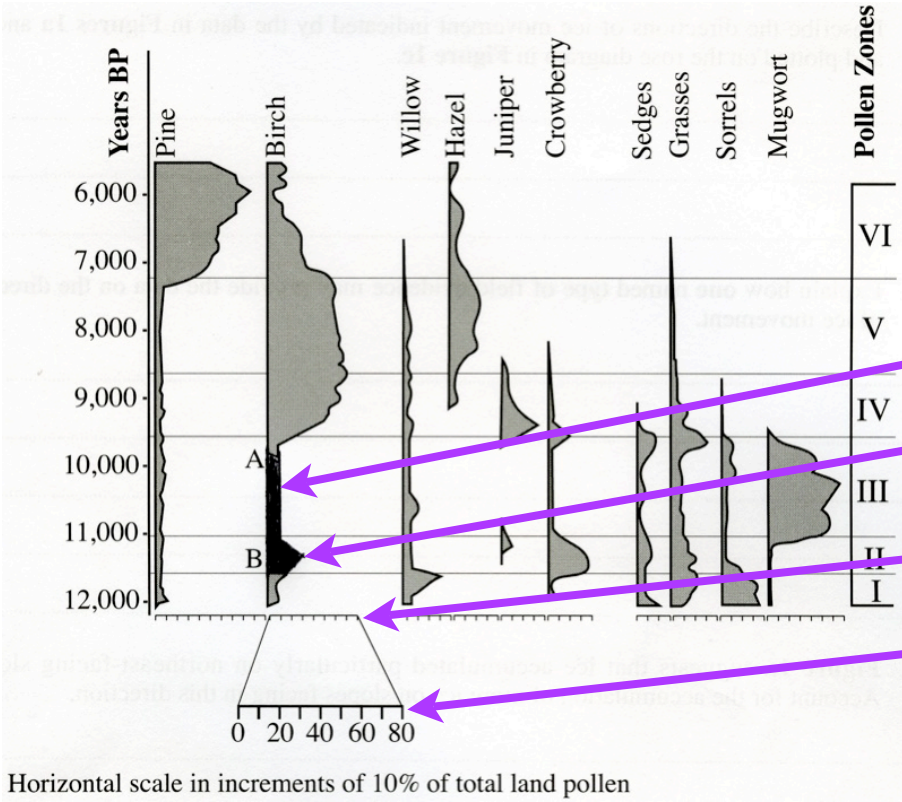

Figure 2a

(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 pollen assemblage
10,500	10
11,000	11
11,500	32

flat portion (10 - 11%) - see below

spike (32%) - see below

actual scale - see below

details of scale - see below

This was not very well answered.

The major problem seemed to be lack of understanding of the scale.

Essentially what was wanted was a flat portion of the graph for the readings 10 and 11 at 10,500 and 11,000 years; and then a "spike" for 32% at 11,500 years.

Most candidates got marks for this but often the scale was completely out.

Some obviously thought that the horizontal line separating zones I and II was at 11,500 years. Close inspection will show that this is not the case. Thus the spike should have been just above the horizontal line.

Also, the actual scale and details of the scale were often confused.

Many candidates plotted 32% from the lower scale and put it on the figure. The lower scale is nearly twice the upper (true) one. This gave a spike that was much too big - usually twice as big as it should have been.

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

only a small percentage in Zones I to V

large increase in percentage in Zone VI

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

Mugwort is dominant in Zone III

Birch is dominant in Zone IV

(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)

the sediments may have been removed due to erosion

there was no lake here before 12,000 years BP

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

wide distribution by the wind

preserves well

easily recognised

particular plants indicate particular climatic conditions

Here figures are not used but it is worth 2 marks.

Pleasingly, most candidates used the actual data : approximatly 10% of the total for Zones I to V which rises to over 80% in Zone VI before decreasing over the last 6000y.

This is an excellent answer which is really worth more than 2 marks !

Worth 2 marks for the 2 main points.

Again it was very pleasing the number who quoted correct percentages. This would have gained the other mark.

Alternatively, a correct comment on other species would have secured the third mark (e.g. Juniper only present at the beginning and end of Zone III but present throughout the whole of Zone IV.

There are a number of reasonable suggestions here.

No vegetation in the area ? Completely covered by ice ? No sediment deposited ?

All of these area REASONABLE suggestions and so are OK.

"Plants had not evolved" might at first sight seem reasonable. However, this was not accepted. Can you suggest why not ?

Four correct points ONLY 3 marks awarded ! WHY ?

THERE IS NO ATTEMPT TO EVALUATE. There must be some comment such as "pollen is a good indicator because ....." then one or more of the points has to be elaborated to explain why it makes it useful.

Alternatively, you might argue that pollen is NOT useful because it is so small and is hard to find. Although the latter view is not one that, other things taken into consideration, is generally accepted as sufficient reason; it is a reasonable argument that shows you are aware of some of the factors involved. Therefore, it would be credited.

Also, always remember the trade off between depth and breadth. This example goes for breadth.

Section B

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

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

   - Dipping strata
   - Folds
   - Faults
   - Joints
   - Igneous bodies (25)

A generally well-answered question, but many candidates did not obtain as many marks as they might have by not including labelled diagrams. Answers on folds and igneous bodies were generally much better than those on faults, joints or dipping strata. There was sometimes considerable overlap between igneous bodies and joints when tors were discussed. This was credited if in context.

