GCE A LEVEL EXAMINERS' REPORTS

GEOLOGY
A LEVEL

SUMMER 2022

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Unit	Page
Component 1	1
Component 2	4
Component 3	10
Component 4	17

GEOLOGY

GCE A LEVEL

Summer 2022

COMPONENT 1: GEOLOGICAL INVESTIGATIONS

General Comments

As in previous years, 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, giving it variable accessibility across a wide ability range.

Comments on individual questions/sections

Q.1 This proved to be a good discriminator. The vast majority of candidates had little difficulty with sections a(i), a(ii), b, c(i) and c(ii). However, most candidates failed to appreciate that c(iii) required them to account for the distribution of copper and often just gave a description which could not be credited. There was also a disappointing lack of evaluation given by the candidates in c (iv), the best responses were those when the candidates objectively discussed the accuracy of geochemical surveys.

Q.2 Although most candidates had little difficulty identifying the sedimentary structures in section a(i), a surprisingly high number of candidates showed the current directions the wrong way round in section a(ii). Relatively few candidates scored full marks on the graphic log, with the most common mistakes being to draw the very coarse sandstone beyond the 2mm line and to draw the shale on the $1/16^{th}$ mm line. The QER component of this question produced a wide range of answers with some candidates being able to give very detailed descriptions of processes such as flocculation and turbidity currents. However, a number of candidates linked the cross-bedding to aeolian conditions and this limited the marks that these candidates could be awarded.

Q.3 It was pleasing to see that nearly all candidates had little difficulty conducting a streak test and calculating the density but very few candidates were able to calculate percentage uncertainty. It is hoped that the few candidates that incorrectly identified Specimen T as gold did not attempt to take the specimen from the examination room.

Q.4 This question was very well answered with a pleasingly high quality of textural diagrams drawn. The most common error was either not to indicate a scale or to have added an incorrect scale. A number of candidates even managed to identify Specimen E as “Shap” Granite.

Q.5 This question produced a range of responses with the most common errors being to incorrectly identify Specimen X as limestone and to give the angle of dip at locality I as 180°. An impressively high number of candidates were able to relate the difference in dip angles between the two localities with the intrusion of the igneous body.

Q.6 While nearly all the candidates had no difficulty in stating how the transfer of thermal energy had been maximised, a significant minority confused the independent with the dependent variable.

Q.7 This question produced three typical responses:

Some candidates appeared to write a pre-planned response which did not relate to the geology shown in either of the photographs. Only limited credit could be awarded to these candidates.

Some candidates decided to interpret the photographs rather than plan an investigation. Again, only limited credit could be awarded in these cases.

However, some candidates were able to give a wide range of potential geological observations which were fully justified and described. It was very pleasing to see that despite the recent restrictions on fieldwork, some candidates have still experienced a wide variety of skills required to conduct geological fieldwork.

Q.8 Candidates who were able to recognise the transgressive nature of Rock Unit B scored highly on Question 8. A significant minority of candidates appeared to think that olivine cannot be found in lava flows.

Q.9 This question proved to be a good discriminator, with many candidates picking up full marks on section a. The full range of response options were given for section b, the most common error being the identification of Fault 2 as a strike-slip fault.

Q.10 The geological cross-section continues to provide a wide range of marks, although the number of candidates scoring full marks was noticeably fewer than in previous years. The most common errors were failing to recognise that the base of H should have been drawn with an apparent dip angle rather than a true dip angle, and to plot rock unit B as a series of vertical dykes. The majority of candidates struggled with section b with a surprisingly high number of candidates arguing that the folds were isoclinal.

Q.11 This question revealed that very few candidates understand that different types of data sets require different statistical tests. It was very rare to see a candidate being able to give a correct reason for choosing Chi-squared, with Spearman's Rank being by far the most common response. Most candidates were able to offer a correctly reasoned judgement, but few failed to recognise the cognitive conflict of Locality IV having a larger range of grain size, yet Locality V having a larger inter-quartile range. Section c produced a good range of answers although some candidates tried to relate the clast lithology to modern shells rather than the erosion and subsequent transport of the solid rocks shown on Map 1.

