

GCE

Geology

Advanced GCE A2 7884

Advanced Subsidiary GCE AS 3884

Report on the Units

January 2009

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Reports should be read in conjunction with the published question papers and mark schemes for the Examination.

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Advanced Subsidiary GCE Geology (3884)

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2831 Global Tectonics and Geological Structures (Written Examination)

General Comments

There were some excellent scripts demonstrating very good subject knowledge from candidates able to express themselves clearly and concisely using good technical terminology. Performance at the top end was very good with some candidates achieving more than 50 marks out of the 60 available. Very few candidates gained less than 23 marks out of 60 which indicates thorough preparation. There was no evidence that time was an issue, almost all candidates attempting the extended guestion.

Some candidates need to pay far more care and attention to the quality of their written communication. Poor handwriting and spelling continue to be issues for some candidates and they should be encouraged to learn the correct spelling of key geological words and terms.

Comments on Individual Questions

Question 1

The quality of responses to this question on discontinuities and Earth structure was very good with a mean of over 10/17.

(i) The majority of candidates were familiar with the discontinuities, although the 1 (a) spelling of them was sometimes incorrect. This is the kind of question where accuracy of spelling may well be tested.

The three discontinuities candidates need to know are:

Crust/mantle	Moho / Mohorovicic
mantle/outer core	Gutenberg
outer core/inner core	Lehmann

(ii) Candidates showed a sound understanding of the Lehmann discontinuity, most knowing that it is a phase boundary between the liquid outer core and solid inner core. Other candidates indicated that it is a transitional boundary and others knew the depth at 5 100km.

(iii) Many candidates knew that discontinuities can be detected by changes in velocity of P or S waves as a result of refraction or reflection of the waves. (Very few students used the incorrect term *defraction*!) Few candidates described the shadow zones which are key pieces of evidence. Candidates should be familiar with the relevant epicentral angles; 103° to 103° for S waves and 103° to 142° for P waves.

(b) (i) Many candidates knew that the lithosphere was solid but not many knew any extra detail. Candidates should be aware that the lithosphere constitutes the plates and consists of the crust plus the upper part of the mantle. A few candidates confused the lithosphere with the asthenosphere.

> (ii) Many candidates knew that the asthenosphere was (5%) partially molten, with a very few candidates stating semi molten, which was not accepted. Many candidates knew that the asthenosphere could flow and was rheid. Candidates need to be careful that they do not contradict themselves by saying the asthenosphere is solid and then saying it is 5% partially molten.

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1 (c) (i) The vast majority of candidates completed the graph with little difficulty. Candidates should be encouraged to be as neat as possible when completing the graph, possibly drawing it in pencil first and then in black pen.

(ii) (iii) Only about half the candidates successfully calculated the geothermal gradients. Candidates should be able to calculate gradients and should be encouraged to show their working. Candidates should expect various calculations within examinations, especially spreading rates at Mid Ocean Ridges.

(iv) Many candidates were unsure about whether the geothermal gradient increased or decreased, and some responded in terms of the steepness of the gradient. The simple solution was to use the results from (ii) and (iii).

(v) Candidates could describe either the difference between region A and B or the differences with depth of region A. Candidates clearly understood this and most gained the mark.

(vi) 40% of candidates could name an area of low heat flow such as *deep sea trenches* and *cratons*.

Teaching Tip

Candidates should be familiar with high heat flow areas at volcanic regions. Candidates could colour code a map of the world with red for high heat flow and blue for low heat flow.

- 1 (d) Very few students knew that radioactivity is the main source of the Earth's heat. However there are other sources such as:
 - latent heat of crystallisation as the inner core crystallises
 - residual heat from Earth formation
 - gravitational contraction of the core

Question 2

Candidates found aspects of this question difficult especially finding enough detail to gain two marks in many of the part questions. Evidence for continental drift could well be set as an extended prose question so it must be understood in detail.

2 (a) (i) The majority of candidates knew at least one plate margin example with 25% knowing all three. Candidates should be familiar with a tectonic map of the world.

