

Candidate Name	Centre Number	Candidate Number

WELSH JOINT EDUCATION COMMITTEE
General Certificate of Education
Advanced

WJEC
CBAC

CYD-BWYLLGOR ADDYSG CYMRU
Tystysgrif Addysg Gyffredinol
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455/01

GEOLOGY GL5
THEMATIC UNIT 1
QUATERNARY GEOLOGY

P.M. TUESDAY, 19 June 2007

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).

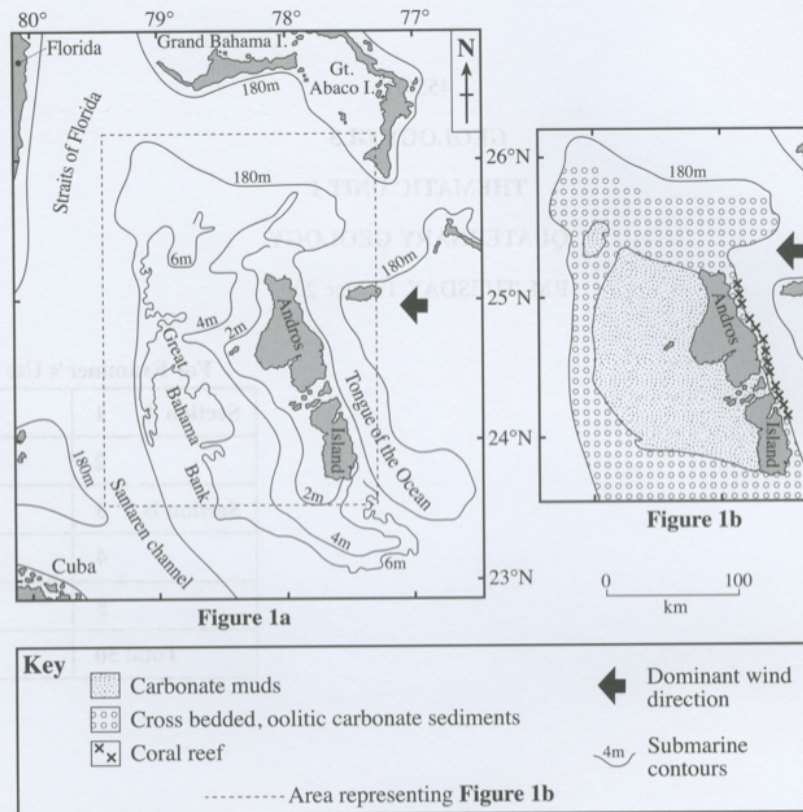
SECTION A

Answer **both** questions in the spaces provided.

This section should take approximately half an hour to complete.

1. **Figure 1a** is a relief map of the Great Bahama Bank and Andros Island.

Figure 1b shows the distribution of carbonate sediments around Andros Island.



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

- (a) (i) Describe the distribution of carbonate mud sediment.

[2]

West of Andros Island in shallow waters

- (ii) Explain why carbonate muds are being deposited in these locations.

[2]

conditions here are warm, shallow and evaporation will be high

An easy starter. Several alternatives. 2 valid points needed.

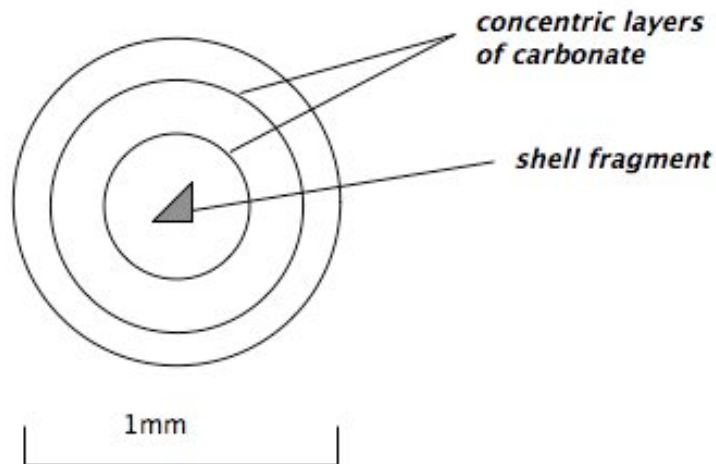
Again 2 valid points for 2 marks is the rule. Actually 3 valid points given here (= warm / shallow / high evaporation) so should be an easy 2 marks BUT concern is if this is an **explanation**. Just about gets away with it (warmth + shallow = precipitation of muds)

- (b) Explain why coral reef development is confined to the east coast of Andros Island. [2]

Corals need sunlight and well-oxygenated waters

Two true brief statements. Not related to the east coast but worth the 2 marks (it is at least an **explanation**.)

