GCE EXAMINERS' REPORTS

GEOLOGY
AS/Advanced

SUMMER 2012

Statistical Information

The Examiner's Report may refer in general terms to statistical outcomes. Statistical information on candidates' performances in all examination components (whether internally or externally assessed) is provided when results are issued.

Annual Statistical Report

The annual Statistical Report (issued in the second half of the Autumn Term) gives overall outcomes of all examinations administered by WJEC.

GEOLOGY

General Certificate of Education

Summer 2012

Advanced Subsidiary/Advanced

Principal Examiner: Mr. David Evans

Unit Statistics

The following statistics include all candidates entered for the unit, whether or not they 'cashed in' for an award. The attention of centres is drawn to the fact that the statistics listed should be viewed strictly within the context of this unit and that differences will undoubtedly occur between one year and the next and also between subjects in the same year.

Unit	Entry	Max Mark	Mean Mark
GL1	1578	60	35.3

Grade Ranges

A	43
B	37
C	32
D	27
E	22

N.B. The marks given above are raw marks and not uniform marks.

GL1

The GL1 examination tested a wide range of skills including the interpretation of diagrams, a photograph, a map and geological cross-sections. As usual the paper covered many areas of the specification content and included both straightforward and more complex ideas, making it accessible to a wide ability range.

Q.1 (a) (i) Many candidates, although by no means all, knew the terms cephalon and pygidium. Most candidates recognised rock R as limestone.

(b) This question involved the need to describe features of the rock and/or its fossil content and to interpret the observations. The most common answers referred to the marine, shallow and tropical environment of deposition of limestone, noted the presence of marine fossils such as brachiopods or trilobites and linked the style of fossil preservation to energy levels. The responses were generally very good.

(c) Full credit was given to those candidates who defined a life assemblage and described and interpreted evidence to evaluate their viewpoint. Acceptable answers noted that some fossils were fragmented, although others were not. The random orientation of the fossils was also mentioned by some candidates. Full marks were also given to students who argued it to be a life assemblage, as well as those who regarded it as a death assemblage.

(d) Most candidates correctly noted that in part (i) the rock was deposited in time zone 3 since this is when specimens A and C co-existed. Most candidates also correctly noted time zone 4 in part (ii) although fewer correctly interpreted species B as the derived fossil.

Q.2 This was the most successfully answered question of the examination.

(a) Most candidates located E at the point of origin of the seismic waves on Figure 2a. A significant minority of students did not attempt part (i) of the question, presumably because they did not notice it. Most students correctly noted the role of the liquid outer core in creating the S-wave shadow zone.

(b) The majority of students correctly indicated the arrival of the waves in order P, S and surface. The cause of the different arrival times was most commonly answered as being due to variation in velocities, but the better answers also developed the idea of different paths for different seismic waves. In part (iii) most answers correctly located N between the epicentre and the S and P-wave shadow zone, with recognition that all 3 wave types recorded on the seismogram could only occur outside a shadow zone.

(c) The calculation required students to note the distance of 6600km and the time of 600 seconds. The most common error was to divide the 6600km by 10 minutes, rather than the 600 seconds required for the units of the answer. Part (ii) was successfully answered by students noting the outline of a P-wave shadow zone on Figure 2c. The best answers also developed evidence for the map representing neither an S-wave shadow zone nor the pattern associated with surface waves. Part (iii) was well answered with most candidates noting that only surface waves could be recorded in the P-wave shadow zone.

Q.3 (a) Few candidates gained all 3 marks in part (i), the most common error being to misinterpret the 3 dimensional nature of the diagram, and refer to igneous body A^1 as dipping South-East from an incorrect interpretation of the front, vertical face of the quarry as a map. In part (ii) most answers correctly identified a dyke, with the discordant and linear nature of the body cited as evidence.

(b) The majority of answers noted the displacement of the beds as evidence that the igneous body had formed along a fault line. However only the better candidates correctly noted that the fault showed reverse movement, and supplied relevant justification for this identification.

(c) Part (i) was correctly answered in its most simple form by most candidates, but fewer answers noted that the principle only applies if the beds have not been overturned. Part (ii) was less understood but the best answers stated that the clasts of mafic igneous rock were older than the conglomerate. Part (iii) built on the knowledge displayed earlier in part (c). The most common error was the assumption that the clasts of mafic igneous rock in the conglomerate derived from igneous bodies A^1 or A^2, despite the cross-cutting nature of A^1 and the fact that A^1 and A^2 are the same age.

Q.4 This was the least well answered question on the examination, despite the fact that most candidates completed it. Consequently it seems that a lack of time was not the reason for poor performance on question 4.

(a) Very few candidates recognised Feature M as a mineral vein, with the majority of students incorrectly offering the term dyke. This mistake triggered further errors in part (c) of this question. In part (ii) Mineral L was invariably correctly identified as quartz, but very few students offered fluorite as the correct answer to Mineral P.

(b) Few candidates fully understood how load casts and flame structures form, with many referring to processes involving solid rocks, or erosion and subsequent deposition. In part (ii) few students referred to how the load casts and flame structures provide evidence that the beds are the correct way up and hence with the older rocks in the core, the fold is, by definition, an anticline.

(c) The final question of the paper proved to be a good discriminator. The weaker candidates, having incorrectly noted a dyke in Figure 4a, wrote about the role of contact metamorphism. Some candidates whilst recognising that slate is a low- grade, regional metamorphic rock formed by heat and directed pressure, still considered that the inter-layered metaquartzite could have formed by the entirely different style of contact metamorphism. The best answers focussed solely on the presence of slate and its slaty cleavage illustrated in Figure 4a.

GEOLOGY

General Certificate of Education

Summer 2012

Advanced Subsidiary/Advanced

Principal Examiner: Mr. Craig Wall

Unit Statistics

The following statistics include all candidates entered for the unit, whether or not they 'cashed in' for an award. The attention of centres is drawn to the fact that the statistics listed should be viewed strictly within the context of this unit and that differences will undoubtedly occur between one year and the next and also between subjects in the same year.

Unit	Entry	Max Mark	Mean Mark
GL2a	1514	60	36.4

Grade Ranges

A	43
B	38
C	33
D	28
E	24

N.B. The marks given above are raw marks and not uniform marks.

GL2a

The paper tested the range of skills and techniques flagged up in Unit GL1 of the specification. It had to be, like GL2b, centre-marked with moderation by the WJEC team.

A meeting, whose personnel included the moderators, took place the day after the paper was timetabled. The mark scheme proposed by the Principal Moderator was reviewed against some students' scripts and a definitive version was then published, downloaded by centres from the WJEC website. Guidance in its application was available, as in the previous year, via e-mail to the Principal Moderator for this unit. There was also a marked example available from the website which demonstrated the application of the scheme, and also the mechanics of marking.

The scheme suggested expected, acceptable and unacceptable responses. It stated that alternative answers could be credited. The e-mails and the moderation process indicated that this did occur. Feedback from centres, and moderation of sample scripts suggested that the application of the mark scheme by teachers was successful (see below). There were a very small number of teachers who failed to apply the mechanics of marking stated on the cover of the mark scheme, and these issues are discussed in their Centre Reports, which are available when results are published. Clerical errors by teachers, particularly in the paper totals, were corrected before moderation took place; WJEC were informed of the new marks and candidate records were adjusted.

The total entry was up this year to 1514 candidates, of whom 567 had their scripts moderated. Of the 88 centres, marks were adjusted for only four. Overall, the statistics for the 2012 paper are almost identical with those of 2011, and it is concluded that this year's paper performed at a similar level to previous ones.

It must be mentioned that it appears that some Examination Officers are not aware of the distinction between the two types of centre-marked assessment. Over 20 centres (appearing on the Moderators' GL2a lists) failed to send scripts to the team. They had in fact followed the GL2b route.