Teaching tip

Candidates should have a map of the world with named plates indicated as well as the movement directions. Key mountain ranges could also be labelled.

(ii) 80% of candidates achieved at least two marks, with many gaining full marks for the diagram of a constructive plate margin. Although labels were quite accurate, the diagrams themselves were often poor. Convection currents need to be drawn accurately and not as a small circle adjacent to the ridge.

Teaching Tip

Candidates must practice drawing detailed and fully annotated crosssections of all types of plate margin. Candidates should be able to add at least four labels to a plate margin diagram. (b) (i) Most candidates knew that the age of oceanic crust increases away from the Mid Ocean Ridge. However about 28% could add a second point explaining either the symmetry about the Mid Ocean Ridge or the idea that new crust was being created at the ridge.

(ii) Most candidates explained how iron rich minerals in a cooling magma preserve the magnetism of the time. Candidates need to have a clear description of this process as many explanations were too vague. 30% of candidates were able to gain a second point mainly for mentioning the "flipping" of the Earth's magnetic field. Candidates need to use an alternative term to "reversing" if the term reversing is in the question. Candidates must also be aware of the symmetry of the magnetic "stripes" around the ridge.

2 (c) (i) Most candidates were able to discuss the use of fold mountains and indicated a jigsaw-like fit.

Teaching tip

Candidates should be able to draw a map showing Africa and South America joined together with fold mountains and cratons crossing the join. Carboniferous glacial deposits and fossil outcrops are also useful.

(ii) Candidates found the lithology evidence more difficult. Candidates could discuss the use of specific rock types like desert sandstones, coal or glacial deposits that form in specific climatic zones or else use the matching outcrops of rock types like Carboniferous glacial deposits in Gondwanaland.

(iii) Most candidates discussed finding the same fossils on different continents. Many also mentioned the idea that most of these organisms could not have swum or flown over the expanse of ocean and so the continents must have been part of the same land mass. Many candidates could quote specific fossils especially *Mesosaurus* and *Glossopteris*. In addition, candidates could discuss the use of corals as equatorial/sub equatorial palaeolatitude indicators.

Question 3

Question 3 produced a range of excellent responses indicating that candidates had a clear understanding of earthquake measurement and impacts. Average mark was 11/16.

3 (a) (i) Almost all candidates were clear that the technology did not exist to record magnitude in 1556.

(ii) Less than half the candidates knew a precise definition of earthquake magnitude often using terms such as *strength, size* or *power* of the earthquake rather than *(strain) energy released*. A few candidates also mentioned seismic wave magnitude. A significant minority also confused magnitude with intensity.

Candidates must learn these definitions and be precise in the use of the terms.

(iii) This question was answered very well with 70% of candidates gaining both of the available marks.

3 (b) (i) 70% of candidates gave a good definition of a tsunami. Errors occurred when they called it a "tidal wave" with no link to an earthquake or else just called it a wave, without any indication of size.

(ii) Only 33% of candidates were able to give an accurate explanation of how tsunamis form by ground movement displacing a body of water. Many discussed the seismic waves themselves creating the wave which is not the case. Tsunami formation does need to be clarified in candidates' minds.

3 (c) (i) Almost all candidates gave an appropriate definition of *intensity* in contrast to the magnitude definitions.

(ii) Half the candidates knew that 12 is the maximum intensity figure currently used in the Mercalli scale. Candidates need to be familiar with the differences between the Richter and Mercalli scales and not confuse *magnitude* and *intensity*.

(iii) This was the most difficult part of question 3 requiring candidates to be aware that the nature of the ground has a major influence on intensity with unconsolidated ground being prone to liquefaction and so giving rise to higher intensity. Candidates instead discussed varying population or building type. This is not relevant as the Mercalli scale takes account of construction type. A few candidates were also aware of the subjective nature of intensity readings.

(iv) The majority of candidates could locate the epicentre.

