GCE A LEVEL EXAMINERS' REPORTS

GEOLOGY
A LEVEL

SUMMER 2019

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GEOLOGY

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COMPONENT 1: GEOLOGICAL INVESTIGATIONS

General Comments

This examination was designed to test a wide range of skills including the interpretation of specimens, diagrams, maps, geological cross-sections and photographs. The paper covered many areas of the specification content and included both straight forward and more complex ideas, making it accessible to a wide ability range. The mean mark was 62.5 with a standard deviation of 15.4. The modal mark was 63 with the highest mark being 99 and the lowest mark 13.

Comments on individual questions/sections

Q.1 The majority of candidates had no difficulty correctly identifying the trilobite features and most candidates could correctly state the period and era. Some candidates did not appreciate the significance of time being on the vertical axis and incorrectly suggested that *Ogygiocarella* had a faster rate of evolution than *Nobilasaphus.* It was also clear that a significant number of candidates had difficulty in applying their knowledge and understanding of gradual/punctuated evolution to the data in Figure 1b. The best answers to part (d) discussed the functional morphology of *Trinucleus* however it was disappointing that many candidates failed to offer more than just "Trilobites are extinct" in part (ii).

Q.2 In part (a) most candidates recognised that a marine transgression had taken place. The most common error was a failure to appreciate that location Q was in the siltstone and therefore coarser grained than the shale and as such suggested an increase in energy levels.
The majority of candidates were unable to correctly describe the appearance of anthracite, most incorrect answers stated the chemical composition of anthracite as opposed to its appearance. The vast majority of candidates scored full marks in part (b ii). Pleasingly the majority of candidates had little difficulty in calculating the volume of the coal in the pillars. Part (d) proved to be a good discriminator with a wide range of understanding of borehole drilling. High scoring candidates were able to discuss the strengths and weaknesses of borehole surveying and related the systematic approach to the resource that was being targeted.

Q.3 This proved to be the second most accessible question on the paper. The majority of candidates scored full marks on part (a) and (b). The most common error in part (a) was to draw the groundmass as euhedral crystals. A number of candidates suggested that the steel pin would scratch the feldspar for which no credit could be given. The most common error on part (c) was to draw the aureole around the unconformity as opposed to the pluton. It was pleasing in part (d) to see a wide range of factors explained in detail.

Q.4 This was the most accessible question on the paper. Most candidates were able to score full marks in part (a). A small number of candidates decided that the specimen was granite and made their response to part (ii) fit this incorrect identification. Centres are reminded that candidates may request to see alternative samples of each specimen during the examination. Part (b) was generally well completed.

Q.5 Despite this question being similar in nature to the one used in the SAMs this proved to be the least accessible question on the paper with a mean mark of 3. A significant minority of candidates decided not to state any observations and instead just described the photograph, no credit could be awarded to those candidates. There were however a number of candidates who had a clear understanding of how to conduct a field investigation suggesting that they were familiar and comfortable with taking an investigative approach to fieldwork. It is essential that centres use fieldwork as an opportunity to allow candidates to plan their own investigations when conducting fieldwork. I would advise referring to the online examination review to see exemplar answers for this question.

Q.6 A variety of standards of accuracy were seen in the drawing of the coral with the most common error being an incorrect scale. Most candidates had no difficulty identifying the fossil group. Part (c) discriminated well with most candidates correctly discussing the graded bedding. Some candidates incorrectly claimed that it was upside down because the pedicle valve was on the bottom and it should be on the top.

Q.7 A wide range of responses was seen on this question. High scoring candidates were able to describe the processes involved in regional metamorphism from both a textural and a mineralogical perspective. The weakest answers simply listed the conditions involved in regional metamorphism without any explanation as to how these conditions relate to texture and mineralogy. Credit in these answers was necessarily limited since they failed to address the main point of the question.

Q.8 The table concerning the two faults **F1** and **F2** was generally well completed. Fewer candidates were able to correctly interpret **F2** as a thrust fault despite being told its angle in the first row of the column. The most common error on part (b) was the incorrect location of the unconformity.

Q.9 The cross-section proved to be an excellent discriminator with a wide range in the quality of responses. The most common error was the incorrect plotting of Rock Unit E next to the dyke. In most cases the fold structures across the cross-section were correctly drawn and the unconformity drawn appropriately. A small number of candidates drew the pluton as a horizontal feature for which no credit could be awarded.

There was a correlation between the marks awarded on the cross-section and the geological history, with a number of candidates scoring full marks on both. The most common error on the geological history was the incorrect location of the folding.

Summary of key points

- Candidates need to be confident in planning field observations, the best way to achieve this is for them to be given the opportunity to plan their own investigations in the field.

- Successful cross-section drawing requires practice, some candidates' responses suggested that they had little experience of drawing geological cross-sections

- Centres need to ensure that they cover the entire specification, the responses from some centres suggested that the candidates hadn't been taught certain sections. For example, the candidates from one centre were unable to identify any features of the trilobite in question 1.