Summary of key points

It is important that candidates understand what is meant by ‘planning’ a field investigation. In addition, they should not only be able to describe and justify fieldwork techniques but should also be able to decide which techniques are relevant to a given field investigation.

There was encouraging evidence that many candidates were able to undertake statistical tests. However, candidates also need to understand why different tests are used in relation to the type of data being analysed.

Candidates had difficulty with a few specific laboratory and mathematical skills. For example, many candidates were unable to differentiate between dependent and independent variables, and with the calculation of percentage uncertainties.

Many candidates were unable to draw the graphic log effectively. This is a skill that can be practised in the classroom as well as in the field.

GEOLOGY

GCE A LEVEL

Summer 2022

COMPONENT 2: GEOLOGICAL PRINCIPLES AND PROCESSES

General Comments

This examination was designed to test a wide range of skills including the interpretation of diagrams, photographs, graphs, map extracts, as well as mathematical skills. The paper covered many areas of the specification content and included straight forward recall and more complex application of knowledge, making it accessible to a wide ability range.

Comments on individual questions/sections

Q.1 **(a)** The number of correct responses for this question was perhaps lower than anticipated. Most candidates were able to recall solar radiation. Fewer candidates were able to recall primordial thermal energy or some mention of radioactive decay. Many instead vaguely mentioned heat from the core or mantle.

(b) **(i)** The response rate for the question was very good; the majority of candidates had no difficulty in labelling uplift correctly. The most common errors were candidates assuming all blank boxes needed to be completed, or overestimating the depth at which lithification takes place.

(ii) This question also proved accessible to most candidates, in fact many candidates listed differences and gave explanations worthy of more than the maximum four marks. However, candidates were let down in some instances by not making their comparisons transparent, i.e., use of comparators such as 'sediment B has undergone *more* transport than sediment A' as opposed to stating, 'B has undergone some transport'. Others failed to achieve the full four marks as they had only provided explanations, or more likely just descriptions without any explanations.

(c) **(i)** Many candidates were able to identify the foliation and were able to provide a description or descriptive term for this, although others incorrectly stated that the rock showed 'lamination'. Many were able to identify some form of recrystallisation or porphyroblastic texture, and/or the presence of metamorphic garnet crystals. However, there was a significant proportion of answers which incorrectly referred to multiple cooling rates / phenocrysts / a porphyritic texture.

(ii) On the whole candidates performed very poorly on this question. Full marks were very unusual. Many answers focussed on the different depths of the two locations (and assumed different metamorphic conditions) rather than the type of crust they were located in, and many failed to spot the mafic minerals labelled in Figure 1b.

(d) (i) Not all candidates were able to select the correct section of the graph. Some took values from the temperature rather than the depth axis. Others stated the correct depth but did not include units, or incorrectly stated 'metres'. Many found it difficult to articulate the evidence for why they had chosen 0-200km. References were made to this being the steepest gradient on the graph. Better answers calculated the rate of increase as 10 $^{o}C\ Km^{-1}$ or compared the section to other sections of the graph.

(ii) Imprecision let many candidates down here. Both T and B needed to be labelled accurately for the mark; candidates should be reminded to draw arrows with a sharp pencil with the tip of the arrow in the precise location they wish the examiner to mark. Very few in fact drew their arrows in box Y as requested, although candidates were not penalised for this. In the explanation many candidates correctly stated that the outer core is liquid but fewer candidates referred to Figure 1c (as required) to achieve the third mark. Some of those that did, provided vague statements that alluded to the geotherm being 'higher than the temperature'; again, candidates should be reminded of the importance of precision and proof-reading their answers to prevent loss of marks.

Q.2 (a) (i) This straightforward question reading values from a graph was also answered well. Most candidates had no trouble in providing the minimum velocities using Figure 2a. Candidates who achieved no marks, in most cases, had mixed up the curves and therefore the values.

(ii) The question was poorly answered overall. Many candidates repeated the notion that different velocities are required for erosion and transport, essentially repeating the stem of the question. Some candidates correctly referred to the *energy* required for each process. But the most common error was the misinterpretation of 'erosion'; many answers attributed this to the breaking down of minerals or even went off on a tangent about the hardness of quartz grains, rather than showing an understanding of the Hjulström curve, entrainment velocity, and the effect of momentum when already in transport.