(v) Most candidates cited the San Andreas Fault although the spelling was very variable. Candidates may be penalised in the new specification for inaccurate spelling of such names.

- **3** (d) Most students knew the correct definitions of *focus* and *epicentre*. The main errors were confusing the two terms or not mentioning that the epicentre is on the surface.
- **3** (e) Most candidates knew enough to gain one mark for the name of the technique, although many did not always follow this up with a detailed description of it.

Many discussed the seismic gap theory, some candidates however, mentioned recording the timing of earthquakes and looking for time gaps. The gaps are in fact places along the fault where the fault has not moved. This builds up stress on the fault which is likely to move. Many also successfully discussed radon gas increasing, water levels changing and the ground moving. Earthquake prediction could well be an extended prose question so candidates need to be able to describe at least four different prediction techniques.

Question 4

Question 4 proved to be difficult for many candidates with only 6% gaining full marks. Structural geology questions tend to be challenging for candidates and this was the case here. Many candidates, however, were able to write in some detail about different types of folds and so gained the full 4 marks for this section. Many also named and drew reverse faults. Errors included discussing *normal* faults and not adding many labels onto the diagram.

Teaching tip

Candidates should be encouraged to practise fully annotating folds and faults. Labels could include the location of the oldest rocks for anticlines and synclines and the hanging wall and footwall in reverse faults.

Some mentioned horst blocks which can occasionally form as a result of compression but candidates tended to draw them with normal faults, which is not the case.

A minority of candidates described the formation of cleavage and those who did made excellent use of diagrams. Candidates who discussed tension joints had more difficulty describing them in detail. A significant number of candidates discussed large scale structures such as fold mountains and subduction zones, and were given credit where such responses were linked to annotated diagrams.

2832 The Rock Cycle - Processes and Products (Written Examination)

General Comments

This examination paper generated a wide range of results with marks ranging from 15 to 57 out of the maximum 60 marks. Question three which included metamorphism was found to be the most challenging with almost half of candidates being unable to explain how to identify regional metamorphic rocks. Question two on sedimentary rocks was the most accessible with almost everyone being able to recognise definitions of weathering processes. There was no evidence that the paper could not be completed within the time allowed.

Comments on Individual Questions

Question 1

Marks awarded ranged from 1 to 16 with the modal mark being 11.

- (i) (iv) The majority of candidates gained three or four marks for this question.
 Some lost marks by repeating the same name for more than one feature
 - (b) (i) Most candidates had difficulty describing two features of fissure volcanoes. It wasn't enough to say they are 'a crack', some idea they are linear was needed. Knowledge of fissure volcanoes seems to be less secure than of other types of volcano.

(ii) The differences between these two types of volcano were generally well known, although some candidates could only think of one difference and others had the characteristics reversed. Some are still not sure what to do when asked for differences, simply stating what one of the types of volcano is like without making any reference to the other.

(c) (i) This proved to be surprisingly difficult. The term 'partial melting' was only used in a minority of responses.

(ii) There were many who did not make the link between partial melting of the oceanic plate and subduction zones

- (d) Most candidates gained some marks. The most frequent mistake was to write about hot, or in some cases warm water rather than superheated water or steam. Some answers did not convey the idea of forceful ejection.
- (e) There were some good diagrams. A basic omission in some cases was not to label them. There is still a fairly large minority of candidates who think that calderas form from the top being blown off a volcano. The idea of collapse due to chamber emptying seems to be unknown or unlearned.

Question 2

Candidates performed well overall on this question. Marks ranged from 4 to 17 and the modal mark was 13.

- 2 (a) (i) Just over half of candidates gained full marks. *Asymmetrical ripple marks*, or *ripple marks* was required for C, not just *ripples*.
 - (ii) Almost all candidates identified the cross bedding as being the wrong way up.

(iii) Explaining how you could tell they were the wrong way up was found to be much more difficult with half of the candidates being unable to do it. There was some confusion about using concave and convex correctly. In cross bedding, the laminae are concave upwards, when the structure is the right way up.