- When asked to draw a fossil using the scale provided it is essential that a mathematical approach is taken so as to determine the exact size that the drawing needs to be.

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COMPONENT 2: GEOLOGICAL PRINCIPLES AND PROCESSES

General Comments

The paper provided good differentiation between candidates with the maximum mark of 81 and the minimum mark of 18. The mean mark was 50.9 and the standard deviation 11.1. There was a very slight positive skew. Question 2 had the highest facility factor of 70.5 and the remaining questions all had similar facility factors with Questions 3 and 6 having the lowest facility factors of 50.6 and 50.7 respectively.

Comments on individual questions/sections

Q.1 (a) (i) The response rate for the question and indeed the remainder of part (a) was very good. The better answers achieved full marks by recognising the need to provide exemplar data to support their qualitative description. The data does suggest a strong positive relationship between the two variables but is not in the form to indicate direct proportionality as a number of candidates incorrectly suggested.

(ii) This question develops from (a)(ii) and most candidates were able to use the temperature and precipitation data from Figure 1a appropriately.

(iii) This question also proved accessible to most candidates. However, weaker answers often failed to use the information on Figure 1a to name the correct climatic zone. Candidates need to take care with the clarity of their answers as the recognition that it is water that is freezing and expanding rather than the rock itself undergoing expansion and contraction (insolation) was sometimes not made.

(b) This question is an indirect assessment of the rock cycle- Topic F4 KI2f. Very mixed responses were received. Although candidates generally recognised that sedimentary processes are generally restricted to the surface of the Earth there was little development of this point. Additionally, few candidates then went on to explain why sedimentary rocks are transformed into metamorphic and igneous rocks with burial, hence explaining the lack of sedimentary rocks by volume.

(c) Responses to this, which a further assessment of candidate’s knowledge of Topic F2 KI1b, were generally poor. Weaker answers confused the question and concentrated on describing the relative effects of weathering on mudstones, sandstones, carbonates and evaporites rather than on igneous and metamorphic rocks. Those candidates who discussed the chemical weathering of igneous and metamorphic rocks only tended to concentrate on the hydrolysis of silicate minerals to form clays which then went on to form mudstones. The role of insoluble quartz in forming sandstones and ions in solution precipitating to produce limestones or evaporites was rarely covered.

Q.2 **(a)** **(i)** This was a very accessible question, addressing Topic G3 KI1a of the specification, with full marks being the norm. The only mark that was commonly lost was a mistake in reading the total number of species present on Earth today as 5.0 million.

(ii) This question presented few problems and full marks were quite common. However, candidates should be ready to provide at least the appropriate number of observations for such a descriptive exercise, once again backing their qualitative statements with quantitative exemplar data.

(b) The stem of the question is very explicit in saying 'with reference to Figure 2a' and therefore the candidates who restricted their answer to the graph achieved the best marks. Candidates who quoted their own knowledge (e.g. 95% extinction rate at the P-T mass extinction) rather than processing the data on Figure 2a were disadvantaged. Weaker answers strayed into providing an explanation for the cause of the P-T mass extinction which was not required.

(c) Given the fact that this was the first time that a six-mark QER style question had been used in Component 2, then this question performed better than expected. The candidates that performed best were those who used the 'scaffolding' provided by the four bullet points in the stem of the question. Key to achieving well in this question was an evaluation of Figure 2c by realising that whereas type and age of lithosphere shows a clear relationship with mass extinctions, the link with timing of large scale volcanicity is variable and with volume of emitted lava is at best weak. Weaker answers strayed into providing an explanation of the mechanisms of mass extinctions.

Q.3 **(a)** This question differentiated well between those who knew the characteristics of slate (foliated, fine and containing chlorite) and those who did not. Additionally, the question exposed those candidates who used inappropriate terminology e.g. laminated as opposed to foliated (Topic F2 KI2g).

(b) **(i)** This question performed relatively well despite having the cognitive conflict of sedimentary structures being preserved in metamorphic rocks.

(ii) Candidates were generally able to measure the dip angle with some confidence but the dip direction proved more problematic as candidates either did not recognise that the photograph was taken at right angles to strike or they were not able to orientate themselves with respect to compass directions. A common error was to state E-W or to state SW-NE believing that north was at the top of Figure 3b.

(iii) This question differentiated well, requiring candidates to objectively and systematically analyse a complicated new data source. Candidates who annotated Figure 3b and referred to their labelling in their written answer often performed the best. However, this was unusual. Candidates must be clear about which rock type they are considering in their descriptions.

(iv) Virtually all candidates were able to access this question despite the difficult scale for the thickness of the metaquartzite at X.