(iii) Generally, this question was answered well; some candidates drew a continuation of both lines over to the right-hand side of the graph achieving no marks, and others drew the erosion velocity curve correctly, but drew the settling velocity too low, achieving one mark.

(b) (i) Most candidates correctly identified the positive correlation and were able to provide accurate exemplar values. Not many were able to describe the line as non-linear or an s-shaped curve. Some candidates did correctly refer to the map part of Figure 2b giving the relationship a geographical context.

(ii) Candidates' achievement in this question was very much centre specific as generally candidates either achieved four or zero marks. The best answers demonstrated a good understanding of the role of salt, correctly explaining the effect on charge. It became clear that some candidates were lacking in knowledge or understanding of flocculation altogether, whereas others held misconceptions about the process, namely describing a process by which salt sticks to clay making it heavier, or in thinking that water of high salinity affects buoyancy and somehow keeps clay in suspension.

Q.3 **(a)** **(i)** The hard parts were labelled correctly in most cases. A few incorrectly referred to a 'cerebellum' or 'glabella' instead of the cephalon. A significant number referred to 'genial' rather than 'genal' spines.

(ii) It was clear that not all candidates understood the term pelagic. Candidates were generously awarded marks here for any sensible interpretations of the morphology and associated mode of life, but confusion of pelagic and benthonic let candidates down here. A small number of candidates recognised the difficulty in evaluating the student's statement, and instead took the opportunity to point out that uniformitarianism can only be applied to extant organisms, for which they were rewarded a mark.

(b) Although candidates were required to apply their geological observation and interpretation skills to an unfamiliar fossil here, most succeeded in making sensible deductions. Common errors included the assumption that *Spriggina* had a pygidium, not spotting that *Olenellus* did in fact have eyes, and referring to central 'spines' in both organisms. Language skills let some candidates down here too who were, for example, incorrectly using 'long' when they instead meant 'elongate'. Others talked about both organisms existing in marine environments or their preferred diets, perhaps indicating that they had not understood the term 'morphological similarities' that the question was asking for.

(c) This was generally answered well by candidates. Most implied that the change was sudden or rapid, and nearly all referred to some sort of increase in diversity and/or presence of hard parts. A small number of candidates confusingly interpreted the Cambrian Explosion as a mass extinction event.

(d) This was a question that differentiated well, with some evidently different approaches centre by centre. Candidates seemed to have little difficulty in *describing* the changes using Figure 3c, but significantly more difficulty in *explaining* how these changes brought about the Cambrian Explosion. There was some confusion in particular about the role of chemical weathering, with several candidates keen to mention increased ocean acidity and dissolving of $CaCO_3$-rich organisms. For the most part, the impact of increased oxygen was understood better, and some candidates demonstrated superb thinking outside the box with clear evidence of research beyond the specification e.g., cap carbonate effect.

Q.4 **(a)** Pleasingly most candidates identified the igneous body as a pluton and were able to provide two sound reasons; this was clearly a style of question they were used to and confident in answering.

(b) This question differentiated very well. Most were able to identify several processes that had taken place and put a number of them into the correct chronological order. Fitting the deposition of the argillaceous protolith and its metamorphosis to slate into the correct place in the geological history proved to be tricky for some. Others misinterpreted the order of deposition of the four main sedimentary units, failing to identify the younging direction, while others had not thought about their order and simply listed them. The most common omission was any reference to compass directions in relation to structural deformation, or the orientation of principal stresses. A few suggested that during the folding episode compression had been in a N-S orientation, but very few talked about the formation of the slaty cleavage in any detail.

(c) **(i)** Due to an omission during the examination paper production, candidates were unable to complete the calculation. In the interest of fairness, all candidates were therefore awarded the full three marks for this question.

(ii) Despite the confusion with the previous question candidates seemed to have little difficulty in explaining the age difference of the locations here. Many achieved the first two marks, but few had written enough to warrant a third mark. Candidates struggled to link cooling rate and proximity to the country rock to the concept of radioactive decay and blocking temperature.

Q.5 **(a)** Many candidates had no difficulty in stating two pieces of evidence. In cases where candidates achieved no marks, they usually had not stated evidence seen in Figure 5a alone, and had instead provided typical identifying features of convergent boundaries. In other cases, candidates had implied that there were earthquakes of varying depths but had not stated the presence of deeper focus earthquakes >70km.