- (c) (i) Cross-bedded, oolitic carbonate sediment is being deposited in the sea around Andros Island.
Oolites (or ooids) are formed by the accretion of carbonate in concentric layers around a nucleus such as a shell fragment or a sand grain. They are typically 1mm in diameter.
Draw, to scale, a labelled diagram of an oolite (ooid). [2]



Sketch OK. Shows structure and is well labelled.
The scale was a reserve mark here as this was considered essential.

- (ii) Using **Figures 1a** and **1b**, explain how the sedimentary environment around Andros Island leads to the formation and deposition of cross-bedded oolitic carbonate sediment. [4]

The oolites are confined to shallow waters. This is a high energy environment.

Not answered the question here. "Cross-bedded" has been ignored. Two STATEMENTS have been made with no attempt to EXPLAIN. This is the last part of the question and is designed to be the most demanding. Not worth any marks.

2. Figure 2a is a Quaternary landform map of the Cadair Idris area in Wales.
Figure 2b is a cross-section along the line X-Y on Figure 2a.

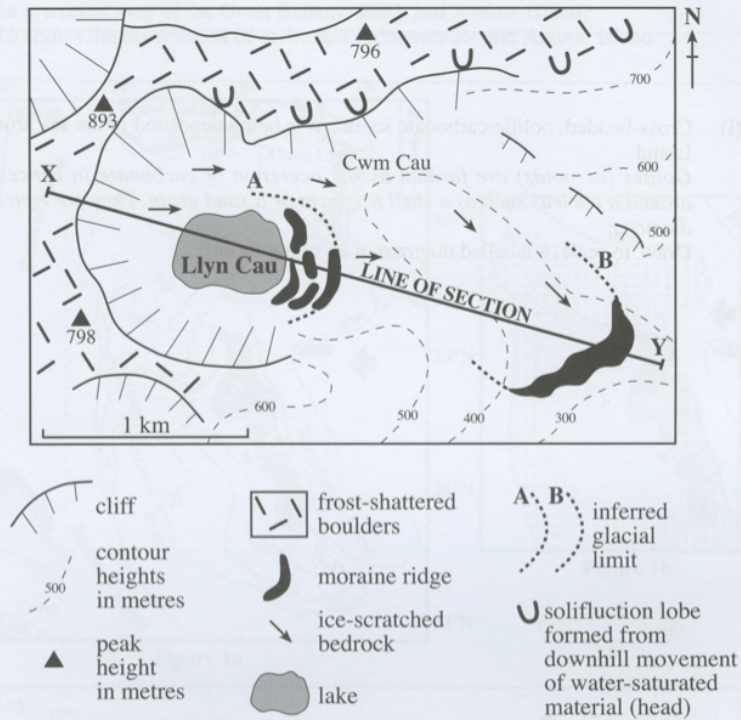


Figure 2a

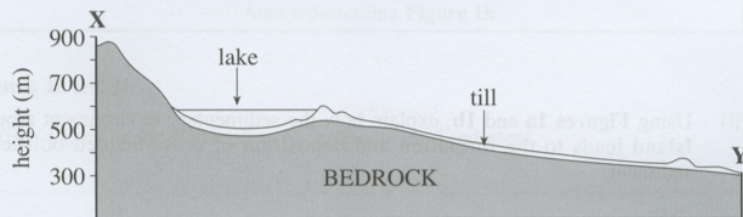


Figure 2b

- (a) State **two** pieces of evidence from Figure 2a which indicate that this area has been glaciated. [2]

1. *moraine*
2. *ice-scratched rocks*

Best way to answer this is to look at the key.

Which of the things listed in the key are evidence for glaciation ?

Plenty of choice for an easy starter.



Not really worth 2 marks.

Eroded basin - yes. Water drains and accumulates - yes.

BUT : Eroded by water ?