(v) This question differentiated well between candidates who were, or who were not, aware that changes in metaquartzite bed thickness most likely occurred during folding &/or metamorphism. However, it was much less common for candidates to recognise that the role of ductile flow (Topic G1 KI2d) of incompetent rocks (Topic G2 KI1a) was integral to the thickening of the hinge and thinning of the fold limbs.

(c) This question performed very poorly. Full marks were very unusual. Some candidates are still mistaking a symmetric fold as one with equal limb dip angles. Many candidates considered that the only way to identify an overturned fold is with sedimentary way-up criteria. It was rare to see a candidate able to communicate how to recognise an overturned fold or how to discriminate between isoclinal and other fold types. Candidates need to be reminded that annotated diagrams will be accepted even if they are not explicitly asked for in the question.

Q.4 **(a)** This question was generally answered well with candidates able to apply size and shape criteria to crystalline and clastic sedimentary rocks, with good responses often including quantification of grain/crystal size.

(b) **(i)** This straightforward question involving reading values from a graph was also answered well. However, many candidates failed to miss the link between this question and (c)(ii) where this data is an important aspect of explaining how salt domes form.

(ii) The calculation of the gradient of a straight line from a graph with a false origin and a non-origin, y-axis intercept did not prove to be an obstacle for many candidates. Indeed, where there was an error in this calculation, candidates still showed their ability to determine the appropriate units during a mathematical calculation.

(iii) This question differentiated well. Most candidates were able to recognise that rock salt, in having no porosity, would not undergo compaction whereas porous sandstone would, but a few candidates mentioned the role of other diagenetic processes including pressure solution and surprisingly cementation. The use of key terminology from Topic F2 KI1g was conspicuous by its absence.

(c) **(i)** Candidates' achievement in this question was very much centre specific as generally candidates either achieved 2 or 0. The realisation that sandstone would be the porous reservoir rock, shale the cap rock with the two contrasting trapping mechanisms associated with the salt dome was not always made.

(ii) This question differentiated very well. Candidates are not meant to be able to recall how a salt dome forms but given the data in Figure 4b and Figure 4c they are able to deduce this. Consequently, candidates who just used their knowledge did not perform well, but those who used all the data had many opportunities to obtain full marks. Nonetheless, those who did perform well often missed the significance of the zone in which salt becomes ductile from Figure 4b. Weaker answers commonly invoked the need for compressional tectonics to generate the folding.

Q.5 **(a)** **(i)** This question was generally answered well although there was a wide spread of marks. Better answers clearly understood the differences in speed, and hence arrival time, between the two types of body wave and surface waves.

(ii) This question was also generally answered well with candidates realising that the seismic station must have been outside the P-wave and S-wave shadow zones.

(b) **(i)** This question differentiated well. Unfortunately, many candidates included a valid explanation for the path of P-wave Z which could not be credited in this part of the question or (b)(ii). Candidates need to be reminded of the necessity using the correct technical language e.g. refraction instead of bending and not diffraction.

(ii) This question also differentiated well. Candidates who performed well recognised the significance of the denser liquid outer core resulting in a reduction in speed of the P-waves but very few candidates stated that the refraction of P-waves occurs towards the normal creating a 'focusing effect'.

(iii) Most candidates were able to follow the instructions to construct the P-wave that reflects off the inner-outer core boundary. Candidates who redrafted the diagram and then annotated this appropriately were rewarded.

(c) As with the previous question testing mathematical skills [Q4(b)(ii)] candidates performed well choosing the correct trigonometric function and halving the epicentral angle. Those candidates who used the alternative method (using sine) were also rewarded.

Q.6 **(a)** Candidates achieved moderately well here, with the majority spotting the positive correlation (as suggested by the correct answer to (c)(iii)) between the two variables. However, surprisingly, few candidates used exemplar figures to demonstrate/support their answer. As the graph has a logarithmic x-axis 'directly proportional' was not accepted.

(b) This six-mark QER style question did not perform as well as Q2c perhaps due to the reduced scaffolding built into the question stem. Candidates were generally able to describe either the conflict in magma types or the origin of a secondary magma in some detail but rarely in conjunction. Alternatives to gravity settling e.g. magma mixing and assimilation were accepted when technically correct. Few responses recognised the importance of the time of fractionation for producing more silicic magmas.

(c) **(i)** This question was answered well with the only error being in ranking the volume of erupted material where it was not realised by all candidates that if the quantity is tied the mean rank is given.

(ii) This question was answered very well showing that virtually all candidates are able to substitute values into a relatively complex formula and accurately calculate the result.

(iii) This question differentiated well. Candidates who performed well recognised the statistical significance of the r_s value with 8 degrees of freedom and were able to coherently say why the null hypothesis could be rejected at the 95% but not the 99% level.

(d) If candidates did not perform well in (c)(ii) they were still able to, and often did, provide a geological explanation for the volume of erupted material and interval between eruptions at Hekla. Very few candidates however achieved the second available mark for noting the strong positive correlation between these two variables.