(b) **(i)** This question was answered well; most candidates spotted that the speed increased towards the west and/or in the direction of the older oceanic crust, and many were able to support their answer with exemplar values or by calculating the range of speeds.

(ii) Some candidates were able to imply that the older crust is denser, but few used the term slab pull or sufficiently explained the connection between the two. A good number of candidates identified the change in relative plate movement in Figure 5a, but found it difficult to link this to friction, and some confused the terms parallel and perpendicular.

(c) **(i)** Some candidates managed to achieve both marks here, but many had drawn a line decreasing towards Y which did not curve in any way. Others were evidently confused by the question and/or graph and drew either a horizontal or a vertical line.

(ii) Again, most candidates either scored the full two marks or no marks at all on this question. Common errors included labelling M beneath the line they had drawn showing the top of the subducting plate, or labelling the V volcano below the 0km surface.

(iii) Disappointingly the most common error here was the mixing up of east and west. Candidates who did achieve marks usually identified the two plate types and some mention of mafic/silicic, but few linked this to the rock types of the erupted lavas, or some explanation of contamination/assimilation.

(d) On the whole this was answered quite well; candidates often indicated that there was little or no subduction around location Z. Fewer candidates then linked this to the sense of plate movement and/or the type of plate boundary.

Q.6 **(a)** **(i)** Most candidates were able to refer to the correct latitudinal range, and/or tropical conditions. Although some incorrectly referred to corals being 'equatorial' rather than at tropical latitudes. Many also correctly included coastal/shallow water abundance. Some candidates were able to correctly interpret the geographical distribution e.g., abundance in the east of the map, or by referring to concentrations near specific continents/countries. However, a large proportion struggled to refer to the 20^{o}C seawater isotherms correctly, often incorrectly stating that corals are found *at* a temperature of 20^{o}C, or not referring to the isotherms at all.

(ii) Most candidates were able to recall the principle of uniformitarianism and name it in many cases, but few referred to continental drift and the idea that the UK was likely positioned at a lower latitude in the past.

(b) **(i)** A few misconceptions were apparent in answers to this question; some candidates were of the impression that corals only take in oxygen through respiration and were not able to explain how it is stored in the coral.

(ii) This straightforward question, reading values from a graph, was answered well. Most candidates had no trouble in providing the ratios using Figure 6b. Candidates who achieved no marks, in most cases, had incorrectly read the graph or were confused about how a ratio should be written.

(iii) This question was also answered well. Most candidates were able to calculate a difference between their values and divide the answer by 0.18.

(c) Noticeably few candidates mentioned that ^{16}O is lighter than ^{18}O. Furthermore, candidates who referred to evaporation rates often implied that only ^{16}O evaporates rather than ^{16}O preferentially evaporates. Nevertheless, many candidates correctly interpreted Figure 6c to deduce that ^{16}O returned to the oceans in sufficient quantities to reduce the ^{18}O:^{16}O ratio only in warmer climates.

Summary of key points

- Candidates should carefully scrutinise the data provided in diagrams, photographs, and graphs when formulating their answers.

- Candidates should try to be more specific in the phrasing of their responses to be explicitly clear as to what they are describing/explaining, especially in answering questions that require a comparison.

- Candidates should endeavour to accurately use key terminology from the specification whenever possible.

GEOLOGY

GCE A LEVEL

Summer 2022

COMPONENT 3: GEOLOGICAL APPLICATIONS

General Comments

The Component 3 paper produced a wide range of marks with candidates able to access all parts of the paper.
Candidates who used the data in the figures carefully were able to achieve good marks across all sections of the paper.

Comments on individual questions/sections

SECTION A

Q1 **(a)** These questions were well answered with most candidates being able to determine the distance from the epicentre and calculate the travel time for the seismic waves. Many candidates were able to relate the geological setting of Mexico to its seismic risk.

(b) **(i)** Most candidates were able to interpret the seismic traces very well.

