GCE EXAMINERS' REPORTS

GEOLOGY
AS/Advanced

SUMMER 2016

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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 2016

Advanced Subsidiary/Advanced

GL1

The GL1 examination was designed to test a wide range of skills including the interpretation of graphs, diagrams, maps, geological cross-sections and photographs. 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.

Question 1

(a) (i) A simple starter which made use of the mineral data sheet. The vast majority of candidates scored 2 marks here. A few candidates confused mineral 1 with mineral 2 and lost marks whilst a small number of candidates failed to state the type of feldspar.

(ii) The texture of Figure 1b was generally well described with most candidates referring to size, shape and sorting of the constituent grains. Weaker candidates failed to use the scale bar to describe the range of particle sizes. Some candidates clearly did not understand the term texture and described the mineral content instead or used igneous terminology.

(iii) The majority of candidates got this question wrong by giving the answer as orthoquartzite. This may in part be due to the answer to question 1(a)(ii) where most candidates gave orthoclase feldspar and quartz as the answers and they then combined this to produce orthoquartzite. Fewer than 25% of candidates correctly identified Figure 1b as greywacke. Following on from part (ii) many candidates demonstrated poor follow on logic, using igneous terms like crystals, they then chose a sedimentary rock type but did not trigger a review of their answer for part (ii).

(b) This question was generally quite poorly answered as candidates failed to make full use of the information available in Figure 1a. Many candidates failed to notice the sandstone xenolith within the pluton meaning the granite was younger than the sandstone and therefore the sandstone could not be formed from the granite. Very few candidates referred to the metamorphic aureole- again proving the granite was younger than the sandstone so could not be formed from it. Some candidates did not realise that the mineralogy of the granite and gneiss were the same. A large proportion of candidates referred to superposition and the idea that the sandstone was younger than the gneiss. Few noticed the irregular erosion/unconformity surface between the gneiss and sandstone.

(c) (i) This question was quite poorly answered with many answers lacking the necessary detail. In order to gain credit a difference between both the sandstone and metaquartzite needed to be clearly stated. Simply stating grain size or mineral content was insufficient. The most common answers referred to crystalline rather than clastic texture, clay matrix would recrystallize to new minerals such as chiastolite, Z would be coarser grained following recrystallization, Y is poorly sorted, Z would be porphyroblastic, Y may contain fossils, Z fossil evidence destroyed by recrystallization.

(ii) Well answered by many candidates but a significant number confused regional and contact metamorphism, incorrectly referring to pressure and foliation. The better candidates simply stated Recrystallization (1) due to Heat (1) alone by Contact (1) for 3 marks.

Question 2

This was the most accessible question on the paper and generated many maximum and close to maximum marks by the better candidates.

(a) (i) Very straightforward starter with the vast majority correctly identifying P waves as the faster of the two waves.

(ii) The answer was exactly 9 000 km. Any other value given was not credited. About 10% of candidates failed to read the graph accurately.

(b) (i) Most candidates scored either 2 or 3 marks here by making use of the data on Figure 2b. A few candidates described how P wave velocity varied from the surface down to 6 000 km and lost marks as a consequence. The better candidates quoted depths and actual speeds of wave travel rather than just referring to increasing or decreasing speed.

(ii) A good discriminator with a wide range of responses being given. Many candidates do not understand that an increase in rock density alone will cause earthquake waves to slow down whilst an increase in rigidity (incompressibility) will cause waves to speed up. A number of candidates ticked more than one box for each option and scored zero marks.

(iii) A large number of candidates were unable to accurately locate the lithosphere/asthenosphere boundary accurately on Figure 2b. Many incorrect locations were at depths between 500 and 700 km from the Earth's surface. The mantle/core boundary and the outer core/inner core boundary were accurately plotted by the majority of candidates. A small number of candidates failed to draw any lines on Figure 2b to indicate the positions of the boundaries. A small number thought the graph was a cross section of the whole earth and marked a central core at 2 000 - 4 000 km, flanked by mantle and crust and did not pay any attention to the S and P wave data.

(c) (i) A very well answered question with the majority of candidates scoring either 2 or 3 marks here. In order to achieve maximum marks, reference to the actual decrease in speed of the P waves was required.

(ii) Many candidates scored full marks here and demonstrated a good understanding of why P waves slowed down and S waves stopped at this boundary. The best answers clearly explained the effect of decreased rigidity on wave travel. Weaker candidates explained the decrease in velocity due to the waves being longitudinal or transverse.

Question 3

(a) (i) More than half of the candidates failed to score 2 marks here. The only answer for dip direction was WEST, the angle of dip was 10 degrees (margin of error allowed +5 or -5 degrees so the range was 5 - 15 degrees). Some candidates seemed to be measuring the angle of the fault, whilst a number of candidates gave the angle of dip as more than 100 degrees. This outcome has been similar each time this question has been asked and may be worth re-enforcing as a teaching point by centres.

(ii) Generally well answered but weaker candidates failed to explain the evidence, instead just stating 'superposition' or 'periods in the right order'. A few candidates compared the 20 000 year old plant fragments with the 100 000 year old ones but gained no credit. Very few candidates mentioned folded/tilted strata beneath undeformed/horizontal strata.

(b) A very straightforward question answered correctly by the majority of candidates. The most common incorrect answer was normal fault.

(c) (i) Answered correctly by the majority of candidates but the range of spelling for suture was highly variable.