Summary of key points

- Candidates could be reminded to carefully scrutinise the data provided in tables, diagrams, photographs and graphs when formulating their answers.
- Most candidates have shown themselves to be adept at meeting the mathematical requirements of the specification and this new aspect to the A level course should not give centres significant concerns.
- Candidates should try to be more specific in the phrasing of their responses to be explicitly clear as to what source they are describing/explaining.
- Candidates should endeavour to accurately use key terminology from the specification whenever possible.

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COMPONENT 3: GEOLOGICAL APPLICATIONS

General Comments

The mean score for this paper was 53.1 with a standard deviation of 16.4 with a range of 7 to 98 marks.

Section A Geohazards: This section of the paper challenged candidates of all abilities. It showed a development from AS level questions, where this content was covered in the previous specification, to an A level standard.

Section B Mapwork: This section performed as in the previous specification to which it closely resembled. Questions 3 and 6 had facility factors above 50% with 4 and 5 slightly lower.

Section C Options: The mean mark for each of the 3 options varied by less than 1 mark, indicating parity of challenge between each option. The uptake of the different options was similar with 226 candidates for the least chosen option and 287 for the most chosen.

The data response part of the **Quaternary Geology** and the **Geological Evolution of Britain** options performed as in the previous specification to which they bear some resemblance. The quality of the extended responses (questions 9 and 12) lacked some of the detail that had been seen in previous iterations of this assessment.

The topics in the **Geology of the Lithosphere** option were generally understood and the option discriminated well.

Comments on individual questions/sections

Section A

Q.1 (a) (i) This question was answered well with most candidates recognising the differences between the two rock types with many candidates then able to relate that to the energy conditions of deposition.

(ii) Most candidates identified the permeability of the gravels and location on a floodplain were the main environmental risk from the geology of the site. Weaker candidates discussed features of the landfill rather than the geology.

(b) This question was usually answered correctly, with many candidates able to relate potential subsidence to changes in pore water pressure in the gravels.

(c) (i) This question produced a full range of answers, with the marks often related to the detail of the explanation of the creation of the cones of depression.

(ii) This question also produced a full range of answers. Some candidates seemed confused about the role of the impermeable cap on the landfill, but most were able to explain the role of the impermeable barriers.

(d) Most candidates were able to state the type of problems commonly found when developing brownfield sites. Some weaker candidates discussed the challenges of operating landfill sites, largely without gaining credit.

Q.2 (a) A question that discriminated well with most candidates able to identify the fault as strike-slip, with many able to add a description of dextral movement.

(b) (i) Many candidates were able to calculate the return period accurately. Mistakes were made with counting the number of earthquakes and a small minority of candidates attempted a range of incorrect complex calculations to work out time gaps.

(ii) A range of answers was accepted for this question looking at not just the westward movement of the ground surface displacements over time but also the diminishing extent of those displacements. Some candidates attempted to link the extent of surface displacement to the magnitude of the earthquake, despite this interpretation being unsupported by the data.

(iii) This question discriminated well with only the stronger candidates being able to explain the pattern of displacement.

(c) (i) Most candidates were able to determine the range of movement accurately.

(ii) Many candidates were able to suggest a potential reason for the variation in surface displacement, often linking the data to their knowledge of rock competency from elsewhere in the specification.

(d) This question provoked a full range of responses. Many candidates were able to link the answers to previous questions with their discussion. In particular, the use of their result for return period and the description of the earthquake pattern were used as the basis for their evaluation. The better candidates were able to give a balanced consideration of the data.

Section B

Q.3 (a) (i) All the answers in the mark scheme were covered by the candidates' responses with individual levels of success. Vague references to stratigraphy were not credited. The idea of this question was to focus candidates on features of the map that would be important in future questions in order to lead them through the data. Simple descriptive terms for what was seen is all that was required (oval, discontinuous, offset by faults, variation in width etc).

(ii) This was poorly answered even though the thickness on the generalised geological column was given (0-30m). Few candidates appeared to be familiar with the concept of facies change and lateral discontinuity of beds.

(b) **(i)** This was usually answered correctly with many candidates able to measure the width of the Aymestry Limestone on the geological map within a permitted range and use the scale to correctly calculate the true width. The main errors were inmixing up the units and obtaining a width that was often out by a factor of 10.

(ii) Whilst this was a challenge for some, many candidates were able to use the Sine formulae to establish the correct dip of the beds. In some cases, Tan (or Cos) was used where candidates failed to realise that the true thickness represented the ‘side opposite’. Follow on credit was given where it was possible to see the error in the working which included using the width obtained in (b) (i) even if incorrect.

(c) Whilst this discriminated well, many candidates were able to give at least one plausible reason for the variation in outcrop width, showing sound 3D understanding.