(ii) This question discriminated well. Most candidates were able to describe the relationship between clay thickness and building damage and many could then relate this to the ground conditions. A minority of candidates were able to give a full explanation of why the clay thickness is relevant to damage caused (liquefaction, increase in wave amplitude etc), with only a few using the description from part (i) of the question to inform their answer.

(c) Most candidates recognised that building height does have an effect on damage. The better responses to this question considered the reduction in damage to taller buildings and offered suggestions to explain its cause (e.g. resonance, aseismic building design etc).

Q2 **(a)** Many candidates were able to identify the potential carcinogenic effect of radon gas (though vague answers citing “health problems” were not credited) and the granitic source of the gas.

(b) **(i)** Many candidates were able to correctly calculate the hydraulic conductivity. However, a minority of candidates used the height of the ground surface to calculate the gradient. Such candidates were awarded marks for the correct rearrangement of the equation with an error carried forward error.

(ii) This question differentiated well. The best responses used the values for hydraulic conductivity (given in Figure 2 or calculated) to explain the differences in radon measurements at the different sites by referring to the permeability of the rocks and gas dilution in the groundwater with distance from the source.

(c) (i) Many candidates were aware of changes to radon emissions immediately prior to an earthquake. A majority of these were able to develop this answer with reasons for this change occurring.

(ii) This question proved to be accessible for candidates with many good answers explaining a scientific method for monitoring earthquakes.

SECTION B

Q.3 This question produced a surprising range of marks. Candidates do need to take care with the accuracy with which they read grid references and attention to the map keys. The relative order of events in part (b) was usually completed well.

Q.4 (a) The question aimed to assess the skills learnt from Specified Practical 12. Many candidates focused their answers on describing the geological structure and using that to determine location. The best answers incorporated a simple diagram to illustrate the method of triangulation using bearings from known landmarks, often referring to locations from the geological map.

(b) (i) Most candidates were able to correctly identify the coral and the majority of these could support that identification with a valid reason.

(ii) The palaeoenvironmental conditions indicated by the presence of coral in a rock were very well understood by most candidates. Some of the best answers used figures for temperature and seawater depth to support their answers.

(iii) This question generated a range of answers with many candidates recognising the contradiction between tropical and freeze-thaw conditions. The better answers went on to explain the concept of derived fossils as a reason for the contradiction.

Q.5 (a) (i) There were many good responses to this question, with only a few candidates confusing the difference between an antiform and an anticline. However, considering this question has been set many times before it was surprising to see that some candidates were unable to gain all three marks.

(ii) Showing the direction of plunge of the two folds proved to be challenging for many candidates. Recognising the more northerly fold as a syncline needed careful reading of the map and many candidates mistook this for a northerly plunging anticline rather than part of a basin.

(iii) This question rewarded candidates who took a careful approach to interpreting the map. A minority of answers showed a clear understanding of fold wavelength which gave rise to some impressive evaluations of the data.

(b) **(i)** Many candidates were able to select the correct cross-section and to back up that choice with good reasons. A few candidates gave correct reasons (for which marks were awarded) matched to the wrong cross-section.

(ii) This question led to many good responses with good understanding of the link between stress fields and the deformation of rocks.

Q.6 **(a)** **(i)** This question was answered accurately with only a few candidates not giving an answer.

(ii) This question was almost universally answered correctly.

(iii) Many candidates failed to recognise that the figure for degrees of freedom is one less than the number of values (i.e. 7) and that the chi-squared value was greater than this significance number.

(iv) A wide range of answers to this question were seen. The best responses focussed on the specific information that the statistical test was able to add to the conclusions gained from the rose diagram.

(b) Most candidates were able to demonstrate some understanding of the process of freeze-thaw weathering. The better responses linked the weakening of the rock as a result of this process to the causes of specified mass movement events.

(c) This question generated a full range of responses. The best answers used the structure given in the question to organise the response. Explicit links to the geological situations of the three landslides were a key feature of the answers that earned the highest marks; more generic statements of how the factors listed could influence landslides limited the marks that could be awarded.

SECTION C

QUATERNARY GEOLOGY

Q.7 **(a)** **(i)** Most candidates recognised the reduction in temperature, and many were able to then develop this by using values from the graph or a description of the fluctuations.