(ii) The majority of candidates incorrectly identified the fossil group as Ammonites. Many candidates incorrectly suggested Cephalopods, Ammonoids, Ceratites, Goniatites or Graptolites. The candidates who identified feature X correctly more often than not could cite the correct reason being the most complex/very frilly lobes and saddles suture pattern.

(iii) Generally well answered with many candidates scoring at least 3 out of 4 marks. Most candidates tried to prove it was either a life or death assemblage rather than weighing up the evidence for both. The more able candidates realised that it had to be a death assemblage as ammonites were free swimmers and would sink to the ocean floor after death.

(d) Generally quite poorly answered, most candidates ignored the information in Figure 3a which stated the plant fragments ranged between 20 000 and 100 000 years old. Many candidates were clearly unaware of the dating limitations of Carbon 14 dating. The maximum age for Carbon 14 dating is generally 60 000 years BP and in exceptional circumstances 75 000 years BP. The best answers stated that the upper plant fragments could be dated but not the lower ones. Weaker candidates ignored the command 'assess the usefulness' and simply stated yes, fine you can date the plant fragments.

Question 4

(a) (i) This question proved to be a good discriminator with around half the candidates scoring 2 marks here. An alarming number of candidates inserted the fold axis and axial plane trace in the syncline. A significant number of candidates correctly inserted the anticlinal fold axis but not the axial plane trace on the surface of the block.

(ii) Another good discriminator with the best candidates expressing themselves clearly to explain how steep dip produces a narrow outcrop and gentle dip resulted in a wider outcrop. A number of candidates got the angles and outcrop widths the wrong way round. A significant number of candidates were unable to use written English to express their ideas clearly in this question. A small number of candidates inappropriately referred to stress and strain, competent and incompetent behaviour and even p max and p min directions.

(iii) The majority of candidates correctly drew one or more lines parallel to the top edge of the side face of the block. Incorrect answers were generally extensions of the anticline from the front face of the block.

(b) This question was again a very good discriminator. It was disappointing to see so many candidates ignore advice given in the stem. A significant number of candidates made no reference to strike, dip, fold type, axial planes, limb lengths or fold symmetry whatsoever. A number of candidates still do not understand fold symmetry. Candidates needed to convey that they understood that the folds were asymmetrical because the limbs were different lengths (**not** that they dipped at different angles). Only a relatively small number of very good candidates scored maximum marks on this question.

(c) (i) Only around half of the candidates correctly identified Figure 4b as a load cast and flame structure. Incorrect answers included flute casts, trace fossils, cross bedding, desiccation cracks and despite the question asking for sedimentary structures - pillow lavas. In order to achieve maximum marks it was necessary to refer to the denser sand/sandstone sinking into the less dense clay/shale after the sediments had been deposited. Many candidates did not realise that the photograph was upside down so referred to the dense clay/shale sinking into the less dense sand/sandstone.

(ii) The majority of candidates ignored the wording in the stem of the question which specifically asked for reference to the relative ages of the beds shown in Figure 4a. Many candidates correctly stated they could be used as a way-up structure but then failed to state that the beds in Figure 4a must have been overturned as the flame structures were pointing down/load casts bulging upwards.

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GL2a

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

A meeting, whose personnel included the moderators, took place on the day after the paper was timetabled. The mark scheme proposed by the Principal Moderator was reviewed against some candidates' scripts and a definitive version was then published via the WJEC website. Guidance in its application was available, as in previous years, by e-mail request to the Principal Moderator for this unit. There were also examples of marked questions 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 received 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. 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 individual centre reports, which are available on results day.

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 was also given to make some questions data response.

Question 1

In part (a) most candidates noted the crystalline nature of Specimen E, and the fact that it showed coarse crystals lead the best candidates to select that it was the product of slow cooling at a constant rate. In addition, rock unit E was clearly shown on the map as being a pluton. Candidates should have made use of information contained on the map to help form their answers. In part (b) the question required the candidates to identify minerals using their diagnostic properties. The best answers noted the angle at which the cleavages intersected on photograph 2 and the more able candidates had no problem correctly identifying peridotite as the most likely rock forming the included fragment.

Question 2

The majority of candidates gained both marks in part (a). Similarly the responses in part (b) were mostly correct however some candidates were unable to recall the term 'columnar jointing'. In part (c) the best answers were able to differentiate between what would be expected to be found at the top and at the bottom of a lava flow. Credit was also awarded to candidates who were able to describe textural features that could be used to confirm the presence of a lava flow such as vesicles.

Question 3
Most candidates were able to correctly identify that the fossil was a coral but a surprisingly high number of candidates were unable to calculate the correct size of the specimen using the scale shown on photograph 4 in part (a). In part (b) the most common errors were to draw interlocking crystals rather than grains (a response for which a maximum of only one mark could be awarded) or to draw rounded grains which were well sorted but not drawn to the correct size. As in previous years, a few candidates drew "floating" grains with none of the grains in contact with each other. In part (c) most candidates noted that age suggested that the statement could be correct but the mineralogy proved that it was incorrect, although a number of candidates described the evidence but failed to provide any evaluation of this evidence.

Question 4
The evidence indicating that F1 showed dip-slip movement was generally well completed with the change in the width of the outcrop of rock unit A, and the lack of displacement to the western outcrop of rock unit B commonly noted. A number of candidates incorrectly suggested that the straight line outcrop of the fault indicated dip-slip movement. Most candidates were able to interpret F1 as a reverse fault with its footwall to the north-east.