Q.4 **(a)** This was answered poorly. The majority suggested the fossils were bivalves and gave reasons that were not evident from the Figure 3. Where brachiopods were correctly named, often the reason was bilateral symmetry, which was only credited if there was clear understanding the shells were equilateral or inequivalve. Credit was also given if a candidate stated that there was not enough clear evidence to identify the fossil group from the data provided in the photograph.

(b) **(i)** Life assemblage concept was well understood and many candidates gained full marks for this question.

(ii) This question discriminated well with many candidates referring to the biased nature of the fossil record in term of the presence of hard parts and the chance of preservation as a result of natural processes. A few mentioned the statistical bias of such a small sample but some candidates made vague references to environmental conditions in the Silurian.

Q.5 **(a)** **(i)** Most candidates, but not all, were able to identify the 40-degree dip of the strata and fewer were able to give an appropriate bearing within the accepted range. The question specifically asked for an azimuth in degrees and a general compass direction was not accepted. Candidates were expected to use a protractor to obtain a reasonably accurate measure of the dip azimuth in this case.

(ii) Only data the candidate had entered for (a)(i) was credited in answer to this question and, where a compass direction had been given within a suitable tolerance range, this was also credited.

(b) In this question candidates were asked to evaluate a statement with reference to the evidence from the map, cross-section and ‘stereonet’. Many concluded correctly that the anticline has the oldest rock outcropping in the centre but then erroneously suggested that this meant it was ‘upright’ (in terms of stratigraphy – ‘way up’) rather than referring to the inclination of the main axis. The ‘stereonet’ clearly shows that this has a main NW-SE orientation and is inclined with dips to the NE and SW at differing angles. The term ‘open’ was often ignored with only a few making reference to the wide interlimb angle.

The ‘stereonet’ shows, as does the geological map, that the beds dip out radially from the core of the anticline making it an elongated dome (pericline). The evidence shows the beds close to the SE and NW along the main axis indicating the fold is plunging in those directions.

(c) **(i)** An adequate description was required for the pattern of normal faults on the geological map. Whilst few candidates suggested a radial pattern, many were able to identify a general NE-SW and N-S preferred trend. All sensible alternatives were credited.

(ii) This was generally done well with acceptable pieces of evidence given for and particularly against the Woolhope Fault being accurately described as a thrust.

(d) Many good responses were seen with candidates giving answers for and against crustal shortening of the fold and faults. Some did not distinguish between the type of fault to gain maximum marks.

Q.6 Question (a) was a variation on the usual testing of scale on the geological column and discriminated well.

(a) **(i)** It was surprising that not all students were able to identify the Woolhope Limestone Formation and clearly had misread or misunderstood the question. Incorrect formations were sometimes given whilst others suggested the formation would be an unconformity!

(ii) Many candidates were given credit for calculating the depth of 1500m using the scale of 1:20 000. (7.5cm). It was surprising that given this, they were then not able to locate the appropriate formation at depth, with a few measuring **up** the geological column rather than down from the WoL.

(b) This question, based on a real case study, asked candidates to identify and make judgements on the suitability of the area for hydrocarbon exploitation and suggest why the potential was low. The results were generally good, although this question differentiated well across the range of abilities. Many candidates were able to explain the potential for an anticlinal or fault trap and use the data to suggest the low potential might be linked to the leakage of hydrocarbons through faults and fractures. Few used their specification knowledge to suggest the maturation conditions at depth were not suitable for oil/gas maturation.

Section C: Quaternary Geology

Q.7 **(a)** **(i)** Few students were able to state a piece of evidence (such as raised beaches) for isostatic uplift.

(ii) Surprisingly few students were able to describe a method of dating Quaternary sediments. Many students tried to describe calculating the rate of uplift rather than its timing.

(b) **(i)** Many students were able to rearrange the equation, though a few did substitute an incorrect value for isostatic uplift. Some candidates failed to convert their answer into kilometres and gave answers for ice thickness of nearly 3,000 km.

(ii) Very few students understood the process of isostatic uplift and the concept of isostatic equilibrium. Only a small minority recognised the significance of the ongoing isostatic uplift in Scandinavia.

(c) Most candidates were able to score some marks for this question, but only the strongest candidates linked the differences in scale of postglacial isostatic uplift and eustatic sea level rise. A minority of candidates interpreted a drowned valley as a proglacial lake.

Q.8 **(a)** **(i)** This question was generally answered accurately.

(ii) This question was generally answered accurately, some candidates failed to gain the mark by falling just out of tolerance for the correct answer.

(iii) Many candidates were able to explain how the Milankovitch cycles would lead to cyclic climatic change.

(b) Most candidates described a link between temperature and carbon dioxide. Many candidates were able to qualify that relationship further.

(c) This question discriminated well with a full range of answers. Most candidates were able to describe the behaviour of the different isotopes. Some candidates confused the isotope preserved in ice cores with those from the marine fossil record.