The demands made by the paper on candidates were designed to be broadly comparable with papers from previous years, being an integrated test using maps, photographs and specimens. Extra information is also given to make some questions data response. There is usually broad coverage of GL1 content but there is no fixed length of questions (a few centres commented that Q1 was too long this year, a few said that the mark allocation to the cross-section was too low, and one complained about the use of a borehole). Past papers illustrate the range of questions used. Credit is often given to GL4/GL5 knowledge and understanding but re-sit students must always be aware that Map 1 is designed to meet AS standards and so, for example, it should not be assumed that dip-slip faults have an element of strike-slip movement – that is the type of progression demonstrated in GL4 mapwork.

Q.1 Candidates who read the question stem usually had no difficulty in separating evidence from Map 1 (part (a)) and fieldwork (part (b)). The mark scheme was very flexible here with answers expected from the map also being allowed as fieldwork if they hadn't already been credited. Alternative answers for fieldwork evidence included a possible deflection of the dip of the country rock by the intrusion – this was tested in a previous paper. Part (b)(i) asked students to name a mineral; if the data sheet gives a full name for a mineral, candidates should use it e.g. "*plagioclase feldspar".* Some candidates in part (ii) didn't appreciate that the cleavages didn't intersect at 90^0 and so got the evaluation wrong. Part (c)(i) usually gave a response within the range allocated indicating a *"coarse"* rock; (ii) depended on candidates understanding that the other two named rocks are also coarse so the evaluation is false. A handful of centres complained that this evaluation was a double negative and therefore was a test of English, but it caused no real difficulty to the vast majority of students who understood the textural element of igneous rock classification. Study of past papers will show that this form of evaluation has been used before – with no comment received from centres! Part (d)(i) needed the figures to total 100%; (ii) tested the mineralogical/compositional side if igneous classification. Part (e)(i) was a standard type of question, used many times before. This year Specimen B was a dolerite. It is not always possible to give identical rock specimens to centres and WJEC had to deal with several issues regarding the *"colour"* or *"texture"* of the specimen compared with that on the photograph sheet which is included in the specimen box. Specialist teachers can, and must, access the specimens prior to the test date and are encouraged to raise any issues with the Subject Officer. The front of the question paper clearly states that *"the geology is not designed to represent any particular area"* as to do so may give an unfair advantage to candidates who are familiar with such an area. Part(ii) showed columnar jointing within a vertical dyke. One centre thought their students would be confused by the photograph and later sought advice from a local university to query whether joints of this quality could be found in a dyke. A few others had obviously done fieldwork on the Giant's Causeway and based their answers on processes within a lava flow – credit was given to cooling and contraction but this interpretation meant that marks couldn't be given to explanations as to why the joints were horizontal. Part(iii) saw many students failing to relate dykes to areas of crustal tension.

Q.2 Part (a) produced a range of drawing quality, with some being rather stylised – candidates simply have to draw what they see. Some centres were very generous in crediting the drawings despite the examples contained in the mark scheme. Candidates who read, and remembered, the question stem ("*Rock Unit C is an aeolian sandstone"*) correctly named quartz as the dominant mineral in part(b), but despite being told not to test for hardness, some did just that! When dealing with a medium textured sedimentary rock where the mean grain size is 1mm, candidates are better served by observations rather than tests. It is very difficult to test a grain of haematite-stained quartz for a streak and come up with the answer that it *"scratches the streak plate",* when a *"cherry-red"* colour is more likely to be seen! (c) required *"contact metamorphism"* as the process to gain full credit.

Q.3 Part(a) again produced a range of drawing quality, and, despite the prompt on Photograph 4, a side-view was not always drawn and a suture line labelled. Some centres were very generous in crediting the drawings despite the examples contained in the mark scheme. (b) and (c) were good discriminators. The major error in (c) was to use period names as an era.

Q.4 The maps this year contained much less information regarding be dip information, so it was pleasing to receive so many correct answers to parts (a)(i) and (ii). Part (iii) caused some difficulty, despite the definition of wavelength being given in the stem. Part (b) discriminated well with the usual variation of interpretation of faults on maps being evident.

Q.5 Part (a) had the type of flexible mark scheme previously used in tasks of this type. It allowed credit to be given for any correct interpretation of the information given on the map. The instruction this year said *"draw …… using the borehole data".* Many of the stronger candidates realized that this was an instruction to *"construct"* and produced sections of the highest standard. Candidates who failed to use the borehole could still score a maximum of 5 marks. It is pleasing to note, however, that there are now very few candidates who get 0 marks on the section. The relatively low sub-total for the section was compensated by an equal number of marks available in part (b). It is a false assumption to think that candidates either get the column "correct" and therefore gain full credit, or they get it "wrong" and gain none. This type of question was common before this paper became centre-marked and hopefully the mark scheme demonstrated to teachers how students could make errors in the geological history, but still accumulate marks to allow discrimination.

Q.6 More students failed to score in this question than in any other on the paper. There were those who just ignored it (no centres have raised timing issues), but this year there was also a trend where some attempt was made, but not focused on the question asked e.g. by discussing fossils. Previous reports have stated that some candidates were getting full marks without relating their answers to the kind of interpretations encouraged by fieldwork. This year, maximum marks were not possible if the answer was not linked to field geology/Photograph 5. Reserved marks were awarded to description and explanation of one structure and one texture with additional credit being given for either higher level description/explanation of the chosen feature or by mentioning others. Full marks were awarded to candidates who drew an annotated sketch as well as those who only gave a concise written answer. A few candidates mistakenly treat this question as an essay; full marks are not guaranteed by these lengthy (2-3 page) responses.

GEOLOGY

General Certificate of Education

Summer 2012

Advanced Subsidiary/Advanced

Principal Moderator: Dr Alan Seago

Unit Statistics

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Unit	Entry	Max Mark	Mean Mark
GL2b	226	60	41.5

Grade Ranges

A	48
B	42
C	36
D	30
E	24

N.B. The marks given above are raw marks and not uniform marks.

GL2b INTERNAL ASESSMENT

25 centres submitted field investigations for moderation including some centres acting as a consortium It is pleasing to report that centres are taking note of comments made in individual centre reports in previous years so that there is a continuing improvement in the suitability of tasks being undertaken and the quality of candidates' work. Few centres now require scaling. There are two main reasons why scaling has to be applied;

- reliable rank order but marks generous or severe
- failure to show how criteria have been achieved by annotation of candidates' work

Centres should be aware of the required context of the investigation at all times as described in the specifications.

The centres are to be congratulated on:

- the standard of work produced by the candidates
- the opportunities given to the candidates to study geology in such suitable areas
- and in most cases the accuracy of the assessment.

The enthusiasm for geology and expertise of the teaching staff in centres is obvious from the quality and effort put into coursework submissions.

There were one or two examples of errors in administration such as using the incorrect forms, not doubling the marks to a mark out of 60, errors in addition of marks, discrepancies between marks on the work and on the forms and not authenticating the work of the candidates. This can affect candidates' grades if not picked up by the Moderator so centres are urged to double check the accuracy of their paperwork. Similarly centres are urged to ensure samples of coursework arrive at the Board by the correct date.

The better investigations include the demonstration of basic field skills such as rock identification and textures, identification of field structures using dip and strike/field sketches, sedimentary logging and fossil identification. The data collected can be manipulated and presented in cartographical or graphical form. Some excellent field investigations are now being seen which are well suited to the assessment framework. It is good to see geological field skills being demonstrated with a high degree of competence.