Why does the water accumulate / Why doesn't it just drain away ?

Supposed to be an easy starter so would give 1 mark.

Just about sufficient.

Stated that they are "terminal moraines" but is it just repetition to then argue that they are "two positions of the front of the glacier"?

Difficult one but the correct use of terminology would swing it (even though the question asks for reasons and only one is given.).

(b) Use Figures 2a and 2b.

(i) Give a geological reason for the presence of the lake (Llyn Cau).

*this is an eroded basin in which the
water can drain and accumulate*

[2]

(ii) Suggest reasons for the presence of two different glacier limits in Cwm Cau (labelled A and B).

*both are terminal moraines and they show
two positions of the front of the glacier*

[2]

(c) Solifluction lobes can develop in periglacial conditions. Use Figure 2a.

(i) Describe the distribution of solifluction lobes in the Cadair Idris area.

*to the north of the area
above the 700m contour
on a south facing slope*

[3]

No problems here.

Like the quantitative input of 700m.

Other alternatives such as E-W or at the edge of the frost shattered boulders.

(ii) Explain the distribution of solifluction lobes in the Cadair Idris area.

*south facing so will be exposed to stronger solar radiation
this will melt the ice in the soil so the soil flows*

[2]

Three good points here : "stronger radiation" + "melt" + "soil flows."

Also they combine to EXPLAIN so no problem.

Be careful you do EXPLAIN and not just repeat what you wrote in (c)(i) - which are all significant but do not EXPLAIN (so would get no marks.)

(d) The Cadair Idris area has been interpreted as experiencing glacial and periglacial conditions at the same time. Evaluate this interpretation.

*the glacial conditions can be seen at the bottom of the valley
the periglacial features are higher up*

[2]

Last part of the question. Not an easy part. Need a good answer.

This is a good start BUT response is SO WHAT ?

Not enough here to warrant any marks. Important thing to note is that the question asks for "at the same time." So you must address this for 2 marks.



SECTION B

Answer **one** question from this section.

Write your answer in the remaining pages of this booklet.

3. (a) Explain how Milankovitch Cycles are thought to cause climatic fluctuations in the Quaternary. [25]
 (b) Discuss the importance of the distribution of continents and mountain belts in influencing global climate in the Quaternary. [25]
4. (a) Explain how fossils can provide evidence for Quaternary climatic fluctuations. [25]
 (b) Evaluate the use of radiocarbon (^{14}C) dating in determining the duration of Quaternary climatic fluctuations. [25]
5. "The geological structure and lithology of an area controls the drainage patterns of water both above and below the surface."
 Evaluate this statement with reference to examples you have studied. [25]

This essay was very popular but there were not many very high marks - so we'll have a go at this one. 😞

(a) is 'straightforward' part of the essay. (b) asks for an **EVALUATION**. This is meant to identify the Grade A/B candidates.

- (a) Loads of choice here. The other big decision is whether to go for depth or for breadth. The most popular in depth discussions tend to be pollen or foraminifera (and oxygen isotope ratios). It is important if you choose oxygen isotope ratios to make it clear what this has to do with **FOSSILS**.
- (b) Details of ^{14}C dating are not essential here. What is essential is a discussion of **HOW EFFECTIVE** the method is in determining the **DURATION** of climatic fluctuations. This part is assessed strictly and you **MUST** stick to the point. 😞

Very much field based and note the importance of 'EVALUATE' If you attempt this question you must have studied (one or more / depth versus breadth) in some detail and cannot just rely on examples. You must **evaluate** the statement.

The other thing to watch out for is "....both above and below.."

Many candidates only discussed the "above" part.

This essay is difficult to review.

It caused more difficulty to markers than any other popular essay on any of the units.

The following attempt is to show common misconceptions along with some excellent points that were made. Thus this essay is not representative of any one essay that came to the attention of the Principal Examiner.

One of the biggest problems was that many essays were very inconsistent. Sometime good points were made but quickly followed by completely erroneous ones.

The nature of the cycles was generally well known and understood. Many candidates scored all of their marks here.