- (iv) Almost everyone recognised the current as travelling from left to right.
- (b) (i) About 30% of candidates did not know the environment that would include all three of the structures.
 - (ii) Almost everyone gained some marks here, with most getting both.

(iii) Most candidates gained one mark here. It was usually for saying something about a current. There was little clear reference to sediment movement up the windward side and falling down the leeward side of the structure.

- (c) Most gained full marks. There were quite a few who did not read the question properly and did not label their diagram.
- (d) Definitions of weathering processes were very reliably recognised with virtually all candidates gaining the marks.

Question 3

Following past trends, this question based on metamorphic rocks was the least successful from the point of view of most candidates. Marks ranged from 2 to 16, the maximum available.

3 (a) (i) Most candidates gained half marks. It was not possible to gain marks simply by ticking all options.

(ii) Candidates often found it difficult to say how they identified regional metamorphic rocks. Some linked foliation to heat rather than pressure.

(b) (i) Quite a number answered schist and gneiss here.

(ii) Schist or gneiss were again thought to be a good bet, often by those who had trusted in them for part (i) The conclusion is that many candidates cannot distinguish between contact and regional metamorphic rocks.

(iii) Most candidates could link crystal grain size to rate of cooling but often did not make a link to the context; e.g. by saying that the rapid cooling occurred next to cold country rocks. Some made the mistake of describing the grain size of the country rocks instead of the intrusion. (iv) Many gained one mark rather than two by realising that heat was conducted from the igneous rocks to the country rocks but then not following it up by stating that recrystallisation resulted.

(c) This question produced a wide variation in response with most candidates gaining some marks. Quartzite was often correctly included, as were limestone and calcite. The last line of the table was found to be the most difficult with 'burial' being confused with regional metamorphism and gneiss being confused with schist.

Question 4

This question was well answered by a large number of candidates with about 15% gaining full marks. The question produced a wide spread, using the full range of marks. The modal mark was 7. Written communication was usually clear. Candidates appeared not to have run out of time.

There were some very good responses with the process of compaction clearly described and well learned. Marks were awarded for descriptions of load pressure, often shown by arrows on diagrams. Often a sequence of diagrams was used to show the reduction in pore spaces. Arrows were again used to show fluids leaving the sediment. Nearly all responses included suitable diagrams with most of them being clearly labelled.

Cementation was generally well understood but many did not refer to minerals being carried in solution and the precipitation of minerals. It was not possible to gain credit for the same description twice. Some candidates said that porosity was reduced in compaction and then repeated this for cementation. However if they stated that porosity was reduced further / even more then credit was given.

It was unusual for candidates to refer to specific sediments, for example by saying that compaction primarily affected clays whereas cementation affected sands. Many candidates realised that both compaction and cementation were diagenetic processes and that they lead to lithification.

2834 Palaeontology (Written Examination)

General Comments

Overall, the paper was of appropriate difficulty for the A2 candidates. Candidates were well prepared for this subject, a reflection of increased calibre of teaching and examining over the past years. Recall of complex morphology and classification was much improved and knowledge of types of preservation was excellent. The extended answers 5 (a) and (b) were answered in detail, with many students gaining full marks for part (a). There was no evidence that the candidates ran out of time - to the contrary, a large proportion of them used extension paper.

Comments on Individual Questions

Question 1

(a) (i) Most candidates identified the fossils correctly. Few identified fossil C as a brachiopod and a few identified fossil D as a gastropod, a nautilus or as a cephalopod (unqualified).

(ii) The quality of fossil diagrams was generally good. Only a few candidates failed to label the diagrams, and most technical terms were spelled correctly. Some excellent diagrams with complex structures and labels were evident, requiring much more effort than required in the question. Some diagrams included soft parts which were not required for the question.

(iii) Most candidates knew, or correctly guessed, the mode of life of belemnites. There were correct comparisons with modern squids by some candidates.