In some cases there was no risk assessment although the number of instances is decreasing. It was pleasing to see the extensive use of the Planning Tracking sheet. **Some thought has to be given at the planning stage as to whether the data being collected is suitable for processing and analysis e.g. histograms, cross-sections, logs, rose diagrams maps and geological histories.** A number of centres are now making preliminary visits to sites in order to allow some forward planning by candidates, which often results in better Planning marks. Some candidates devoted insufficient time on the retrieval and evaluation of relevant material from different sources. **Evaluation still remains as the weakest skill.**

Some field notes consisted entirely of tables of data and it would be an improvement to see a variety of data collection including field sketches and rock descriptions etc. In a number of cases, opportunities for the collection of basic field data have been missed. Centres should ensure that candidates have sufficient time at the investigation site to collect appropriate and sufficient data. **Observations such as rock identification, grain size, sorting, direction of cross- bedding, clast roundness/orientation, field sketches, dip and strike measurements should normally be part of every investigation where appropriate.**

There is no need for candidates to repeat observations made in the field notebook within a report unless it contributes significantly to the analysis. It is more advantageous for candidates to concentrate their efforts on the analysis and evaluation. In a minority of cases it was difficult to distinguish between field data and secondary data or individual work and collective work. Centres and candidates should ensure that the nature of the work is clearly identified for moderation. Candidates are making good use of their IT skills.

A number of centres are using Field Study Centres in order to carry out their fieldwork. In the majority of cases this proves to be a successful venture. However, centres should be aware that in some cases the field study centre may not be familiar with examination assessment criteria and geology teachers should make sure that the field study centre knows exactly what is required for the field investigation in terms of the specification.

A variety of tasks were undertaken, with investigations into:

interpretation of sedimentary environments (sedimentary logs, fossils and rock description)
mapping exercises (leading to drawing up of geological sections and history)
analysis of fossil assemblages
joint orientation related to faulting (rose diagrams and stereonets)
structural analysis (faulting and folding styles related to compression or tension or to specific orogenies)
crustal extension related to dyke intrusion
nature and relative age of igneous intrusions

Centres are to be congratulated on the variety of opportunities given to candidates in areas of outstanding geology such as, Isle of Arran, Amroth, Ogmore, Styal Mill, Mumbles, Lulworth, Black Mountain, Anglesey, Cheshire, Halkyn Mountain, Barry, Harlech Dome, Wren's Nest, Bridgnorth and Carrock Fell Other centres made good use of suitable local geological locations.

Centres should be aware that there is help available from the WJEC. Published exemplars of coursework investigations can be obtained from the WJEC offices and INSET activities are provided. Moderators' reports on the current moderation process are sent out to centres. Centres are urged to act on any recommendations in the Moderators Reports, The Moderators do not enjoy moderating work which achieves low marks as this is going to be disappointing for the centre and the candidates, especially when there is often so much suitable geology on the centre's doorstep which with a little help and guidance can result in a successful submission. There are guidelines in the specification such as Planning Aid p62 and suggested investigations p22. Alternatively the centre could discuss suitable investigations with me through email/ telephone as several centres do. This can include advice on the suitability of coursework investigations prior to carrying them out and examination of candidate's draft field investigations. Any centre having a problem with applying the assessment framework should contact the WJEC well in advance of the submission date. If a centre requires further clarification of the Moderator's Report or assistance with future presentations please contact me at the following e-mail address a.seago@open.ac.uk.

GEOLOGY

General Certificate of Education

Summer 2012

Advanced Subsidiary/Advanced

Principal Examiner: Mr. Pete Loader

Unit Statistics

The following statistics include all candidates entered for the unit, whether or not they 'cashed in' for an award. The attention of centres is drawn to the fact that the statistics listed should be viewed strictly within the context of this unit and that differences will undoubtedly occur between one year and the next and also between subjects in the same year.

Unit	Entry	Max Mark	Mean Mark
GL3	1314	50	31.9

Grade Ranges

A	36
B	32
C	28
D	24
E	21

N.B. The marks given above are raw marks and not uniform marks.

Section A

General Comments

Section A discriminated well with both questions demonstrating areas that were more or less accessible to candidates. Question 1 was slightly better answered than Question 2 where candidates sometimes gave vague answers which did not answer the question set. A number of illegible scripts continues to hinder examiners in giving candidates just credit.

Q.1 (a) (i) Most candidates were able to identify somewhere near the centre ofuplift though some locations were associated with the caldera rim or the 1000mm contour. A few good candidates also appear to have missed this question as they did not respond.

(b) (i) Whilst many candidates were able to successfully give the lowest and highest readings , the maximum uplift proved to be a discriminator with 3000mm as a common answer while a significant number did not offer any answer.

(ii) This was generally well done with most candidates producing an answer between 1.5 and 1.6mm per day. Candidates were given credit for showing an understanding of the how to work out the rate from their working. Those who did not show their working were penalised.

(c) (i) This was generally answered correctly and most candidates adequately described the variation between the two dates. However, some mistakenly suggested the data illustrated the ‘size’ or ‘strength’ of an individual earthquake rather than total number per month. Others confused the scales e.g. "… rose to 3000 earthquakes per month."

(ii) Most correctly suggested that "as the height increased so did the the number of earthquakes” however, a significant number of candidates failed to suggest that the correlation was “good”. Even fewer suggested that when the monthly earthquakes fell to almost zero the uplift declined slowly.

(d) The response to this was generally disappointing with many candidates failing to suggest a convincing link between uplift, earthquakes and magma movement beneath – many failing even to consider the role of magma. A large number of candidates suggested that earthquakes "trigger" eruptions rather than the movement of magma producing the earthquakes. Many also assumed that there had been an eruption in 1983-85. Poor grammar was once again an obstacle to candidates obtaining full marks for their explanations.

Q.2 (a) (i) Considered to be an easy starter, this was very poorly answered by many candidates with only a few obtaining full marks. Many considered the Richter scale to be a fixed 10 point and there was much confusion with the modified Mercalli “intensity “scale. Vague terms such as *size, power, strength* were used to convey *energy* or *magnitude.* Many had difficulty spelling "logarithmic." and often even the more able candidates suggested that the interval between points on the scale was a multiple of 10 or 32, without relating to *ground motion* or *energy released.*

(ii) This also proved to be surprisingly difficult. The earthquake focus was often placed well away from the fault plane and not beneath Bam, despite the data indicating that Bam was the epicentre.

(iii) The most significant problem here was that many candidates chose to state rather than explain the evidence from the data – even though the key words were in **bold** type. Thus "the earthquake was directly beneath Bam" or "the roofs were heavy" failed to gain marks without qualification.

(b) This was answered well by the majority of candidates; the most popular response being porous and permeable (although their spellings varied considerably.) However there were some comments on the properties of the clay beneath which did not get credit or textural features of sands and gravel that would not have made them suitable as aquifers (e.g. poorly sorted).

(c) (i) Responses to this were excellent, surprisingly with "antiform" being as popular as "anticline." A number also identified the asymmetry showing excellent knowledge and understanding of this part of the specification. Some, however, did not read the question and referred to reverse faulting.

(ii) Whilst this was generally answered well, few made reference to the synform / syncline /basin as a favourable geological structure. Some answered with reference to the fractured rock unit beneath the clay at the expense of the sand and gravel, though identified the impermeable nature of the clay layer. A smaller number considered that salt water incursion might occur in the oasis.

Section B

General Comments

Questions 3 and 4 were the most common questions chosen and marks given covered the whole range. Question 5 was least popular and was generally done poorly.

Q.3 This was generally well done and many excellent answers were seen gaining high marks.

(a) Many described pyroclastic flows as flows of tephra but ignored the importance of gases. Few commented that they were density currents. Some did not define a flow at all and went straight into "hot and fast". It was also common to read that they are "extremely" hot or "very" fast without quantification or with unrealistic values. Expected values for these are accepted within a reasonable range e.g. 60-120 kmh^{-1} for nueé ardentes and temperatures of 500-1100°C.

Mount St Helens was by far the most popular choice of case study, followed by Pinatubo, Vesuvius and Mt Pelée. Unfortunately Mount St Helens was often poorly explained in the context of this essay, with many describing the ground deformation before the eruption together with the lateral blast and damage caused, to the exclusion of the description of pyroclastic flows.

Lahars were also credited as a type of pyroclastic flow.