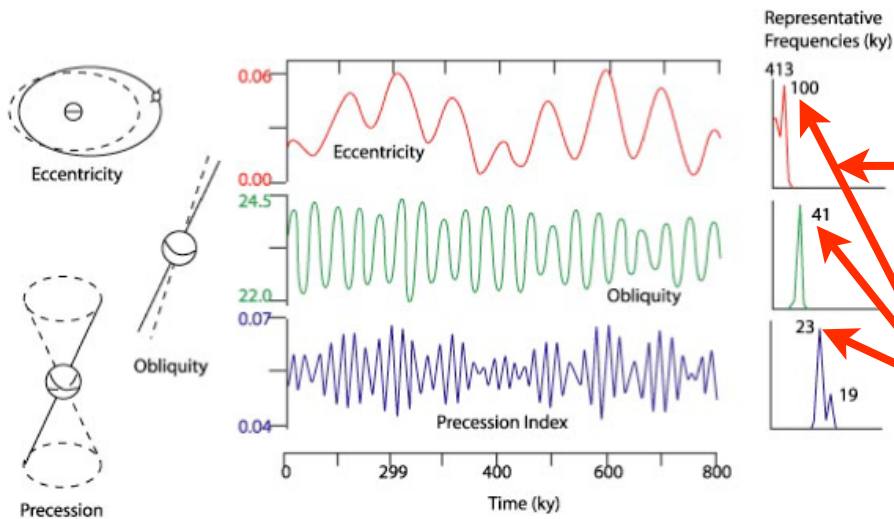
The fact that it is a COMBINATION of the cycles that is most critical was not well known.

MANY exaggerated claims were made about the possible effect of each of the cycles. It was commonly claimed that each of the cycles INDEPENDENTLY could cause an ice age (or major fluctuations in climate.)

In general, candidates made this essay much more difficult than it was intended to be. Section (a) just needs an outline of the 3 cycles and how distance from the Sun and the latitude at which the most intense radiation hits the Earth will have a profound effect on seasons and climate. If you read the question carefully, you will note that you are NOT actually asked to say what the changes ARE but how they are CAUSED. It was (b) that was supposed to be the difficult part to identify the Grade A/B candidates. This is far from easy. You need to be aware of how the distribution of continents and mountains may have affected climate during the Quaternary.

It was also hoped that the best candidates might have made one or two points emphasising the fact that all of the evidence is debatable - particularly the Milankovitch Cycles. (This makes them an excellent example of a scientific investigation.)

3 (a) Explain how Milankovitch Cycles are thought to have caused climatic fluctuations in the Quaternary.



Milankovitch Frequencies

The Milankovitch Cycles are shown above.

The orbit of the Earth around the Sun changes from being circular to being elliptical every 100,000 years. When it is circular the Earth is closer to the Sun so there will be an interglacial. When the orbit is elliptical the Earth is further from the Sun so there is a period of glaciation. Therefore, there are glacials every 100,000 years.

The Earth's axis of rotation is not at right angles to the plane of the orbit. The axis is tilted and the angle of tilt varies. When the tilt is greatest the earth is closer to the Sun so there is an interglacial. when there is no tilt the Earth is further from the Sun so there will be a glacial. This causes glacials every 40,000 years.

The axis of rotation not only tilts but moves in a circle like a spinning top. this is called precession. It has the same effect as tilt so if precession means that the earth is farther from the Sun there is a glacial and vice versa. Therefore, there are glacials every 20,000 years.

This was generally interpreted as "Explain how the Milankovitch cycles cause ice ages." This showed a general lack of understanding as will be discussed below.

This is about the upper limit of what is expected. Having said that, there were some excellent diagrams. What the three cycles are seems to be well understood.

It is not expected that the exact (are they exact ?) time periods of the cycles are known but they should be of the correct magnitude. So, 100, 40 and 20 ky are reasonable (100, 40, 20Ma are not).

(HWK question : any idea what the other numbers 413, and 19 are ?)

A good start. There is not really a sensible alternative to describing the cycles other than by using labelled diagrams.

This is the general description provided by the average candidate.

It is riddled with misconceptions. ☹️ ☹️ ☹️

Eccentricity : it sounds as though the orbit jumps from one to the other every 100ky and that eccentricity can act independently of everything else to cause glacials and interglacials.

Obliquity and precession : is the Earth any closer to the Sun when its axis tilts ? Another common claim was that the Earth is either tilted towards, or away from the Sun. The former results in interglacials. Also, if it is tilted away from the Sun it is the INCREASE IN DISTANCE that is the significant factor.