(d) Stronger candidates were able to suggest a potential reason for the variation in thickness of different parts of the ice core.

Q.9 Many of the answers to the QER question were let down by very vague statements about continental climates and the impact that Pangaea had on climate. Few candidates discussed the content from the specification on the opening of the Drake Passage and the rise of the Himalayan mountains. Many candidates' responses were confined to Band 1 in the mark scheme by the lack of any examples quoted in their answers. The best responses were concise discussions of how these two events affect heat transfer from equatorial to polar latitudes.

Section C: Geological Evolution of Britain#

Q.10 **(a)** **(i)** Many candidates were able to make accurate statements about the size and shape of the negative anomaly. Some candidates described the size and shape of the granite plutons for no credit.

(ii) Only a minority of candidates were able to link the negative anomaly with the low density of the granite plutons. Many made erroneous statements about its high density being the cause of the anomaly.

(b) **(i)** The calculation was often attempted well. Some candidates limited their marks with an inaccurate measurement of the width of the pluton. Carried error marks were awarded in such a case.

(ii) It was disappointing to see that only a few candidates were able to transfer the result of their calculation to completing the cross-section. The strongest candidates were able to combine the answer from part (i) and the gravity anomaly graph to plot an accurate cross section.

(c) Most candidates were able to relate the granites to the Variscan Orogeny. The question produced a full range of responses with the best responses using the cross-cutting relationships and the radiometric age to inform their evaluation.

Q.11 **(a)** **(i)** This question was generally answered very well.

(ii) Many candidates were able to relate the texture of the rock to the energy conditions of deposition. Fewer candidates referred to the palaeogeographic map to inform their interpretation.

(b) A generally well answered question.

(c) **(i)** This question generated a wide range of responses with the better candidates using information from all the data given. Very few candidates used the theory of uniformitarianism as part of their answer.

(ii) Many candidates recognised that paleomagnetism would determine palaeolatitude and there were some good explanations of how this could be achieved. Some answers were let down by vague statements about magnetic poles. A few candidates discussed magnetic “stripes” in the oceanic crust.

Q.12 A full range of answers was seen with the stronger candidates able to link the tectonic processes at a divergent plate boundaries with the geological evidence seen in northwestern Britain. The best answers were specific about the examples from the British geological record that illustrated the processes occurring as the Atlantic Ocean opened. Many answers though only gave a cursory list of igneous features that could be found in northern Britain.

Section C: Geology of the Lithosphere

Q.13 **(a)** The nappe structure was generally identified correctly within the orogenic belt although some candidates drew arrows that were not clearly focused on a suitable structure and were not credited. Whilst folding was often mentioned in explanation, few referenced recumbent folds and even fewer referred to thrust faulting moving material large distances.

(b) The changing shape of the basin elements over time were generally stated although vague statements not relating to shape were not credited. Some candidates did not understand that the model in Figure 9b represented a subsiding basin but identified the data as showing a rise in the level with time despite the evidence.

(c) **(i)** The answers for this question were somewhat hit and miss indicating patchy understanding of principal stress directions.

(ii) Maximum marks were gained where candidates were able to suggest a change in principal stresses as a result of lithospheric loading and subsidence. Credit was given to those who suggested that normal faults in the basement may have reactivated and therefore predated the formation of the orogenic belt.

(d) This question was generally answered well and the results of isostasy on the position of the Moho beneath the orogenic belt and the basin was described correctly. However, many candidates who scored 2 marks for the description failed to refer to isostasy or its equivalent for maximum marks.

Q.14 (a) (i) Many candidates were able to gain full marks on this question for correctly calculating a distance of 375km. Credit was given where candidates failed to convert to the correct unit (km) but used the correct formula.

(ii) Credit was given where candidates correctly put the value calculated in (a)(i) on Figure 10a. Only a few realised that there were two possible locations either side of the oceanic ridge axis that related to the 5Ma crust and marked both.

(b) (i) This was well answered with credit given to candidates who gave qualitative and quantitative descriptions.

(ii) Whilst this was generally answered well with reference to changes in rigidity and or density of the mantle, a number of candidates stated that the asthenosphere is partially molten, with some mistaking this for the core! The asthenosphere is less rigid as the temperature of the mantle at that pressure is closer to the melting point of peridotite. If the mantle is partially molten then the percentage must be very low.

(c) This question discriminated well with higher scoring candidates correctly identifying that Figure 10c must be further from the ocean ridge axis than 300km (as shown by B). This in itself was not the explanation required and full marks could only be obtained where candidates referenced the deeper LVZ with a deeper asthenosphere; as the lithosphere is thicker further from the ridge – by virtue of it being older, colder, denser and the 1300°C isotherm deeper.