Question 5
Most candidates were able to correctly state the result of the diagnostic test but some candidates quoted a value from Mohs scale for hardness suggesting that they had simply looked at the mineral data sheet rather than carrying out the test as asked for in the stem of the question. No credit was awarded to these candidates. The result of the diagnostic test was credited if it correctly stated that it "did not scratch" or "did scratch" with the relevant tool and if the result of the test was given in the reason column. The vast majority of candidates correctly identified that Specimen H was not Pyrite although a number decided that Specimen H was Pyrite and made their responses in Table 5 fit this incorrect identification.

Question 6
The nature of the specimens was somewhat variable and every effort was taken to ensure that candidates were not penalised as a result of this, with the mark scheme written to allow full credit to be given for the identification of Specimen A as either shale or slate. Surprisingly few candidates were able to correctly identify location T as the most likely location for chiastolite crystals to be found but most were able to link chiastolite to the contact metamorphism of shale/slate and credit was awarded for this.

Question 7
A variety of standards of accuracy were seen in the drawing of the fold axis in part (a) but most candidates were able to place the axial plane traces into the correct outcrops. A small number of candidates did not add symbols or had the symbols the wrong way round. Part (b) proved to be a question which discriminated well, with the more able candidates often scoring full marks.

Question 8
The cross-section proved to be an excellent discriminator with a wide range in the quality of responses. The most common errors included the failure to recognise and draw vertical bedding, and the incorrect drawing of the unconformity horizontal rather than dipping at 10°. In most cases the fold structures across the cross-section were correctly drawn and the unconformity drawn appropriately. The best answers correctly interpreted the detail of the cross-cutting relationships of F2 and the folded strata. The most able candidates also drew the extent of the metamorphic aureole.

Question 9

The best answers to this question explained in detail how an unconformity provides evidence for a significant time gap in the geological record. Credit was given to responses that explained the geological processes required to form an unconformity with the best answers often being supported with a number of diagrams clearly annotated. In addition good answers incorporated information from fieldwork. Credit was also given to detailed responses describing how to recognise an unconformity. Full marks were seen from responses involving the photograph on the resource sheet, or the geological map as well as answers involving the candidates own fieldwork. The weakest answers simply stated what an unconformity was without any reference to the processes involved in the formation of one or how one can be used to provide evidence of a significant time gap in the geological record. Credit in these answers was necessarily limited since they failed to address the main point of the question.

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GL2b

Specific points are made in the Moderators' Report to each centre but some general points can be made.

Administration
There were one or two examples of errors in administration including not filling in the correct forms. Centres are urged to ensure samples of coursework reach the Moderator by 15 May. There continue to be cases where the marks have not been doubled before submission through the EMI system. Mostly the work was well organised and easy to follow thanks to the detailed annotation.

Suitability of tasks
Centres should be aware of the required context of the investigation at all times as described in the specifications. The centre must remember that the skills range exhibited in GL2b should equate with those assessed within the GL2a paper.

Some centres provided worksheets which gave far too much help to the candidates some of whom only annotated photographs and measured dip and strike. Where annotated photographs of a location are being used then it is expected that original field sketches should be part of the evidence for AS fieldwork. This prescriptive method hinders individuality and thus ranking of candidates based upon ability.

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 is then 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.

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 the relevant assessment criteria. Teachers should make sure that the Field Study Centre knows exactly what is required for the field investigation in terms of the specification.

A mixture of tasks was undertaken, with a rough break down being 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
- Structural analysis (faulting and folding styles related to compression or tension or to specific orogenies)
- Nature and relative age of igneous intrusions
- Geological history of an area involving both sedimentary environments and structural history.

Centres are to be congratulated on the variety of opportunities given to candidates in areas of outstanding geology such as, Isle of Arran, Alderley Edge, Ludlow, Amroth, Saundersfoot, Ogmore, Styal Mill, Black Mountain, Nappa Scar, Blencathra, Cow Green, Alderley Edge, Traeth Bychan. Other centres made good use of suitable local geological locations.

Planning

Plans tended to be fairly simplistic with no details for example as to how to measure clast roundness, sorting etc. or identify rocks and fossils. Planning is required to be specific and related to the chosen fieldwork site. It is not sufficient to write:

'I will carefully observe and identify the rock types and will describe the rocks in detail'
'I will observe minerals and explain where they come from.'
'I will locate and identify fossils.'

Candidates could also have included background material specific to the area, such as a geological survey map segment and the relevance of this site to the overall geology of the area.

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. by the use of 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.

Field Notes

Some field notes consisted entirely of tables of data or a very detailed map of a small area. This does not fit particularly well with GL1 and GL2 and it would be an improvement to see a variety of data collection including field sketches and rock descriptions etc. In other cases, opportunities for the collection of basic field data have been missed.

A minority of field notes were untidy and unclear with poor field sketches. Some field sketches lacked detail. Some candidates are sketching geomorphological features from afar rather than looking at the rocks in detail then stepping back to make a generalised sketch with the knowledge of what is present.

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 be part of every investigation, where appropriate.

Report (Analysis and Evaluation)

There is no need for candidates to repeat observations made in the field notebook within a report unless it contributes significantly to the analysis. Repeating field notes in locality sequence is not required for the analysis. It is more advantageous for candidates to concentrate their efforts on the analysis and evaluation. The conclusions should link up the important evidence from relevant sites rather than describing each site again in sequence. **There should be evidence for graphical or numerical techniques e.g. a rose diagram for trends or dip direction and angles**. Candidates must process data such as clast orientation, sedimentary logs or dip and strike measurements which have been collected in the field. 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.