(ii) This question was often answered poorly with many candidates restricting their answers to modern isotope ratios. There was much confusion in answers that tried to link the amount of one isotope to a temperature. Very few answers referred to the isotopic ratio in microfossil shells to show the record from the past, as covered in the G3 part of the specification.

Q.7 **(b)** **(i)** Many candidates were able to describe some of the changes to oceanic circulation shown in Figure 7c. The better responses included reference to named locations, such as the Drake Passage or the Panama Gap.

(ii) This question proved to be more challenging. Some candidates didn't refer back to Figure 7a and tried to explain an increase in Antarctic temperatures. The best responses showed a good understanding of the role of the Circum-Antarctic current in restricting heat flow from the Equator.

(iii) This question produced a range of answers with many candidates recognising that the temperature at location T would increase as a result of changing oceanic currents. The best responses related this to the plate tectonic changes in the Atlantic Ocean.

Q.8 **(a)** Generally this question was answered well.

(b) Candidates responded well to the idea of a pioneer species, and many were able to relate this concept to the data on the pollen diagram.

(ii) It was encouraging to see candidates taking a methodical approach to the description of the data on the pollen diagram in many cases. The quality of answers to this question was good, with the better descriptions using values to support their response.

(iii) This question proved to be more difficult with a range of answers offered. Only a few students offered changing climate as a possible reason for the changing amount of oak and alder in the later zones on the diagram or related this change to vegetation succession and species competition.

(c) The full range of marks for this question were awarded as candidates' responses varied considerably in quality; as a result, it discriminated well. The better answers considered the nature and abundance of the organic material as well as its preservation potential.

Q.9 The quality of answers for this extended response question were often disappointing. It was clear that some candidates gave prepared descriptions of Quaternary fossil data and failed to engage with the question. Many candidates had some awareness of radiocarbon dating of Quaternary deposits and the limitation of age of material that can be dated. However, explanations of the causes of this limitation were often vague. Understanding of other dating techniques (isochrons and incremental dating) was often superficial or absent from the answer. The best responses assessed 3 dating techniques with a clear understanding of how they can provide dates and an assessment of limitations of each method.

GEOLOGICAL EVOLUTION OF BRITAIN

Q.10 **(a)** Candidates generally had a good understanding of the idea of "two-way travel time" and many good answers were seen.

(b) **(i)** Most candidates were able to link Triassic salt deposition to evaporite processes. Only a minority were able to explain the geological setting of Britain during this period.

(ii) Candidates displayed a limited sense of a link between the salt domes shown on Figure 10b and their formation studied in the G4 section of the specification. The better responses explained the density contrast that creates such cross-cutting relationships.

(c) **(i)** Most candidates recognised the tensional stress that these rocks were subject to, and many could link that to the divergent plate boundary in the Atlantic. A minority of candidates were able to identify the normal faulting shown in the sections.

(ii) This question proved to be challenging. Many candidates focussed on the ongoing opening of the Atlantic Ocean and few answers engaged fully with the geology shown in Figure 10b. The best responses discussed the varying thickness of the Upper Palaeogene beds and the lack of persistence of the faulting through those beds.

Q.11 **(a)** Many candidates correctly identified the unconformable boundary and were able to support that interpretation from map evidence.

(b) **(i)** Many candidates were able to correctly identify the youngest graptolite and give reasons for that identification. The best answers focused on the morphology of the fossils, whereas weaker responses looked at the colour of the matrix shown in the photographs.

(ii) A range of answers were seen for this question. The best responses were able to relate the presence of graptolites to a marine environment and the fine grain size and fossil preservation to the low energy conditions.

(c) **(i)** This question produced many good answers. Folds were often correctly identified, and the evidence given to support the identification.

(ii) A minority of candidates were seen to mistakenly assert that the Caledonian Orogeny did not affect rocks in Wales. The best responses considered not only the orientation of the structural features but also the age of the rocks affected and the unconformity at the base of the Silurian rocks in this area from a previous question.

Q.12 The quality of answers for this extended response question were often disappointing. It was clear that some candidates gave prepared descriptions of Britain's geological history and failed to engage with the question. Many candidates had an awareness that magnetic records were preserved in rocks, though few good explanations of how that process occur were seen. Understanding of how palaeomagnetic inclination and polar wandering curves indicate that latitude has changed was often only vaguely explained. The best responses explained the Curie temperature, alignment of magnetic minerals and magnetic inclination, and gave examples from the British geological record to support the explanation.