Q.15 The QER discriminated well and appeared accessible to all candidates. Most candidates were able to link the differences in density (values often given) or buoyancy with subduction and many referred to crustal recycling, some referencing the Wilson Cycle. Whilst subduction of oceanic crust was well understood, references to obduction and accretionary wedges of continental crust were features mentioned by those gaining marks in the higher band. Candidates obtaining the top mark frequently discussed ophiolite formation and gave a time scale for the differences in recycling between ocean crust and continental crust, relating the latter to surface processes.

Summary of key points

- Candidates should be encouraged to take more care with the use of diagrammatic data to make their interpretations before they reach conclusions.

- The marks achieved for mathematical questions were often limited by the candidates' lack of simple checking techniques. Candidates should be encouraged to apply checking techniques.

- Question 6 (b) was the focal point of the Section B mapwork. Previous questions in this section were an attempt to familiarise candidates with the solid geology and structure of the geological map in order that they might best tackle this question. Although not marked as a QER, this question, worth 6 marks, was designed to test AO3. It directed candidates to analyse, interpret and evaluate a real situation and this type of approach is a model of future Section B assessments based on a geological map extract.

- The marks achieved in the QER answers in the Quaternary and Geological Evolution of Britain options could be enhanced by use of appropriate examples.

GEOLOGY

GCE A LEVEL

Summer 2019

PRACTICAL ENDORSEMENT

General Comments

The first cycle of monitoring Practical Endorsement covered the period September 2017-April 2019. The second cycle of visits will commence in September 2019.
Approx. 80% of centres passed on the first monitoring visit. Centres which failed the first monitoring visit were given support and were visited a second time. All centres which failed the first visit made by Eduqas subsequently passed the second visit.
Centres are commended for the way in which they have embraced Practical Endorsement. Eduqas geology monitors saw many examples of good practice and assessment used by schools and colleges.

When conducting a visit, monitors were required to examine evidence of how the school/ college conducts practical endorsement. In common with the other sciences, monitors are required to view the following evidence during the visit:

- Plans for completing and assessing practical work - the centre is required to plan to complete the necessary range of practical work required by the specification.
- Teacher records of candidate assessment.
- Candidates' laboratory books / field notebooks.
- Teacher assessment of a practical class - the monitor is required to observe a practical class in which assessment of CPAC is taking place and speak to the teacher about the assessment of the relevant CPACs linked to the session.

There are several key features that characterise centres that successfully implement practical endorsement:

- Clear planning of both practical work, field work and the CPAC statements to be assessed in each practical.
- Candidates are well informed about practical endorsement, the meaning of CPAC statements and the outcome of each assessment.
- Practical books are used in 'real time' by candidates when completing a practical. Practical books should be used in the lesson. We do not expect to see practical books which are in immaculate condition! Candidates should not write on scraps of paper and later copy the work up neatly into practical books.
- The teacher targets appropriate CPAC for assessment in the practical lessons.
- Suitable feedback is given to candidates - this is particularly important when a candidate does not achieve a CPAC; why have they failed to achieve a CPAC statement and what they need to do next time to evidence it? We understand that there are limits to the feedback that may be given. Use peer assessment and self-assessment to reflect on practical work. Encourage candidates to self-annotate work to facilitate learning. This is particularly helpful if you give verbal feedback.
- Where there is more than one teacher of geology, there is evidence of good communication between the staff.
- Information from CPD is fed back to other members of the team delivering the qualification.

CPAC statements

Centres are reminded that in order to award a pass for Practical Endorsement, a candidate needs to 'consistently and routinely meet the criteria'. This means there needs to be evidence of multiple occasions where a candidate evidences a pass for each CPAC statement. It is important that suitable opportunities have been built into the assessment plan which allow candidates to generate this evidence.

CPAC 1

This is generally well assessed by the majority of the centres visited.
In a few cases, candidates did not always carefully follow instructions during the observed practical. When this happens, the candidate should not achieve the CPAC. It is therefore important that candidates are carefully observed when they conduct their work.
When assessing more complex procedures, teachers may wish to use a check list to aid assessment. This is particularly helpful in standardising assessment when a number of teachers are involved assessing the same scheme.

CPAC 2

This is the most difficult CPAC for candidates to evidence since it involves higher level skills. Generally, we do not expect to see this CPAC assessed in the first two terms of an A level course. However, we do expect to see evidence of some assessment of this criterion by the beginning of the second year of the A level course. Some centres make use of the period at the end of the first year to introduce the assessment of this CPAC statement. Please make sure that you know where and when you are going to assess this CPAC. It is also important that sufficient time is given to candidates to develop the necessary skills before assessment occurs.
In order to assess this skill, centres often utilised field work. Learners were asked to plan how they would conduct the field work, consider the equipment used and the basic approach they would employ to gathering information.
On other occasions, monitors have seen candidates asked to complete extension activities to practical work (e.g. to SP20). On another occasion, candidates were given a tray of equipment and asked to use the most appropriate equipment to measure the density of different minerals. Candidates were asked to justify the equipment they used.