(b) This question referred to the hazards associated with different eruptive magmas and some candidates dealt exclusively with hazards without referring to the magma whilst others focused more on the generation of the different types. There continues to be some confusion concerning the description of viscosity e.g. "basalts have a high viscosity and flow quickly." Also it was very common to read that basalts are "thin" while andesites are "thick." Some candidates found it difficult to explain that gases escape more readily from basaltic magmas because of the latter's lower viscosity (and vice versa for andesitic magmas). Whilst some claimed there were no hazards associated with basaltic magmas, others gave excellent accounts of the ash produced during the 1973 Eldfell eruption on Heimaey, though only a very small number discussed lava fountains.

Eyjafjallajokull was very frequently cited and often given by different candidates as an example of both basaltic and andesitic eruptions. It is appreciated that eruptions in Iceland can be complex and so credit was given to all interpretations - so long as the context was correct.

In this respect the following link may be of interest:

http://www.science20.com/tuff_guy/blog/what_have_we_learnt_eyjafjallaj%C3%B6kull-75199)

Q.4 This was also a popular question though often less well answered than question 3.

(a) This generally produced a very disappointing response with most candidates **not accountin**g for the devastation, but **describing** it. Clearly many candidates did not appreciate the significance of the command words "*Account for*…" and gave very general an vague descriptions about the destruction caused by past and recent tsunamis. From reading some scripts it was not even clear that the candidate knew what a tsunamis was and an underlying idea that "tsunamis increase in energy as they near the shore". Credit was given where appropriate but many moved quickly into the spheres of socioeconomics (and even psychology) without exploring the form and structure of a tsunamis, (formation, wavelength, wave height, speed, effect of coastal shape, detection etc.). Thus there were many detailed accounts of how nuclear power stations may be rendered unsafe by a tsunami. A significant number also discussed in great detail items that belonged to section (b).

There were, however, a small number of excellent accounts showing a thorough understanding of how tsunamis are produced and how they evolve usually from low-amplitude waves to walls of water. Some even commented on how the motion of the water results in the loss of very little energy as the waves progress across an ocean. Many cited, as an example, "The Boxing Day Tsunami."

(b) This section produced a much more satisfactory response with many excellent accounts of both tsunamis or earthquake hazard reduction. Very good use was made of well-labelled diagrams and in particular candidates who compared the response of LEDCs to MEDCs. Thus the use of computer controlled counter weights was contrasted with reinforcing walls with chicken wire. Tsunamis warning systems and building strategies reflecting past questions were also in evidence and gained good credit. Some, however, wrote solely about earthquake prediction as it seemed that this was the essay they would have preferred.

Q.5 This was not a popular choice and generally poorly answered though some candidates scored creditable marks.

(a) The effect of the dip of beds is generally well understood as were joints though little reference was made about the significance of joint density on weathering and slope stability. The treatment of faults tends to be very superficial e.g. "faults are weaknesses in the rock which might cause a tunnel to collapse." The nature and significance of cleavage is poorly understood. Some discussed mineral cleavage without any connection to rock cleavage. A significant number did not discuss cleavage at all.

(b) Case studies were generally well chosen although a small number of candidates failed include case study materials. The full range of possible hazards was covered with Wheal Jane and acid mine drainage the most the most popular case study reference though rarely in detail.

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Unit	Entry	Max Mark	Mean Mark
GL4	913	100	62.4

Grade Ranges

A	73
B	65
C	57
D	49
E	42

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GL4

Questions certainly discriminated between candidates, and a wide range of marks were seen.

The mean mark was slightly higher than last year, with the standard deviations showing a narrower range. Data suggests that the candidature was similar to previous years, and the exam team felt the paper was equally accessible to candidates as last year. There was a small increase in the number of candidates sitting the paper and the number of candidates resitting increased slightly.

The new specification is becoming established and the Exam Team have kept to a similar style of GL4 as developed in previous years.

Section A assesses areas which candidates usually find very challenging, in depth knowledge and understanding of dinosaur skeleton and behaviour in Q1 and igneous rocks and their formation in Q2, a more traditional method of assessing three dimensional rock deformation concepts in Q3, and Q4 covering the Snowball Earth event of climate change in geological time. Item level data revealed that Q2 was the least accessible for candidates with Q1 the most accessible..

Section B, as in previous years the candidates showed they are getting familiar with the style of questioning and reasoning and a good range of answers was seen. Q5 covered traditional aspects of outcrop patterns and rock features. Q6 examined the deformation of the area using a range of techniques. Q7 was similar to previous years in an overview of all factors linked to extending the AS level concepts in synoptic testing.

The paper must be taken as a whole in its coverage, and examiners make use of relevant links wherever possible to point to the specification, aiming to assess the skills based approach of responding to data. The maps used are “real data”, which means that they can be littered with a wealth of information which cannot be touched on in an approximately 1 hour segment of the exam. The questions set by the examiners are an attempt to help focus the students onto specifically relevant data, this may draw out particular topics in Section B and the examiners attempt to balance the specification across the paper. It is a challenge to the examiners to find maps which are “simple enough” for the number of questions available yet “complex enough” to stretch and challenge the candidates.

This year GL4 scripts were marked on-line by examiners, whereas in the past examiners have worked through whole candidate scripts, this year answers were marked question part by question part, and examiners did not have the advantage of following the natural rise and fall of the handwriting and concentration of a candidate.

It is very important that candidates are reminded that scanning struggles to catch their writing if it is right down to the edge of the page, they should use the extra pages within the answer booklet to continue their answers rather than squeezed onto a page or using an additional page. If candidates continue questions onto the extra pages of the answer booklet they must be reminded to clearly label which question they are continuing. Candidates should also be reminded of the need to write legibly and with a decent black pen, as scanning loses some clarity in size and contrast. Examiners will NOT credit things they can’t easily read.

Section A

Q.1 The question focussed on dinosaur data with a wide range of data (including diagrams and written passages) for candidates used to very good effect being the question that the candidates found most accessible.

Candidates scored well on all parts of this question, demonstrating very good levels of responding to the range of data given and showing very good knowledge and understanding.

(a) The majority of candidates got this correct, though in (i) species provided a good discriminator for candidates and in (ii) some candidates did not multiply by 4.

(b) The majority of candidates got both parts correct. (i) There were some very grizzly accounts of how the features aided a carnivore in killing prey! Examiners were looking for more than just writing out the feature, with explanations of how the feature actually helped *Dromaeosaurus*. (ii) generally fine, though some suggested carrying the tail upright would make the dinosaur more streamlined!

(c) In part (i) the majority of candidates saw that 3 statements were required; the larger/bigger (unspecified) dinosaur, a meeting the pack of *Dromaeosaurus* and a scuffle with *Dromaeosaurus* being successful. A very small minority of candidates misunderstood the *Dromaeosaurus* footprints as being 1 creature going to and from and missing out on the pack hunting theme. Some candidates considered the overlying bedding was there and the dinosaurs were trapped or even that it fell on them! As in previous years candidates were required to give evidence rather than speculation. Part (ii) showed some excellent alternative explanations for the data.

Q.2 The question focussed on formation of igneous rocks. Candidates were quite challenged by much of this question and it was the least accessible question on the paper this year.

(a) (i) Surprisingly many candidates found it difficult to locate the trench, with many incorrect lines drawn through the active volcanoes, or further north and even some joining the line of deep focus earthquakes. In (ii) many confused the island arcs of the question with the Hawaiian chain of volcanoes showing that they had not read the question carefully enough, then going on to refer to mantle plumes rather than the convergent plate margin. The best candidates mentioned gravity settling/ differentiation and magma mixing.

(b) (i) Fine.

(ii) Generally fine with some errors in conversion of units from km to cm though gaining credit for the working, (iii) was a good discriminator, candidates should be reminded that if the question asks for evidence from Figures 2a and 2b then they must give a piece of information from each, plus one other to gain the full 3 marks. Many answers for (iii) were vague, and a common problem was that candidates thought the graph showed the rate had slowed in the last 42ma, whereas it had increased.