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 what is meant by a turbidity current.

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

The full range of answers. In contrast to Q.3 diagrams were more common. Bouma sequences were often mentioned and there were some excellent descriptions. However, a common omission was that many candidates did not mention the density of the turbidite flows and only talked in vague terms about their speed (e.g. "fast"). Discussion of graded bedding and tool marks, (popular choices for part b) were generally relatively basic and were not adequately developed. Flute casts tended to be selected by the better candidates and there were some excellent accounts.

5. Explain how changing quantities of continental ice affect sea levels and how the geological record provides evidence of such changes. (25)

Examiners did not expect this to be a popular choice - but it was !

Lets have a go at this one.

5. *Explain how changing quantities of continental ice affect sea levels and how the geological record provides evidence of such changes.* *(25)*

When ice melts, for example from glaciers, it flows into the sea and causes the sea level to rise. At the present time, because of global warming, ice is melting and sea level is rising.

When water evaporates from the sea it rises and cools. If it falls as snow this will build up to form layers of ice. This ice may be in the form of ice sheets or glaciers. The weight of the ice can be very great and cause the continent to sink into the mantle. This is called isostacy. When the ice melts the weight is removed and the continent will rise up. This can cause the formation of raised beaches. As the land rises the beaches also rise and end up several metres above the present-day sea level.

This was the basic outline of the first part of many of the essays, although some did not make the distinction between the two types of sea level change as clearly as this.

There was usually a little more detail on ice formation showing a good understanding of the water cycle (breadth versus depth).

Although this is a very good outline, it does not contain enough detail to obtain high marks.

When sea ice melts e.g. ice bergs, it does not effect sea level. Thus if the North Pole ice cap melted it would not cause a rise in sea level. Changes in sea level occur when ice overlying continent melts. The ice water flows into the sea and causes its level to rise. This world- wide rise in sea level is called termed eustatic. If the ice overlying Greenland and the Antarctic melts it will cause a eustatic rise in sea level of several metres.

There is much more detail here. Very few tried to explain (in terms of density and volume) why a melting ice berg does not add to the volume of an ocean. This was not expected but would come under the depth versus breadth umbrella. The choice is yours !

Here the word “eustatic” has been introduced and it is the simplest way to show (with an explanation) that you understand that there are two different processes operating.

Ice overlying continental lithosphere causes the latter to be depressed into the (upper) mantle. This is one of the best pieces of evidence that the mantle flows. Around the edge of the ice there is a "crustal bulge" which can locally make the sea level appear to be lower than it really is. When the ice melts the weight is taken off the continent and it slowly rises. These changes in height are called isostatic and changes in the height of the continent as weight is added or removed are called isostatic readjustments.

The rate of recovery after ice has melted is much slower than the rate at which the ice melts. Therefore in Scotland and Scandinavia today the continent is still rising even though the ice (that was above) melted thousands of years ago. This shows that the mantle flows very slowly.

There are several pieces of evidence which indicate that changes in sea level occurred during the Ice Ages.

One such example is a submerged forest. This is when fossils of trees are found at or below sea level. As the trees cannot have grown in the sea this is evidence that the sea level has risen.

This is a little superficial. Does it in fact mean that the sea level has fallen or could it be that the land has risen ?

Having said that, it is difficult to expand too greatly on this unless you have actually studied a field example and can add a great deal of specific detail. This would allow depth, but if not, other examples will have to be considered to add breadth at the expense of depth.

Oxygen isotopes can be used to show whether the sea level was high or low. The isotopes may be found in the shells of marine creatures.

This was not what the examiners had in mind when the question was set. Raised beaches and fjords etc are what were expected. However, a case can be made out here. Many candidates went into great detail as to how the isotope ratios may be used to indicate sea level. Some of these accounts were excellent and scored full marks (depth).

Milankovitch cycles can be used to show if the sea level was high or low.

A few candidates chose to discuss this. Non of them scored very highly. It is very difficult (impossible ?) to make out a case for the use of the cycles to indicate sea levels during the Ice Ages.

The above is a basic outline of what was produced by some candidates and also what was expected for higher marks.

A basic outline with (hopefully) a few diagrams is sufficient to get you a reasonable mark (say 15) if all of the important points are covered.

To get the higher marks the depth versus breadth argument comes into play. You have to show that you are aware of the range of considerations that might be made (breadth) OR, the detailed strengths and weaknesses of one technique (depth).

What about full marks ?

Here, examiners are looking for that “little bit extra”.

You may have shown it already.
Have you managed to get into your account as much as can be expected in the time allowed (breadth) ?
Have you shown that you have studied one thing in detail and are aware of the strengths and weaknesses (depth) ?
Have you shown some insight that the examiner was not expecting ?

What about :

What is actually meant by sea level ? Is it a local (isostatic) change or a world wide (eustatic) change ? Is it possible to tell the difference ?

Does plate tectonics effect sea level ?

What if oceanic ridges are forming / developing at the same time as atmospheric temperature changes? Would this effect sea level ?

Will isostatic changes effect actual sea level or is it just land bobbing up and down ?

Is sea level an accurate measurement of the amount of water on the Earth ?

If it gets hotter (colder) will the ocean water expand (contract) and create a rise (fall) in sea level ?

Each of the above were mentioned in some form or other by a candidate.
If a candidate can fulfil the basic requirements and then show some extra insight into the topic, this is the makings of a 25 out of 25 essay.