CPAC 3

There is no need to assess this skill every time a practical is completed. Do not use practical work to assess this where hazards are minimal; rather select practical work where there are some meaningful hazards / risks. Field work is an ideal place for candidates to be assessed.

CPAC 3(a) requires learners to identify hazards and assess the risks associated with the hazards. Some centres choose to assess this by asking candidates to write a risk assessment. This is a valid means of assessment although it goes beyond what is required for the criterion. Some centres required candidates to record 'how they may be harmed' in their field notebook.

CPAC3(b) should be assessed by observation of learners conduct during a practical session. Once again field work is an ideal place to observe candidates' approach to safe working.

CPAC 4

CPAC4(a) making accurate observations
Observations should be made directly into their practical books. They should not be written on to scraps of paper and copied up later. Please also **avoid using proforma** that direct candidates how to record data.

Proforma are useful to teach candidates a good approach to recording data early in the course but when it comes to assessment candidates must devise their own tables. Where necessary, blank out tables to allow candidates to construct their own.
The measurement of density is a good place to assess this skill so you are advised to use it.
The tables candidates construct must have appropriate headings and units, where relevant. If units should be there and they are missing, do not award criteria.
CPAC4(b) obtaining accurate, precise and sufficient data …….
Please carefully check candidates' data. Is it recorded to appropriate precision? It was noticed that in some centres that mass and volume readings were not always consistently recorded by candidates. Make sure that recordings are to the correct number of decimal places.
Is there sufficient data? Is the data what you expect?
If the learner is recording qualitative information, has the candidate recorded the expected information or are there important aspects missing?

CPAC 5 Please remember the difference between CPAC4 and CPAC 5.

- CPAC 4 is about recording data 'live' into appropriate tables.
- CPAC 5 has two main elements: (1) processing data and (2) referencing information.

(1) Processing data
There should be evidence of learners processing data using graphs and calculations. Centres should require candidates to draw graphs by hand on some occasions and, on other occasions, to use software (e.g. Excel) to draw graphs.
Make sure graphs are constructed correctly, i.e. there is a title, each axis is correctly labelled, points plotted correctly, an appropriate scale used, etc.

(2) Referencing data
Candidates **must** show evidence of referencing sources of information. The evidence produced towards this aspect of the CPAC varies considerably among centres. Some have candidates demonstrating referencing on multiple occasions, even using the Harvard System (which exceeds our requirements), while, in other centres, it is rarely evidenced.
Opportunities for assessing referencing must be built in from early in the course. The information referenced may be, for example, data or a quote; the information may come from a textbook, journal, website EDUQAS data sheet, map etc.
A few centres, and therefore candidates, still confuse referencing with a bibliography. There are important differences.

Summary

Make Practical Endorsement a servant to the subject. If Practical Endorsement is done correctly then it should help make better geologists. Use it to this end. Do not let it become an end in itself.

Successful delivery of Practical Endorsement needs careful thought and planning. Now that the first cycle is complete, review and adapt these plans before starting the second cycle. Make sure that there are ample opportunities for candidates to evidence each CPAC statement. We do not expect candidates to achieve CPAC statements every time practical work is assessed. This is particularly true early in the teaching of a new group. Indeed, it is an indicator that a centre may not be appropriately assessing if CPACs are always achieved. Field trips are an ideal place to assess CPAC once candidates have some experience, but this does require some thought beforehand. Which CPAC statements can be assessed? Where is the evidence going to be generated? The field notebook is an obvious place e.g. for CPAC 3(a), 4 and, when assessed, CPAC 2. If it is evidence from observation (e.g. CPAC 1 or 3(b)) how are you going to record this? Will a checklist help? Don't be over ambitious but don't lose the opportunity.

Ensure that candidates are engaged with Practical Endorsement and its assessment. Candidates need to have PE and its assessment explained at the beginning of the course. In addition, candidates must be clearly informed of the CPACs that are assessed in each practical session.

If you teach geology with another member of staff, review your assessment of CPAC together. This is particularly important when new members join your teaching team. Please also remember that candidates **must** be informed whether they have achieved Practical Endorsement **before** the centre submits outcomes to Eduqas in accordance with JCQ requirements. Eduqas will not change centre gradings if a centre has passed the monitoring visit

Finally, expect a visit in the second cycle. Prepare for it by carefully reviewing the centre report from the first visit. Were there action points that need implementing? This report will be referred to in any subsequent visit and it will be expected that you have carefully considered any action points.
Centres are reminded to download the following document which provide support on interpreting CPAC: 'The Practical Endorsement Standard'.

WJEC
245 Western Avenue
Cardiff CF5 2YX
Tel No 029 2026 5000
Fax 029 2057 5994
E-mail: exams@wjec.co.uk
website: www.wjec.co.uk