(c) A good discriminator of candidates. Only the better candidates were able to explain the changes in direction AND rate of movement and again requiring candidates to look at figures 2a and 2b. Weaker candidates focus on a change of direction only. Simply stating that there WAS a change in rate and direction gained little credit as explanations were required.

(d) Was a good discriminator, with many candidates not considering the generation of magma but rather its' emplacement. Good candidates summarised decompression melting as their answer here, weaker candidates simply rehashed the wording of the question.

Q.3 This question examined the rock deformation and structural element of the specification. As in previous years candidates found this a challenging question. This was again examined by means of a block diagram with other data too. Candidates coped well despite no key being given for the sedimentary structures within the sandstone bed.

(a) No problems for candidates.

(b) Part (i) was fine with many encouraging responses which viewed the evidence correctly from the text description, but part (ii) was more challenging for candidates as many were let down by poor phrasing of their answers, with some focussing on locality Y for which there was no credit.

(c) Was a good test of candidates ability, weaker candidates contradicted themselves in each section of the critical evaluation. The overturned section was well done by candidates, giving detailed descriptions of named sedimentary structures in figure 3a which agreed with the statement. Many candidates fell down on the symmetry section by failing to recognise that they could not tell as the full limb length was not shown on the diagram, instead they focussed incorrectly on the dip angle. Teachers could make use of the resources produced in previous years for Inset and also to the ESTA Journal article. The better candidates linked the overturned structures and hence the oldest rocks in the centre with synform (anticline) in the last section, the majority of candidates simply said it was an anticline as it was overturned without giving the evidence.

Q.4 The question focussed on the Snowball Earth event of climate change between 660mya and 630mya of geological time. Candidates were not troubled by the error in the scale bar of figure 4a nor the incorrect spelling of DIAMICRITE in figures 4b and 4c.

(a) The majority of candidates gained full marks in (i) with very comprehensive descriptions of the mean global surface temperature changes from figure 4a. Some described from 630Ma to 660Ma, and suggested changes in the wrong time direction. In (ii) the majority of candidates realised that an increase in temperature correlated to sea levels rising and located the arrow at 635mya, though a significant number placed their arrow at 655Ma corresponding with decreased temperature and more water being locked up in ice showing that they were not following their logic processes through.

(b) In (i) there were a surprising number of blanks considering this question made links back to GL1 knowledge and understanding. Nearly horizontal remanent magnetism should indicate that the magnetic field is horizontal and that is found at the Equator, linking ice being at the Equator. The majority of candidates described glacial transport with ice melting to drop the stones into the sea in part (ii) though the exam team saw few truly convincing answers.

(c) Was a real challenge to a significant number of candidates. Many failed to link how each contributed to the rapid changes in atmospheric gases in the volcanic activity section instead concentrating on the heat of the lava or the ash blocking out the sun. In the Volcanic Activity section: Better candidates described SO_2 and CO_2 being released from volcanoes and trapping heat producing global warming to end the Snowball event. In the Rock Weathering section candidates described greenhouse gases being washed from the atmosphere as acid rain leading to rapid chemical weathering of silicate rocks and the subsequent deposition of carbonates washed into the sea (limestone weathering gained some credit). The Methane Hydrate section was quite well understood and candidates described methane gas locked into frozen sediment/ice being released with rising temperatures, with methane being a far more potent greenhouse gas leading to runaway global warming.

Section B

The 1:50,000 solid and drift map extract of Bristol was clearly reproduced, accompanied by a cross section. The maps are "real data", which means that they can be littered with a wealth of information which cannot be touched on in an approximately 1 hour segment of the examination.

Q.5 This question intends to get candidates familiar with the map and was generally well done.

(a) This was well answered, though a notable howler was shallow hole instead of swallow hole!

(b) The majority of candidates produced very good field sketches showing a good basics, though some then struggled to explain the formation of the boundary (unconformity). Part (i) was fine, in part (ii) many candidates simply listed evidence but did not make the link back to high-energy streams. Better candidates explained poor sorting was linked to rapid deposition from a high-energy stream, or angular fragments linked to short transport distance. The best candidates made the link to flash flood deposits.

Q. 6 This question was based on the dip directions of the Carboniferous Limestone outcrop and moved into the structural element of the map.

(a) It was pleasing to see that the majority of candidates had little difficulty with reading off or plotting data. Only a few candidates failed to add in the 3 dip arrow directions losing credit in (i) but accurate rose diagram plots gained credit in (ii). Scope was given for 1 arrow which could have been judged N or NE and acceptable tally totals were 12,9,3 or 13,8,3.

(b) In (i) many candidates found this question challenging. Agreement with the statement backed up with evidence for each (of elongated, dome shaped and plunge) components completed the mark scheme. Many candidates scored 3 out of 4 as they did not recognise the closing/v-ing of the Carboniferous Limestone for the plunge evidence. Part (ii) was a good discriminator and the majority of candidates gave excellent limitations of rose diagrams, mostly concentrating on not being able to distinguish anticlines/synclines and not giving actual angles of dip.

(c) Part (i) was generally well done. It was interesting the number of candidates who got the type of fault wrong despite the key showing *thrust fault* at that grid reference. Part (ii) was generally well done with candidates recognising thrust (reverse) faults and folds are both the result of compression.

Q. 7 Candidates performed well on this question and examiners saw the whole mark range being used. Only a very small minority left the last part of the question completely unanswered. Candidates should be reminded to look at the marks allocated in [ ] to apportion their time.

(a) There were some very good accounts of cavity formation linked to acidic groundwater chemically weathering the jointed limestone.

(b) A number of candidates did not focus on the geological advantages at this location. A number even suggested that the mineral vein was an advantage as it added lead to the public water supply! The best answers focussed on there being no drift deposits or the bedding dipping towards the borehole or the faulting fracturing the rocks providing natural drainage.

(c) Candidates are by now familiar with drawing together all strands in the final question and some excellent answers were seen which covered all the suggested triggers and developed the points with geological implications. The question was a good discriminator. The best candidates used grid references to back up their line of argument.

GEOLOGY

General Certificate of Education

Summer 2012

Advanced

Principal Examiner: Mr. Elliott Hughes

Unit Statistics

The following statistics include all candidates entered for the unit, whether or not they 'cashed in' for an award. The attention of centres is drawn to the fact that the statistics listed should be viewed strictly within the context of this unit and that differences will undoubtedly occur between one year and the next and also between subjects in the same year.

Unit	**Max Mark**
GL5 (all options)	80

Grade Ranges

Option	**01**	**02**	**03**	**04**	**05**	**06**
A	58	56	57	58	59	57
B	51	49	49	51	52	50
C	44	42	42	44	45	43
D	37	35	35	38	38	36
E	31	29	28	32	31	29
Entry	240	102	145	110	207	94
Mean	48.1	41.4	48.0	49.9	48.5	45.9

N.B. The marks given above are raw marks and not uniform marks.

GL5

General Comment

Section As were generally well done. They all proved to be accessible and many full marks were awarded. The major problem continues to be with essays and candidates' reluctance to adhere to the rubric. There is an apparent tendency to only consider some of the key words in a question to the exclusion of others. A more fitting title to many candidates' essays would be "all I know about ...." As a result, many essays are best described as "hit and miss" where candidates oscillate between answering the question and going off-topic. It can make such essays very difficult to follow.

Theme 1 - Quaternary

Q.1 (a) (i) Very well answered. The vast majority chose the fine matrix as one of the similarities. There was a wide choice for the other. Here, and in (ii), some claimed that **B** is foliated.

(ii) Also very well done. Most correct answers went for (non) alignment and (mono) multi rock type clasts. Only a small minority considered "B aligned and A random" to be **two** differences.

(iii) Generally well answered although some found it difficult to formulate a convincing response e.g. "the rock is poorly sorted which is what glacial deposits are like." A more satisfactory comment being e.g. "a glacier erodes the ground it passes over producing fragments of all sizes." The better candidates tended to claim that the deposit is a terminal moraine, or the result of prolonged deposition at the snout of a glacier.