Evaluation remains the weakest skill. Evaluation should refer to the data gathering process. Reference to inclement weather and the lack of time gained no credit.

Assessment
Centres are to be congratulated on the standard of work produced by the candidates. It is pleasing to report that in general centres are taking note of comments made in individual centre reports in previous years so that there is a continuing improvement in the quality of candidates' work. However there is quite a turnover of centres with some centres submitting work one year and not the next and other centres submitting work for the first time - so that there is a continuous requirement on the part of Moderators to ensure comparable standards across all centres. Centres are to be congratulated on the accuracy of the assessment in most cases although there were some examples of generous and harsh marking.

There are two main reasons why scaling has to be applied:

- Marks generous or severe; sometimes maximum marks are awarded where candidates have clearly not demonstrated evidence of reaching the highest category
- Unsuitable tasks being undertaken which does not give candidates the opportunity to demonstrate the higher level skills.

Help from WJEC
Centres should be aware that there is help available from WJEC. Published exemplars of coursework investigations can be obtained from the WJEC subject officer David Evans (david.evans@wjec.co.uk) and subject support officer Sarah Price (sarah.price@wjec.co.uk). Moderators' reports on the current moderation process are available to centres on results day. Centres are urged to act on any recommendations in the Moderator's 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 centres could discuss suitable investigations with WJEC officers. Any centre having a problem with applying the assessment framework should contact 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 WJEC.

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GL3

SECTION A

General

There was a good spread of marks across the whole paper which represented the abilities of the candidates.

Question 1

(a) (i) The majority of candidates answered this well. Although some candidates referred to the igneous structure as a fault. Reading the stem would have prevented this error.

(ii) The majority of candidates gained two marks for this.

(iii) For two marks candidates had to draw a line above the wells A and B and to the top of the water at well C. The second mark was awarded for continuing the line either to the edge of the island or to the top of the saline water table. Many candidates just drew a straight line that was above the water at well C and gained only one mark.

(b) (i) Most candidates gained two marks for this. Describing size, shape, sorting (SSS) quoting the scale or mentioning the vesicles were all creditworthy.

(ii) Porosity and permeability is the key here with reference to connectedness of pore spaces/ability of water to flow through the rock being essential for the second mark.

(c) Many candidates repeated the stem instead of answering the question. Candidates were not credited for stating that there would be a supply problem if over extraction occurred. Candidates were not credited for mentioning surface subsidence unless they directly linked this with the capacity for the aquifer to hold water. Many candidates referred to a cone of depression/reduction of well levels and saline incursions. Some candidates also mentioned pore pressure reduction - it would be good to see this aspect covered in more responses.

Question 2

(a) (i) Few candidates answered this incorrectly.

(ii) Candidates need to take care to be accurate when completing questions like this.

(b) Candidates were credited whether they used Roman numerals or English numbers. Some candidates did not appreciate that waves on the ground surface were indicative of the highest intensity on the scale.

(c) (i) The question asked candidates to describe and explain the relationship in Figure 2b. Many candidates wrote that as the distance from the epicentre increased so the intensity decreases/ negative correlation this gained one mark. For the second mark candidates had to explain the relationship: energy dissipated so earthquake waves not as strong or words to that effect. Surprisingly few candidates gained the second mark.

(ii) The majority of candidates who attempted this question gained at least one mark. Many gained two. The best candidates drew dots at the correct distance along the line and then joined them up by free hand.

(iii) This was answered well. Many candidates gained two or three marks. Some candidates wrote a great deal without actually saying very much at all.

SECTION B

General

Essay 5 was the most popular. About one fifth of candidates answered question 3 and two-fifths answered question 4 and question 5. Good annotated diagrams are a good way of demonstrating understanding of concepts.

Spelling is not generally an issue for the majority of candidates (examiners will credit them if they can read the word). Poor punctuation can be a problem as candidates then do not show understanding and often end up contradicting themselves. Examiners cannot then credit the response. Candidates should take the time to read through their responses to ensure clarity of meaning. Candidates need to be explicit in making it clear which essay they are answering and also which part of the question they are answering.

Question 3

(a) Many candidates referred to case studies such as Vajont Dam – so long as they wrote about the geological factors that gave rise to ground instability candidates could gain good marks with this approach. Many candidates chose to respond by looking at how major engineering works such as dams, tunnels and building needed to take into account certain geological factors – again candidates could gain high marks. There were a number of candidates who mentioned porosity and permeability and/or joints and faults but were vague about how these factors can cause instability. Many candidates drifted into solutions to the problems but the question just asked candidates to describe the factors. Solutions could not be credited.

(b) Some candidates had excellent case studies. Most candidates referred to longshore drift but many drew incorrect diagrams which did not demonstrate understanding. Good diagrams with good annotations gained candidates good marks. Some candidates had not read part (b) before answering section (a) and seemed to run out of steam.

Question 4

(a) The question asked candidates to describe how groundwater pollution could result from the activities. Candidates who drifted into solutions could not be credited at this point.

(i) Waste Disposal - The best candidates had diagrams of pollution plumes. Porosity/permeability/faults and joints described in detail linked to rock types were also covered by many candidates.