(b) (i) Some candidates were aware of pyritisation but most were uncertain of the mechanism, simply stating 'replacement'. This may reflect poor explanations in some text books or simply confusing another type of preservation. The role of the bacteria was explained well by some candidates. There was confusion over the use of anoxic and anaerobic.

Teaching Tip

Anoxic and anaerobic do not mean the same thing. Try reinforcing this in the following way:

Anoxic = lack of oxygen in the water - use this term to talk about the water. Anaerobic = lack of oxygen in the sediment - use this term to talk about the sediment

(ii) The factors that allow exceptional preservation to occur were well known and described. This did not always apply to the specific question asked, i.e. about amber. Candidates discussed burial in fine sediment or mud, simply stating what they knew about other forms of exceptional preservation.

(iii) Almost all candidates knew of one other type of exceptional preservation and some gave high level responses. The most common responses were *tar* and the *Burgess Shale*. Other answers included *ice, peat, permafrost, carbonisation, mudslide* and *mummification*.

(c) (i) Most candidates were able to define a trace fossil and give an example to illustrate their answer. The idea of the organisms' activity was well understood.

(ii) This was less well answered. There were links made between organisms that made the trace fossils, and then an environment was suggested. More sensible answers commented on the fine grained sediment and low energy necessary to preserve detail of tracks and trails. There were excellent answers discussing burrows used as protection from high energy.

(iii) Many correct examples were given here, including correctly spelled, named examples such as *Cruziana* or *Rusophycus*. Many other examples included *coprolites* or '*fossil poo*'. Less common examples included gastroliths.

Question 2

2 (a) (i) This tested the depth of knowledge about the morphology of crinoids and echinoids. Most candidates correctly answered the morphology of echinoids, but the teaching of crinoids as a minor group was less well known. Very few knew that crinoids had tube feet, a characteristic of the phylum Echinodermata.

(ii) These questions were generally well answered. Some associated tubercles with tube feet. Some reversed the meanings and so gained no credit.

(iii) The modes of life of the two groups were well known. Some candidates used all four terms, and so gained no marks.

(b) (i) The two morphological labels were accurately known almost without exception. Incorrect labels for the labrum often labelled the plastron.

(ii) There were many detailed descriptions of echinoid hygiene. Some candidates gave very bland answers revolving around change of shape or increase in size, without any qualification. A minority of candidates did not 'describe' and 'explain', thus halving their potential marks.

Teaching Tip

Plastron - some candidates were unaware that in irregular echinoids, the area occupied by the plastron houses modified short spines for digging burrows. The structure and function of such adaptations should be stressed <u>together</u> when teaching. These short spines on the plastron are to enable digging burrows in soft sediment.

Pore pairs - these allow tube <u>feet</u> to extend for respiration, movement or attachment. The pore pairs are found in the ambulacra. This is easy to remember as the stem 'ambulacra' in Latin means to walk, and the tube feet allow this attachment / walking to occur.

Question 3

3

(a) (i) Most candidates correctly identified the group as *graptolites*. A few incorrect answers included *ammonite* and *coral*.

(ii) Most candidates did not know the skeletal material of graptolites, a surprising gap in knowledge given the importance of protein preservation in deep waters. A few guessed *aragonite, calcite, clay* or *carbon*.

(iii) There were difficulties in establishing the position of the nema in scandent forms. This resulted in many candidates labelling the features on their own diagrams, which was credited. Candidates should be encouraged to use a bracket or shading when labelling such a large feature as the stipe.

- (iv) Almost all candidates could identify the pendant form.
- (v) Most candidates knew the term biserial.

(vi) Most candidates were able to place the graptolites in the correct order. A few reversed the order putting the oldest at the top, and so gained no marks.

(b) (i) Candidates were able to describe the planktonic lifestyle of a graptolite. There were some detailed descriptions of flotation aids and filter feeding methods. There were references to sessile modes of life, and the association with dendroids was apparent.