(iv) This question proved to be much more challenging. Many candidates thought that the alignment would have been caused by water currents and there were many references to fluvio-glacial streams. These candidates made no attempt to account for the angular clasts or the poor sorting. The best candidates wrote very convincing arguments discussing (for example) permafrost and solifluction. Some very sharp-eyed candidates noted that the deposit is found beyond the limit of glaciation.

(b) (i) Generally a good response. The presence of marine fossils was a popular choice.

(ii) A mixed response. Some candidates were unable to offer an explanation and preferred descriptions such as "Deposit C was laid down when the sea was higher, but then it went down and the glacier deposited A." There was middle ground where candidates used the terms eustatic and/or isostatic to varying effect. The best candidates were able to explain how a eustatic change in sea-level followed by an isostatic change could explain the formation of C before A.

Q.2 A reasonably popular choice but with disappointing results. The lack of examples let down many candidates. Most drew relevant diagrams but of varying quality. The evaluation was generally poor with few properly evaluating the statement. Although the majority of candidates considered such as dipping strata, folds and igneous bodies etc. a few considered this on a larger scale and discussed e.g. volcanoes and mountains chains.

Q.3 Not very many attempted this question and of those that did a sizeable minority did not attempt to draw a sketch of the Hjulstrom curve diagram.

(a) The quality of diagrams was very varied and some preferred not to draw the graph at all and rely on a written description. Few noted that the scale is logarithmic to take account of the wide range of grain sizes. Likewise not many mentioned the fact that the graph is limited to river transportation and does not consider the shape or roundness of grains.

(b) There was distinct lack of inclination to adhere to the rubric. Disappointingly, very few attempted any evaluation. Most chose to describe the structures in detail to the exclusion of discussions of the processes that led to their formation. There were some excellent diagrams of Bouma sequences. Although some candidates drew diagrams, that hinted at a cyclic structure of turbidite sequences, very few actually discussed this. When discussing graded bedding, candidates nearly always discussed the processes but extended this to describe its use as a way up structure, for which they received no credit. Few mentioned the fact that some structures they described, such as convolute bedding and load casts, can only give an indication of post depositional processes and not the processes of formation.

Q.4 A very popular question with some very impressive responses.

(a) Most candidates discussed oxygen isotope ratios, written as ^{16}O and ^{18}O, but there was a significant number of $_{18}O$ and O^{18} and O_{18} etc.

The two major concerns were:

(i) A failure to make it clear where the isotopes were. Many candidates were discussing ice in one sentence and gas bubbles in the next, and relating both to oxygen isotopes. Many claimed that "^{16}O evaporates easier from the sea than ^{18}O. Some just referred to isotopes "in the ice" while discussing bubbles, which again can be ambiguous. Some were completely confused suggesting that water containing the lighter isotope will evaporate more easily from the sea and will therefore be of a higher concentration in the gas bubbles.

(ii) Most suggested that water containing ^{16}O would evaporate easier than ^{18}O because it is "more dense." Few referred to early precipitation which would also favour the molecules containing the heavier isotopes. A very small number actually mentioned that the presence of different hydrogen isotopes would have a similar effect.

Some candidates attempted to discuss carbon isotopes. ^{13}C was quoted in attempts made to relate this to the amount of plant life around at the time. There were a few convincing arguments, but not many.

Many discussed pollen in (a) and (b) often writing the same thing twice. Its significance in ice cores was usually overstated.

Many referred to ash layers but few mentioned that volcanic ash layers in the ice can be dated.

It was often claimed that the ice cores were obtained from glaciers but very rarely was the problem of movement of the ice acknowledged in such cases.

The inclusion of dust in the ice layers was occasionally mentioned but its possible use was rarely discussed in any meaningful way e.g. connection with aerosols or arid conditions.

(b) This part was generally much better answered than (a) with most candidates discussing pollen and ^{18}O from forams at some length. Evaluation was generally poor with most candidates focussing on the incomplete fossil record due to lack of preservation and erosion etc. Few candidates mentioned that pollen does not allow for quantified climate reconstruction and only provides a proxy for the climate.

Many candidates discussed vertebrates but few mentioned that they only provided a snapshot and not a continuous record of climate conditions.

Theme 2 - Natural Resources

Q.1 (a) (i) The vast majority of candidates gave an acceptable dip of 18° to 22°. The direction was occasionally given as N-S which was not credited. The depth was very well done with the vast majority of candidates supplying the correct units (m or km.)

(ii) Phenocrysts, porphyroblasts, quartz crystals and two periods of cooling were the sorts of incorrect descriptions that were not uncommon. There was a small minority who misinterpreted the word "reef" and described corals and warm, shallow marine conditions etc.

(iii) A wide range of answers were accepted for the 2 marks but very few candidates commented on the fluctuating energy conditions.

(iv) Very poorly answered, with the vast majority of candidates completely missing the most important factor which was the difference in density between gold and quartz – the fact that quartz clasts are larger means that the gold and quartz are a similar weight and so are deposited together. Many answers focussed on the difference in hardness between gold and quartz. Some candidates were credited for noting that the smaller gold particles might have been trapped between the larger quartz clasts during deposition.

(b) (i) A very mixed response. It was very pleasing to see that the vast majority of candidates now adhere to the rubric on such questions and show their working. The most common mistake was getting the decimal point in the wrong place.

(ii) Generally a very well answered question, although some candidates lost two marks because they did not read the question properly and only discussed one problem and potential solution, Some others just highlighted the problem without giving solutions. Most had little difficulty suggesting a problem. The most popular were heat and the possibility of tunnel collapse. It was only the solution to the latter problem that caused significant difficulties. Many suggested that the remedy was to "support the roof." This was considered far too vague to warrant any credit. A few mentioned rock bolts but hardly any suggested reinforced shotcrete.

Q.2 This was a reasonably popular question. Diagrams were generally well used and this was encouraging to see. The better answers tended to focus on geochemical prospecting and geophysical surveying, with very few discussing satellite remote sensing. Some candidates only focussed on one technique and obviously did not read the question properly. The exact meaning of the word "cheap" needs to be clearly defined as it is (almost) always a relative term. Although evaluation was better than in the other questions, it was still relatively poor, which prevented some candidates with otherwise good answers from scoring higher marks.

Q.3 The most popular question that was reasonably well-answered, and many candidates scored good, yet not exceptional marks.

(a) Descriptions of the conditions were usually fairly good however, few candidates gave examples of either where conditions like these occurred today, or when and where they occurred in geological history. The terms "decay" and "anoxic" tend to be used very liberally, often without any discussion as to their meaning or importance.

(b) Many chose to describe to the exclusion of any evaluation. Most candidates discussed all the usual suspects and mitigations (noise – baffle banks, dust – wetting wheels etc.) However evaluation was, as in the past, the weakest part of this type of question, which prevented the vast majority of candidates from securing high-level marks. Case studies, would be particularly useful in this regard, particularly if efforts at the mitigation of a particular problem have not been completely successful etc.

Q.4 Relatively few candidates selected this question. Most choose magmatic segregation as one of their processes. However, not many cited examples and those that did almost uniformly mentioned the Bushveld. Other examples such as Sudbury, Norilsk, Stillwater complex and the Great Dyke in Zimbabwe were very rarely mentioned. Most also focused on crystal fractionation, but the role of liquid immiscibility (sulphide-silicate) in the concentration of Ni-Cu-platinum group elements is highly significant yet was mentioned by only a handful. Pegmatite formation and hydrothermal activity were not dealt with as comprehensively or as extensively as magmatic segregation. Examples of both these types were very thin on the ground. In terms of good evaluation in this question, candidates should have talked about the importance of other processes, e.g. sedimentary processes, particularly in regard to energy-related deposits, as well as the fact that these three processes are all very important and are significant sources of gem and industrial minerals.

Theme 3 - Evolution

Q.1 (a) (i) Reasonably well-answered, although a few candidates only put down one direction, and some got quite mixed up with ESE-WNW terminology, e.g., putting EES-WWN etc.