(ii) Mining – Many candidates used specific case studies and many wrote about acid mine drainage in detail – these candidates accessed top marks. Some candidates had limited knowledge and wrote about rusting machines left behind in mines - these had limited credit.

(b) This section usually proved to be very well answered and some excellent responses were seen which scored very good marks. Case studies with excellent diagrams that were a delight to mark for both waste disposal and mining were seen. Some weaker candidates wrote whole essays about reducing/reusing and recycling waste and did not refer to geology in their responses at all. Some candidates did not seem to understand that a perfect hole in the ground is unlikely to be found and that geoengineering is necessary to overcome the problems of waste disposal.

Question 5

(a) In order to gain full marks candidates had to mention to what extent the methods were reliable.

(i) Groundwater levels and pressure: many responses were excellent but many candidates rambled on without actually saying anything and often contradicted themselves.

(ii) Ground movement: generally the best responses in section (a). Candidates were credited for seismic gap theory, long term ground movement and shorter time scales.

(iii) Radon Gas: Some candidates muddled this up with radon from granite/limestone. Many candidates answered this well.

(b) The quality of these responses varied considerably. Many candidates referred to the San Andreas Fault, some candidates referred to the fault as being strike slip/destructive and constructive all at the same time. The very best responses referred to earthquakes which were not on plate margins as well as those on plate boundaries. Candidates need to take care in how they phrase the points they wish to make. There were often sweeping statements. Whilst the magnitude of the recent Nepal earthquake was not as great as the Japan 2011 earthquake it was still a large and devastating event - to state that the worst earthquakes occur at subduction zones does not demonstrate a good level of understanding. Essays that focussed purely on earthquake drills and mitigation received only limited credit.

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GL4

General

Questions certainly discriminated between candidates, and this was a testing paper for candidates showing the synoptic nature of the paper drawing together candidates' AS and GL4 knowledge and testing their application of knowledge to unfamiliar data. A wide range of marks were seen, which stretched the brightest candidates to the top levels.

Section A assesses areas which candidates find very challenging looking to combine depth of knowledge with application to given data. This was generally done better than Section B. Item level data revealed that in Section A Q3 was most accessible and Q1 was the least.

Section B gave a traditional variety of data sources (map, cross-section and generalised vertical section) and was a solid geological map extract from Kirkcaldy Sheet 40E. As in previous years the candidates showed they are familiar with the style of questioning and reasoning and a good range of answers was seen. It was obvious that some candidates did not grasp that the south eastern corner of the map was under water of the Firth of Forth Estuary. Item level data revealed that in Section B Q6 was most accessible and Q7 was the least.

Once again there was good use of colour giving an excellent clarity to some figures and photographs in the paper.

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, testing skills to interpret 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 candidates 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.

Handwriting legibility was sometimes a problem. Candidates should be reminded that examiners are unable to award credit if they cannot read a response! Many candidates had difficulty expressing themselves clearly and spelling of subject specific terminology was often poor.

SECTION A

Question 1

The question focused on igneous processes and application of this to crystallisation processes. The majority of candidates used the data given to good effect. Candidates scored well on most parts of this question, and many full marks were seen, 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 part (i) correct, identifying pillow lavas, there were some unusual answers e.g. Desiccation cracks, which showed some poor terminology links by candidates when they were prompted in the question stem to "identify the structures within igneous body A". Candidates found part (ii) more challenging, often not making the link to the pillows as specified in the question stem and incorrectly discussing superposition. Candidates were often contradictory in their answers, recognising "wrong way up" in part (b)(ii) but failing to review their answer to (a)(i) to correct their mistake.

(b) This was well answered with candidates being well able to describe the distribution of olivine, and they were well versed in the early formation of olivine in a melt, its high density and gravity settling, using the fact the sequence is overturned as the explanation (reserved credit).

(c) There were some variable responses to this part of the question, the weaker candidates really struggled, though good candidates gave excellent responses to substantiate their choice of the peridotite fragments. Even candidates who did not recognise that the sequence was overturned could often still gain mid-range marks (e.g. 9 or 10 out of the total 15).

Question 2

The question focused on sedimentary rocks and the environments of formation were tested with the greatest challenge for candidates being part (d) the post-depositional history of the rock (as has been the case when this has been tested previously). The triangular graph has been used previously and candidates coped well with the skills required.

(a) Many candidates gained full marks, though many candidates had poor use of expression and did not make it clear which rock they were referring to. Little credit was given to differences of "rounding" unless candidates were explicit in B being more rounded, i.e. quantitative descriptions. Some candidates incorrectly described composition instead of texture.

(b) In part (i) the majority of candidates plotted B correctly. Parts (ii) and (iii) required a logical link, and it was evident that many candidates worked "backwards", explaining the changes and then correctly inserting the arrow for (ii). The best answers linked feldspar breaking down to clay and gave detail of the hydrolysis process. Weaker candidates gained little credit for writing about quartz hardness as this gave no link to chemical weathering.

(c) The majority of candidates correctly identified B as beach (marine) and A as semi-arid river (alluvial fan).

(d) This stretched candidates and is a topic which has traditionally yielded poor answers. Credit was given for initial burial/compaction, silica cement surrounding the grains then the calcite cement being deposited from percolating fluids into the remaining spaces between the grains.

Question 3

This question examined deformation and was assessed using data which also examined some fossil concepts. As usual many candidates found the critical evaluation part most difficult.