(ii) Few candidates were prepared to answer this sort of question and generated a whole series of incorrect answers. The answer required an organism that lived in the water column at the same time as the graptolites. Many answered this question with an unqualified *trilobite*. The addition of *nektonic* or *pelagic* along with this was sufficient to gain the mark, and there were many correctly named trilobites given here.

Question 4

(i) The way up structures were often poorly drawn and labelled. The explanations failed to make connections between the relative age and the way up of the rock. Occasionally an excellent diagram did not have any labels at all. The cross cutting relationships were better understood, usually illustrated with dykes or unconformities as an example.

Common problems with both part answers was that candidates simply used a, b, c etc to illustrate parts of the diagrams. These were often not referred to in the description and did not appear in a key of any sort on the diagram.

(ii) This part question was generally answered very poorly. Many candidates ignored the obvious choices of superposition and included fragments, opting to use varves, ash falls, biostratigraphy, K-Ar dating.

(b) (i) Some candidates answered this question very well. Some candidates described a death assemblage and others used the word *different* rather than younger or older.

(ii) Despite the good answers to part (i), few were able to say that this might make the rock appear older than it actually was, with some candidates guessing and opting for *younger*.

(c) (i) All but the highest calibre students gained two marks in this section. Most were able to refer to ammonites as good zone fossils, but were unable to say how an example could be used. The most common response was to explain how ammonites make good zone fossils. This showed that exam preparation sometimes stressed *knowledge* at the expense of *understanding*. A few incorrect examples of fossils were graptolites and dinosaurs.

(ii) Very few candidates were unable to answer this question well. There was some overlap with weaker answers. For example, candidates answering both *fast evolving* and *occupied a small time zone* as two separate answers would only gain one mark.

Question 5

 5 (a) This essay did not provide much differentiation of the candidates' abilities. Overall the standard of answers was generally excellent for this essay question and a large number of candidates gained full marks. The labelled diagrams of rugose corals were often excellent but a few diagrams really were too small to show the required detail.

> Some candidates were confused and stated that it was the corals themselves that photosynthesised. Some students wasted time by comparisons with the other coral types, as this had clearly been a focus of revision.

The modes of life provided much material and accrued marks. There was a lot of detail about temperature, salinity, water depth and energy levels.

(b) This essay proved more helpful in differentiating the candidates. Overall the standard was reasonably good, and fewer candidates gained full marks.

Many students described the reasons for the extinction, but did not say very much about what became extinct and when. Some described one or two of the ideas about this extinction in some depth, showing a robust understanding of the science involved.

There were some excellent answers relating to the *K*-*T* mass extinction which could only score one mark. Although such candidates could score marks for discussing volcanism, ash, and climate change.

There was no evidence that the candidates had run out of time, as many had used extension sheets to complete their answers for question 5 (a) and (b). Many candidates scored between 20 and 25 marks for question 5 overall, making this a very high scoring paper.

The quality of written communication was generally of a good standard though spelling of technical terms is an issue.

Grade Thresholds

Advanced GCE (Geology) (3884, 7884) January 2009 Examination Series

Unit Threshold Marks

Unit		Maximum Mark	Α	В	С	D	E	U
2831	Raw	60	45	40	36	32	28	0
	UMS	90	72	63	54	45	36	0
2832	Raw	60	48	43	38	33	29	0
	UMS	90	72	63	54	45	36	0
2834	Raw	90	75	69	63	57	52	0
	UMS	90	72	63	54	45	36	0

Specification Aggregation Results

Overall threshold marks in UMS (i.e. after conversion of raw marks to uniform marks)

	Maximum Mark	Α	В	С	D	E	U
3884	300	240	210	180	150	120	0
7884	600	480	420	360	300	240	0

The cumulative percentage of candidates awarded each grade was as follows:

	Α	В	С	D	E	U	Total Number of Candidates
3884	10.0	27.5	50.0	80.0	97.5	100.0	40
7884	00.0	00.0	33.3	66.7	100.0	100.0	3

43 candidates aggregated this series

For a description of how UMS marks are calculated see: <u>http://www.ocr.org.uk/learners/ums_results.html</u>

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