(ii) This proved to be quite demanding. Some candidates mistakenly put the arrows on Figure 1a. There was a range of choices, of which parallel to the direction of strike was the most common incorrect one.

(iii) This was very well answered with most getting the right answer to the first part (Variscan) and many correctly identifying the E-W trend and Carboniferous age as reasons.

(iv) Also well done. Folding and faulting with the same trend being by far the most popular choices. Other possibilities included the trends of igneous intrusions, cleavage and geomorphologial features. Some mentioned folds and faults without discussing the trend of these features.

(b) (i) Caused few problems.

(ii) Most candidates who obtained the two marks described the changes in grain size and related it to flash-flooding. Few used the words "unconformity" or "cross-cutting."

(iii) Most chose to answer this by listing relevant properties of A and then those of B. Few chose a direct comparison of features. There is an almost universal claim that shales are **deep**-water deposits. A few even claimed that the shales were "**black**." Some suggested that the shales were deposited on the abyssal plain and gave the occurrence of "**graptolites**" as evidence. Very few candidates suggested that the evidence was of a **gradual** change from marine to terrestrial.

Q.2 A reasonably popular question that was generally well- but not spectacularly well-answered.

(a) Many candidates did not include diagram(s) contrary to what was asked for. This diagram really should have included a map showing the location of the named fault and its relationship to the Iapetus suture etc. More common was candidates' ability to draw excellent cross sections across the fault in question – usually the Moine Thrust. It was noticeable that the vast majority of candidates who chose the Moine Thrust and drew a map also added the other major Caledonian faults and had them all parallel trending in a NE-SW direction. Few, if any, appear to recognise the fact that the Moine Thrust has a different trend on the map to that of the other faults.

(b) This was generally much better answered with some good discussion of nappes, metamorphism, island arcs and associated magmatism, and ophiolites.

There was some confusion as to what actually constituted Caledonian events. A surprising number of candidates did not mention the accretionary wedge in the Southern Uplands, or granites due to crustal melting. There was also confusion as to the origin of caledonian granites. Some stated they were of igneous origin resulting from the partial melting of the continental crust, while others claimed that they were the result of extreme metamorphism. The problems lay with the lack of indication as to where the said granites were actually located, and hence their relationship to a possible plate tectonic regime. Also, some candidates confused the two e.g. "the granites show us that there was volcanic activity ..... they are surrounded by Barrow's zones of metamorphism which indicate high temperatures and pressure."

Evaluation was very poor to non-existent on this question which prevented many candidates securing the best possible marks

Q.3 (a) Although magnetic inclination is well understood few candidates are able to describe adequately polar wandering curves. Some candidates made their task almost impossible by trying to answer the question without using labelled diagrams. Few candidates mentioned that magnetic inclination can also be preserved in sediments. In fact a significant number stated, or intimated, that remanent magnetism is **only** preserved in igneous rocks. Evaluation was significantly better than in Q2, with candidates talking about backing up findings from palaeomagnetism with other evidence e.g., from sediments. Many discussed limitations with the technique, e.g., altered, overturned rocks and problems with accurate radiometric dating etc.

Q.4 This was quite a popular question and was generally reasonably well answered.

(a) Most candidates tended to focus too much on semi arid and desert deposits and only discussed the evidence for hypersaline marine conditions relatively briefly. A few of the better candidates discussed the order of crystallisation (relative solubility) of the various salts. Many candidates did not mention the likelihood of flash floods and the formation of conglomerates. There was some confusion between the NRS and ORS, especially when discussing Arran as a field location. The terms “weathering” and “erosion” are still used very liberally e.g. “red sandstones are well-rounded because of the weathering and erosion of quartz by the wind.”

Generally the evaluation was reasonable with many noting that assumptions had to be made about uniformitarianism and of climate zones being constant through time. Very few however mentioned using supporting evidence from palaeomagnetism .

Theme 4 - Lithosphere

Q.1 (a) (i) Generally well answered, although a surprising number of candidates incorrectly placed the top of the lithosphere at the base of the oceanic crust and not on the sea floor.

(ii) Generally well answered, although some candidates just talked about ophiolites being comprised of sediments and did not mention that they are predominantly igneous rocks.

(b) (i) Well done, although some drew at least part of the isotherm too close to either the 200° or 1000° isotherm.

(ii) Reasonably well answered, with most candidates noting that the isotherm is depressed and angled at the subduction zone due to subduction of the cooler oceanic crust. Fewer noted that the isotherm rose slightly at the site of the arc volcanoes due to elevated heat flow in the lithosphere.

(c) Generally quite well answered, some candidates put multiple letters for the location which scored no marks. Reasons that focussed on variations in temperature and pressure were most common.

(d) Quite well answered with most candidates noting that the introduction of water would lower the melting point (NOT the boiling point as some candidates preferred to write) of peridotite resulting in the generation of melt at a lower temperature than at Y.

Q.2 This question was not attempted by many, and generally was not answered very well.

(a) There was a considerable amount of confusion about the nature of seismic waves and reflection/refraction. Despite it being only tangentially relevant to the question, a considerable number of candidates spent much of the essay talking about how seismic waves explained the nature of the core.

(b) Many ignored the word “importance” and chose to simply discuss the characteristics of the asthenosphere. Evaluation was generally very poor to non-existent.

Q.3 This was not a particularly popular question but was on the whole reasonably well answered. Diagrams were advisable for this question and the candidates that scored high marks produced some excellent diagrams and explained the stress-strain graph very well. In general the significance of elastic versus plastic deformation could have been explained much more clearly. Evaluation was better than in Q.2. with the better candidates talking about the effect of depth and heating. However few mentioned how varying the tectonic setting might affect the type of deformation observed.

Q.4 This was the most popular question, with some candidates giving excellent detailed accounts of the Wilson Cycle, accompanied by good diagrams. Most candidates were let down by relatively poor evaluation. Things that could have been mentioned were that it explains many of today’s observable major geological features. It provides a unifying theory and explains why the Earth is not expanding. However, it does not account for some things unless the influence of mantle plumes is taken into account (‘plume tectonics’ as it has become known.) These include providing a reason for the initiation of, and the driving force behind, continental break up. Some assume that a recognition of plumes formed a part of Wilson’s original suggestions.

GEOLOGY

General Certificate of Education

Summer 2012

Advanced

Principal Moderator: Mr. Ian G. Kenyon

Unit Statistics

The following statistics include all candidates entered for the unit, whether or not they 'cashed in' for an award. The attention of centres is drawn to the fact that the statistics listed should be viewed strictly within the context of this unit and that differences will undoubtedly occur between one year and the next and also between subjects in the same year.

Unit	Entry	Max Mark	Mean Mark
GL6	897	60	44.7

Grade Ranges

A	49
B	42
C	36
D	30
E	24

N.B. The marks given above are raw marks and not uniform marks.

GL6

Administration

The administration and moderation of the coursework samples ran very smoothly again this year. The Principal Moderator is very grateful for the efficient organisation and punctuality of the majority of centres. Only a small number of centres submitted materials after the May 15th deadline.

Coursework Samples

One or two centres were unaware that the method of selecting the coursework sample had changed this year. The new method involves entering the marks of all candidates electronically online using the WJEC Secure website. (www.wjecservices.co.uk) Once the marks have been entered a sample will be automatically generated. The sample should comprise the work of only those candidates listed.

Packaging Coursework

When packing the coursework samples please try to reduce bulk and weight as far as possible. A4 hardback ringbinders should not be used. It is helpful (and cheaper for centres) to use slim plastic folders that can be packed efficiently. The use of large and heavy field notebooks containing only a few pages of assessed material is to be discouraged. Please consider detaching the relevant pages of field notes and inserting them in the front of the report with a paper clip. Alternatively photocopy the relevant pages and include in the front of the report. All materials for moderation should be included in just **one modest sized package**.