(a) In part (i) many correct answers were seen, although in part (ii) there were some very random ideas linking deformation to death assemblages showing that some candidates did not understand the deformation event was significantly post-deposition.

(b) The majority of candidates scored highly.

(c) Parts (i) and (ii) were generally well done, with candidates identifying that brachiopod A had been shortened along the hinge axis/extended along the short axis and that brachiopod G had been extended along the hinge axis/shortened along the short axis. Some candidates lost marks by not stating which brachiopod they were discussing. Part (iii) allowed the stronger candidates to excel, with some very detailed answers showing logical thought processes backed up by evidence. Often candidates missed the "minimum" in the question stem, as long as candidates were clear on which principal stress they were talking about they could be given credit.

Question 4

This question examined the past life and past climate with reference to Sepkoski's curves showing changes in diversity of marine fauna and making links to other theories of diversity controls.

(a) The majority of candidates gained full credit.

(b) Some candidates missed an opportunity to talk about the biased fossil record in this question, thought the majority of candidates were able to discuss lack of hard parts, unfavourable preservation, destruction before (scavengers) or after preservation (metamorphism) with great authority.

(c) In part (i) again candidates often had poor phrasing in their answers which became self-limiting on marks. Some candidates only discussed continental area and missed the focus on shelf seas given in the stem. The best candidates produced very detailed descriptions of the changes linked to geological time periods. In part (ii) the majority of candidates were able to talk of a positive correlation and description, though a minority of candidates missed the "following the end Permian" pointer. Candidates found part (iii) more challenging, and often missed the opportunity to show the breadth of their knowledge that could be covered. Both supportive points and alternative theories were expected to be covered in the critical evaluation. The lower scores on this part of the question contributed to the overall paper mean being lower than last year.

SECTION B

The 1:50 000 map extract of Kirkcaldy (Sheet 40E) 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 exam. This really tests the skills of interpreting the data by candidates. It was obvious that some candidates did not grasp that the south eastern corner of the map was under water of the Firth of Forth Estuary.

Question 5

This question covered aspects linking to intrusions and testing logic skills with critical evaluations. The question was intended to get candidates familiar with the map and was generally well done.

(a) The majority of candidates got this correct, though there were some unusual incorrect answers in the range of hundreds of thousands of metres!

(b) Part (i) tested candidates' knowledge on what would be seen at the contact of the quartz dolerite with the limestone, though there was a wide range of incorrect answers seen. Part (ii) was more straightforward for candidates and was generally well answered. The majority of candidates were able to link crystal size to cooling history. A common incorrect response was the discussion of composition. Candidates found part (iii) more challenging, with the majority scoring 2 marks out of 3. Many gave poor answers linking sills to horizontal and dykes to vertical, but better candidates were able to describe concordant and local discordance, with very few making links to the geological map about it not being a linear outcrop.

(c) Some excellent answers were seen with candidates showing very good critical evaluations linking to the cross-section that the quartz dolerite was partly intruded along the faults.

Question 6

This question examined the deformation on the map extract, initially folding then faulting on the Buckhaven Fault. The last part of the question developed the wider implications of the deformation on the Human Environment, in this case mining in the area.

(a) In part (i) the majority of candidates were able to identify where the fold was on Figure 6 and draw a correctly located axis. However many then were unable to identify the plunge, despite the syncline plunge already being marked. A considerable number of candidates identified an opposite direction of plunge to the syncline. In part (ii) the most common correct answers were that the oldest beds were in the centre of the fold as evidence for an anticline, and that the “V” or closure pointed to the south for the plunge evidence.

(b) Candidates found more difficulty in explaining the map evidence, often missing that the Leven syncline axis was not offset, or the “tick” mark showing a downthrow which indicates vertical movement.

(c) Many candidates only gave one direction for strike, and there were some contradictions in downthrow/hanging wall and the fault type conclusion.

(d) Precision in measuring the thickness of displacement was required in part (i). If candidates used the cross-section they would not achieve this and they would have also ignored the question stem with the explicit instruction to "using the **generalised geological column only**". The majority of candidates noted the throw decreasing with depth in part (ii) but did not give comparative numbers to follow up why they had calculated part (i).

(e) Candidates often gave far too generic an answer for this part of the question, which gained minimal credit. Many answers could have been easily lifted to full marks by the use of data from the map (e.g. naming the fault where the coal seam was offset by). Only a small number of candidates recognised the impact of the Firth of Forth Estuary location and potential flooding.

Question 7

The addition of a block diagram and text information for candidates to assimilate and to apply basic concepts tested their understanding of sub-surface geology. The final part was similar to previous years in extending the AS level concepts via synoptic testing, making links in this case, to the topic of carbon sequestration potential.

(a) Candidates were asked to shade the top surface of the block diagram and there were a wide range of attempts seen. Candidates were rewarded with identifying the lower boundary of the coal bearing strata at 1 200 m and where this would occur on the land surface, and then recognising that it would be parallel to the outcrop of the bed on the surface.

(b) In part (i) the majority of candidates gained full marks. In part (ii) many candidates did not link back to the text box to link the increased surface area with the binding effect for CO_2, and their phrasing implied a thick gas just being stored in the voids - which was not credited. The connected nature of the fractures gave permeability for the liquefied gas to be pumped in.