Climatic changes are a result of the amount of the Sun's radiation that reaches the Earth.

The Milankovitch Cycles are illustrated above.

The first diagram shows how the orbit of the Earth around the Sun changes between being circular to being increasingly elliptical every 100,000 years. This means that the distance of the Earth from the Sun is continually changing and, as a result, the intensity of the radiation reaching the Earth is also varying.

Because of changes in the tilt (either due to obliquity or precession) of the Earth's axis in relation to the plane of its orbit, the radiation from the Sun will be incident on the Earth's surface at different angles at different times.

If the axis is at right angles to the orbital plane (zero tilt) there will be no seasons. The larger the angle the greater will be the difference between the seasons. It is difference between the seasons that is significant.

Milankovitch suggested that these three cycles COMBINE to produce a fluctuating pattern of solar radiation reaching the Earth. He produced solar radiation curves for the last 650,000 years.

His ideas were not immediately accepted and it was not until details of ocean temperature curves were obtained from deep-sea sediments that he was taken very seriously.

When the cycles combine to give reduced radiation during the summer at 60-65°N, where most of the continents now are, then snow from the previous winter will not fully melt. As the snow accumulates more and more radiation is reflected back into space leading to further cooling.

Large and frequent temperature fluctuations are a characteristic of the most recent ice age.

The amount of radiation given out by the Sun is not constant (approx 100y cycle.)

This is better.

Still need the diagrams if you want to make life easy for yourself.

Good concise explanations.

Usual trade off between depth and breadth. You MUST mention all three (to get high marks) but you could go into much more depth with one than the others. Discussing the reasons for, and effects of, the seasons was popular.

MUST emphasise the combined effect of the cycles.

Good here to bring in the possible uncertainty.

Good to bring in other factors which show that you appreciate that the topic is complex.

(b) *The importance of mountains and continents.*
A wide variety of natural causes combined to produce the Quaternary glaciations.
If you look down vertically onto the North Pole you will see a clustering of large continents around the pole. You could argue that the Arctic Ocean should be called an inland sea rather than a true ocean. Also, the continents each have high mountains. This arrangement is key to the origin of the most recent ice age, and it is the result of plate tectonics. Thus, if a single cause has to be chosen for the ice ages perhaps it is best to choose plate tectonics.

Again, emphasising that this is a complex topic.

Nice account of recent distribution and effect of continents.
Could do with a little more detail.

When South America collided with North America it blocked the east-west flow of currents through what is now the Caribbean. The alpine Orogeny resulted in the formation of major mountain ranges (Alps, Himalayas, Rockies etc.) The mountains have a profound effect on atmospheric circulation and precipitation.

When this happens the subsequent weathering and erosion has significant effects on the amount of carbon dioxide in the atmosphere BUT this is considered outside the present specification (although it was referred to by a few candidates.)

The distribution of the continents does not in itself explain the Ice Age.

What finally triggered the most recent ice age seems to have been changes in ocean currents. North and South America collided about 2Ma ago. Ocean currents today are constrained by the shapes of the continents as well as the positioning of the oceanic ridges and abyssal planes. In the North Atlantic the climate can become glacial when the currents are slow moving.

This is very good. Not really expected. Shows good insight. This sort of argument would only be expected from a Grade A/B candidate and an essay containing such as this would be expected to score 20+.

Note that the above is a SIMPLIFIED account of what MIGHT BE causing Ice Ages and fluctuations in climate within them. Are you expected to know all of this ? It would be nice to be able to say yes, but examiners only expect you to be aware that the whole topic is VERY complicated and to be aware of some of the factors. SO - what are you expected to know?

What was expected for this essay was :

- (a) There are 3 cycles which COMBINE to produce a pattern of received solar radiation that (matches that which has been obtained from deep sea sediments) correlates with fluctuations in climate over the recent past. What are they and (briefly) what effect do they have ?
- (b) The cycles do not explain Ice Ages. The (recent) distribution of the continents (due to plate tectonics) and their mountains affect the circulation of the atmospheric and oceanic currents. This has a great effect on climate.

This is not the full picture. We haven't even mentioned what, if any, effect volcanic activity may have had.