Please note that the coursework samples for GL6 and GL2b should not be sent together in the same package as they are moderated by different examiners. If centres are unsure about the address for despatch, they should contact WJEC for clarification.

Fieldwork and Laboratory based Investigations

Please note that the requirements for GL6 are a minimum of two investigations. The assessment must be a minimum of 50% field based work. Therefore three possible combinations are available. Field 50%, Lab 50%, Field 75%, Lab 25% or Field 100%. Please state clearly on the GLF1 form whether Lab (L) or Field (F) is being assessed. It is not appropriate to write F/L.

GLF 1 Forms

The F1 form should list **all** candidates and their marks from the centre, not just those selected as a sample for moderation. It is helpful to mark with an asterisk on the left hand side those which make up the sample.

F 2 Forms – The Tracking/Planning Sheet

A completed F2 form should be included for each investigation undertaken, i.e. two for each candidate in the sample. This is used primarily to assess the planning of the investigation. The quality of the planning sheets varied from exceptional, exhaustive and comprehensive to inadequate, over-brief and quite vague. The best marks for planning were achieved where students carried out a pilot study to test their planning, then modified the original plan in the light of this. A small number of centres were a little over-generous on awarding marks for planning. It is not possible to score full marks on this section when candidates have failed to make any predictions about possible outcomes and anticipated sources of error.

These sheets can be enlarged to A3 where space is insufficient. Additional planning information can be included at the beginning of the written report under a clear 'planning (F2) continued' heading.

Students should be encouraged to plan in detail and should be discouraged from using simplistic bullet point statements on the planning sheet.

F3 Forms

A completed F3 form should be submitted for each candidate in the sample. Please make full use of the opportunity to comment on the work of individual candidates on the F3 form. Ideally the use of 4 'post-it' notes should be used to locate within the work, where and why the marks have been awarded. A few centres still fail to comply with this request each year and possibly disadvantage their candidates as a result.

Please ensure that the centre has the updated F3 form which has the candidate declaration on the reverse. This must be signed by the candidate and teacher to confirm the authenticity of the work being submitted. It was pleasing to see that nearly all centres complied with this administrative task this year.

Downloads from WJEC

Copies of the forms F1, F2 and F3 can be downloaded directly from the WJEC website www.wjec.co.uk by following the GCE/AS subjects and then Geology links from their home page.

Implementation

In order to provide evidence for implementation, it is vital that the appropriate field and laboratory notes are included with the report.
A small number of centres failed to include the laboratory notes this year.

It should also be noted that laboratory work must yield some raw data that could not be collected in the field. Bringing back rock samples then describing them as in a 'traditional' practical is not really in the spirit of the assessment.

Good examples of lab work included:
Making thin sections of rock samples followed by microscope analysis;
Sieving sediments and calculating sorting, skewness and kurtosis;
Establishing composition of sediment samples using point counts;
Testing rock samples for resistance to abrasion, impact and polishing;
Modelling rock deformation using plasticine and mars bars;
Simulating mass movements and tsunami generation in a wave tank;
Porosity and permeability of rocks related to their utilization potential;
Testing the resistance of various mollusc shells to abrasion/attrition and linking to preservation potential.

The overall quality and quantity of the lab and field notes were a little disappointing again this year and could easily be improved upon. Field sketches were particularly poor.

Ideally each field location should have a six-figure grid reference. If sites are close together, then the same reference should be given with '12 metres west of site 4'. It was pleasing to note some very accurate fieldwork locations were given by a number of centres using GPS devices this year. This approach is to be commended and encouraged.

All field sketches should have grid reference, scale, compass orientation and detailed annotations. Simplistic labelling of sketches should be discouraged.

Information from secondary sources such as bed ages or detailed palaeogeographies should not appear in the field notes. Photographs are also inappropriate in the field notes. The field notes should be used to interpret the photographs in the report.

Field notes should consist of detailed observations, measurements and records made individually by each candidate. Identical notes obviously dictated in the field are to be strongly discouraged.

It is strongly recommended to practise field sketching from photographs or slides prior to fieldwork being carried out. The field and lab notes provide the basis for the report and should be considered the most important part of the investigation.

Analysis

This involves some synthesis and interpretation of the primary data collected in the lab or field. There must be some development from the field or lab notes, rather than simply copying out the same information in a neater form.

The use of photographs is to be strongly encouraged but these should be used selectively and integrated within the text. Transparent overlays or outline diagrams adjacent to photographs may be used to highlight important features or annotated digitally. Grid reference, compass orientation and scale should be included as a matter of course.

Please discourage the indiscriminate use of photographs, which lack location and annotations. Only include photographs, which are directly relevant to the investigation. As a general guide no more than 8 to 10 photographs should be included. Less than half the candidates included photographs this year and the majority were poorly annotated.

Statistical analysis is recommended if it is appropriate to the data collected. Excellent investigations on sedimentary environments included work on sorting, skewness and kurtosis. Particle size and shape was assessed using Zinng's, Krumbein's and Cailleux's indices. Spearman's Rank, Chi Square and Vector analysis were also used by some centres. Point counts were used to assess the mineralogical composition of rock and sediment samples.

Spreadsheets were used by a number of centres, but not always to the best effect. Printouts of cumulative frequency graphs, Zinng diagrams and histograms were rarely annotated to show evidence of thorough analysis and interpretation.

Evaluation

Evaluation must be included as a separate section within the report. It is an opportunity for students to reflect objectively on the work they have carried out. The quality of evaluations varied from sophisticated and thorough to simplistic and inappropriate. It may be worthwhile suggesting to students to break up the evaluation into a number of distinct components:

Evaluating the planning sheet they completed. How appropriate were the techniques and methods they selected? This may refer to methods of sampling, sample size and sample number.

What problems or limitations were encountered during implementation? This could involve reference to confusion between true and apparent dip or problems between the base map geology and actual rock outcrops.

An outline of the way in which the investigation could be improved, given more time and/or resources and with the benefit of hindsight.

An overview of the investigation based on the likely reliability/validity of the data collected in the available time frame. Which part(s) of the investigation(s) yielded the most/least reliable data and why? Are the conclusions made concrete, tentative or partial? How do these findings compare with published work on the same area/topic. How do they compare with the results/conclusions of students from last year? How could the work be developed further, with perhaps reference to the outline planning of extension work.

Evaluation is not a list of excuses. Naïve and simplistic statements regarding lack of time, bad weather and lack of familiarity with equipment do not form the basis of a mature evaluation. As a rough guide one side of A4 word-processed text is a probable minimum length for a high scoring evaluation.

The Report

It is now **expected** that students make use of IT and finish reports to a professional standard. It was encouraging to see so many centres making appropriate use of IT this year and only a few hand-written reports were submitted this year.

As a rough guide, the optimum length for each report should be between 1250 and 1750 words. This excludes maps, diagrams, photographs, graphic logs and statistics. Quality rather than quantity is to be encouraged. The reports should be concise, relevant and clearly focused. Please dissuade students from including large amounts of photocopied material from secondary sources.

The report should be based on the primary data collected in the lab or field and there should be some cross-referencing between the two. Safety considerations should be briefly acknowledged and students should be encouraged to be aware of the importance of the need for conservation of geological sites. The report might include the following sections, though they may be subsumed under a smaller number of headings:

Contents Page
Location Map
Introduction
Aims/Hypotheses
Safety Aspects
Methods of Data Collection
Data Presentation
Data Analysis
Statistical Analysis
Graphs/Printouts **with** Annotations
Photographs **with** Annotations
Conclusions
Evaluation
Bibliography
Acknowledgements

Standards

The standard of coursework marking this year has been more reliable than in 2011. Only a few centres had their marks adjusted during moderation this year. From a total of over 90 centres only 4 centres were adjusted downwards and 1 centre was adjusted upwards.

Help and advice is available from the Principal Moderator at any time. Contact email address iangkenyon@aol.com

Coursework for 2013 can be submitted any time after 1st April 2013. The deadline for submission is May 15th 2013.

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