(c) It was disappointing that some candidates did not write much for the 6 mark allocation, but the majority of candidates wrote a considerable amount. Many candidates did not link back to plunge and so only talked about the area not being suitable because the depth was not sufficient, this did gain limited credit. Some candidates erroneously referred to the CO_2 polluting the estuary water when it escaped, or that an anticline would be better because the gas would rise upwards to be trapped which did not link back to the information given in the earlier part of the question. The better candidates talked of numbers of coal seams and their potential, (e.g. ULGS limited coal resources but below 1 200 m; LSC good potential with many seams and below 1 200 m) as well as links to access. Candidates should be reminded that generic answers will not gain much credit when the question makes specific reference to using the data from all the sources given.

GEOLOGY

General Certificate of Education

Summer 2016

Advanced Subsidiary/Advanced

GL5

THEME 1 – QUATERNARY

Question 1

(a) (i) A well answered question with most candidates able to interpret the contour patterns correctly.

(ii) A generally poorly answered question with only a small minority of candidates able to recognise the landform as a cuesta from the map, despite the answer to the previous question. Some candidates were able to earn some credit for an explanation of dip and scarp slopes from the data. There were a significant number of candidates who attempted to answer the question using ideas related to slope stability.

(b) (i) Most candidates were able to describe the main orientation of back walls from the rose diagrams. Many candidates were able to gain all the marks by quantifying the number of measurements or by giving a more detailed description of the data.

(ii) The question discriminated well. Stronger candidates were able to relate the data from the rose diagram to the maps in Figures 1a and 1b. However many candidates resorted to a very general description of glacial movement, disregarding the information from the maps.

(c) (i) A surprisingly large number of candidates were unable to relate ridges in the till deposit to moraines or the process of their formation. A common misconception was that they represented glacial striations in bedrock.

(ii) Many candidates were able to relate the formation of peat to waterlogged/anaerobic conditions and organic material. However very few then were able to make the link to post-glacial conditions or an interglacial climate.

(iii) This question discriminated well. Most candidates were able to give some reasons for the formation of the landslide. Only the stronger candidates demonstrated an understanding of either deglaciation of periglacial processes.

Question 2

This essay produced a wide range of responses. The best essays covered a wide range of drainage patterns and discussed groundwater flow well supported with diagrams and examples. Many essays lost marks for being overly descriptive and failing to evaluate the main idea of the question.

Question 3

This question showed that most candidates who attempted it had some knowledge of both isostatic and eustatic sea level change. However the explanation of the processes that lead to the changes in sea level, particularly isostatic changes, were poorly explained in many cases. Many candidates were able to evaluate the use of radiocarbon dating but there were frequent instances of confusion with oxygen isotope evidence in both sections of the question.

Question 4

This question was only attempted by a minority of candidates with some good answers seen. The best candidates were able to draw on their knowledge from GL5 to discuss processes and sediments on turbidite or carbonate environments. Weaker candidates often resorted to a general description of a sedimentary environment from a different part of the course. Some good evaluations of the Hjulström graph were seen.

THEME 2 – GEOLOGY OF NATURAL RESOURCES

Question 1

(a) A generally well answered question with only a few candidates missing the mark as a result of a lack of precision in reading Figure 1a.

(b) (i) Most candidates were able to identify at least one of the structures that accumulates hydrocarbons in the Brent field.

(ii) Many candidates demonstrated a good understanding of the processes which accumulate oil. However candidates who could give only a general explanation of these processes without relating it to the geology of the Brent hydrocarbon field were unable to access the full range of marks.

(iii) This question was challenging with only the stronger candidates able to suggest two valid reasons for the variation in recovery rates.

(c) (i) Most candidates were able to use the graph in Figure 1a to explain why oil and gas can both occur in the same hydrocarbon trap. Many were then able to relate that information to the geology of the Brent hydrocarbon field.

(ii) Many candidates, despite the rubric of the question, tried to explain the absence of oil from the Leman hydrocarbon field using the graph in Figure 1a. Those candidates who focussed on the geology of the Leman field were able to produce good answers.

(iii) This question discriminated well with the candidates' ability to understand the geology and apply it to the problem. Several misconceptions were evident about the Permian evaporates being used to store the gas; also the structure and geology needed to accumulate large volumes of natural gas was disregarded by many candidates. Some candidates entered into a discussion of the use of the coal to sequester CO_2 despite the question's rubric.

Question 2

This essay produced a wide range of responses showing that candidates did understand some of the basic principles of prospecting for both geophysical and geochemical techniques. Much of the variation in marks seen was a result of the quality of evaluation of the efficacy of these techniques. Weaker candidates largely described the techniques, whereas the stronger candidates were able to form judgements on the strengths and limitations of each technique.

Question 3

The quality of the responses seen for this essay were similar to those for question 2. Basic principles of ore forming processes were understood, but weaker candidates limited their responses to describing the processes rather than making judgements about the importance of these processes for different metals.

Question 4

This proved to be the most common choice of essay with a very wide range of quality of responses. The best answers focussed on the geological aspects of the environmental issues and used specific examples to support the ideas being discussed. There were many answers that were both vague in their level of detail and were too descriptive rather than evaluative in their approach to the question.

THEME 3 – GEOLOGICAL EVOLUTION OF BRITAIN

Question 1

(a) Generally well answered, with most candidates using their knowledge of rock deformation in a stratigraphical context. Candidates should remember to use all the available data provided and to give as much detail as possible.

(b) This question was answered well however many candidates just gave one line of evidence for the Alpine orogeny. Data from Table 1 was not always used despite the fact that this is implicit in the stem of the question.

(c) This proved to be extremely straightforward with most candidates gaining full marks.

(d) This question discriminated well. Good candidates were able to both select diagnostic information from Figures 1b, 1c and 1d and then use this data to justify their hypothesised environment of deposition.

(e) Candidates found this part difficult and not many candidates realised how the information from parts (c) and (d) could be used to help answer this question.

Question 2

This question and question 3 were the most popular questions.

(a) This question was generally well answered. Most candidates were able to draw upon a good bank of descriptive structural and petrological evidence pertaining to the Variscan orogenic belt. Field examples and case studies enriched these answers.

(b) Many candidates convincingly evaluated the positive evidence that this data provides for a destructive plate boundary setting. However, few candidates outlined the uncertainties regarding some of this information.

Question 3

(a) This question was generally well answered. Most candidates were able to draw upon a good bank of descriptive sedimentological evidence pertaining to the sub-environments of the Devonian and Permo-Triassic 'red beds'. Field examples and case studies enriched these answers.

(b) The evaluation was generally better for this question than the other two essays and many candidates were aware of the factors that limit the reliability of palaeomagnetic data.

Question 4

This was the least popular question and, as might therefore be expected, performed the worst. The principal issue was that many candidates did not realise that central to this essay is the question of the validity of the Principle of Uniformitarianism rather than just the incompleteness of the geological record.

THEME 4 – GEOLOGY OF THE LITHOSPHERE

Question 1

(a) Generally well answered, with most candidates scoring at least two marks. The better answers quantified the size and number of the various rock types.

(b) (i) Well answered with many candidates gaining full marks. Candidates should remember to draw construction lines on graphs to get accurate values.

(ii) Well answered with many candidates again gaining full marks.

(iii) Mixed responses were received. More able candidates explicitly stated how the two models differed with respect to the rate of growth of continental crust at specified time periods.

(c) Very mixed responses were received. Many candidates found it difficult to relate the relative surface area of Precambrian rocks on the map to the graph. Few candidates questioned the validity of the comparison or suggested a better model to fit the map data.

Question 2

This was the most popular question.

(a) This part of the question was generally well answered. Diagrams were good and well utilised. More able candidates gave full detail on the composition of the different layers.

(b) Some candidates convincingly evaluated the relative merits of using ophiolites to explain the composition and structure of the oceanic lithosphere but this was not the norm. Most candidates concentrated on the easy access to ophiolites rather than discussing the problems inherent in this approach.

Question 3

A reasonably popular question.

(a) This part of the question was generally well answered. Diagrams were used with good effect to show how lithospheric thickening occurs. Candidates could have given more detail on the role of structural geology in the development of orogenic belts although this was generally discussed at the expense of igneous processes.

(b) Many misconceptions relating to the role of isostatic equilibrium in controlling the height of mountain ranges became evident. Weaker candidates just discussed in detail the various types of erosion and weathering whereas more able candidates evaluated the role of delamination, gravitational collapse and the non-specification topic of under-plating.

Question 4

This was far and away the least popular question and led to a bimodal distribution of results. Less able candidates based their essays on shadow zones and the structure of the whole Earth. More able candidates did concentrate on seismic reflection and refraction techniques limited to the lithosphere although even these candidates struggled to discuss the limitations of the seismic method.

GEOLOGY

General Certificate of Education

Summer 2016

Advanced Subsidiary/Advanced

GL6

Administration

The administration and moderation of the coursework samples ran smoothly once 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 15 May deadline.

Packaging Coursework

When packing the coursework samples please try to **reduce bulk** and **weight** as far as possible. A4 hardback ring binders 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 moderators. 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.

Electronic Sample Selection

This works smoothly and has helped cut down on paperwork and administration. Samples are automatically generated once all the marks for the centre have been entered online using WJEC secure website.

GLF 1 Forms

A completed F1 form should be **included with the coursework sample**. This is used by the moderator to make any recommendations for mark adjustments. 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 are included in the sample.

F2 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 candidates carried out a pilot study to test their planning and then modified the original plan in light of this. A significant number of centres were 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. Candidates should be encouraged to plan in detail and 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 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.

It is pleasing to see that all centres are now using the updated version of the F3 form with the candidate and teacher declaration sections completed on the reverse side of the form.

Downloads from WJEC
Copies of the forms can be downloaded directly from WJEC website www.wjec.co.uk by following the GCE/AS subjects and then Geology links from the 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 again 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 few centres using GPS.

All field sketches should have grid reference, scale, compass orientation and detailed annotations. Simplistic labelling of sketches should be discouraged. It is strongly recommended to practise field sketching from photographs or slides prior to fieldwork being carried out.

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.

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. Many candidates included some excellent photographs this year but 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 candidates 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 candidates 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 candidates from last year? How the work could 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 evaluation.

The Report
It is now expected that candidates 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.

As a rough guide, the optimum length for each report should be between 1 250 and 1 750 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 candidates from including large amounts of photocopied material from secondary sources. Also avoid long-winded generalised introductions on the classification of igneous, sedimentary and metamorphic rocks.

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 candidates 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 the most consistent for many years and suggests that the vast majority of teachers have fully engaged with the assessment objectives and are able to award marks appropriately to their candidates' investigations.

Help and advice is available at any time via the Subject Officer at WJEC:
david.evans@wjec.co.uk

Coursework for 2017 can be submitted from mid-April 2017.
The deadline for submission of on-line marks and the coursework sample is 15 May 2017.

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