GEOLOGY OF THE LITHOSPHERE

Q.13 **(a)** The question provoked many good answers with virtually all candidates able to give some descriptive statements of the distribution of orogenic belts.

(b) Many candidates were able to identify sequence Z as an ophiolite, with most of those able to link this to the process of obduction.

(c) The quality of responses to this question spread across the range of marks. Many candidates could explain at least one feature of an LIP, however, fewer were able to give a full answer to gain all the marks by referring to the data given in Figure 13b.

(d) This question discriminated well with a wide range of marks awarded. Only a few candidates were able to fully explain how accretion from subduction can lead to the growth of continents around a cratonic core.

Q14 **(a) (i) & (ii)** These questions were generally answered well. Where students failed to engage with the data, the base of the lithosphere was often confused with the base of the crust and the granite not recognised as being associated with continental crust.

(b) These questions were generally answered well.

(c) Candidates demonstrated a full spectrum of understanding of this process. The answers that gained the highest marks had carefully used the data in Figure 14c to give a structured response involving density differences between the lithospheric root and the underlying asthenosphere.

(d) This question proved to have a high level of demand. Many candidates recognised the age pattern of the plutons in the orogenic belt. However, only a minority were able to relate this to the delamination of the root of the mountain chain with many suggesting the age relationship of the plutons was because of spreading.

Q.15 The quality of answers for this extended response question were often disappointing. It was clear that some candidates gave prepared descriptions of magnetic anomalies in the oceanic crust and failed to fully engage with the question. Many candidates had an awareness that magnetic records were preserved in rocks, though few good explanations of how that process occur were seen. Understanding of how magnetic "stripes" are found in oceanic crust was often poorly explained and few were able to relate the ages of the stripes to dating magnetic reversals from continental rocks. There was also an erroneous notion that the width of magnetic stripes is a function of the spreading rate. The best responses explained the Curie temperature, alignment of magnetic minerals, magnetic anomalies and then related them to calculate the direction and rate of plate movement.

Summary of key points

The quality of responses to the geohazards questions was generally very good with candidates engaging very well with the data that was presented to them.

Candidates should be encouraged to use numbers from data or calculations to support their answers.

It was gratifying to see most candidates attempting the mathematical questions. However, candidates should be encouraged to use the results of their calculations in subsequent answers.

The quality of answers in the extended writing question in Section C (questions 9, 12 and 15) was generally disappointing in both knowledge of the subject content and the organisation of the written response.

GEOLOGY

GCE A LEVEL

Summer 2022

PRACTICAL ENDORSEMENT

General Comments

The recent pandemic necessitated changes to the way in which monitoring of Practical Endorsement was conducted. Monitoring was carried out remotely which meant that practical lessons were not viewed. All other aspects of Practical Endorsement were monitored as they would have been if the monitor visited the centre. However, centres should note that we will be moving back to face-to-face monitoring from September 2022.

The pandemic also meant some requirements of Practical Endorsement were relaxed. The modification for summer 2022 allowed students to be awarded a Pass in Practical Endorsement if they had demonstrated competence in all of the Common Practical Assessment Criteria (CPAC) routinely and consistently, even if they hadn't completed the usual minimum requirement of practical activities. As centres move back to normal working it is expected that this relaxation of Practical Endorsement will be removed.

The requirement for submission of a Fieldwork Statement that centres have given learners the opportunity to undertake four mandatory days of fieldwork at A Level was also removed for 2022. However, many centres conducted some limited field work which was also used towards the assessment of Practical Endorsement. A few centres also made use of the 'Lab based fieldwork exercise'. Centres may wish to use this for training before commencing field work in the future. The package also shows how evidence towards CPAC 2, 3, 4 and 5 can be generated from fieldwork.

Although the last few years have been difficult times for centres, we have still seen centres maintain a good practical programme as part of their delivery of the specification. There are several key features which characterise centres which successfully implement practical endorsement:

- Clear planning of both practical work (and field work). A good plan identifies not only when specified practicals will be conducted but also states the specific CPAC that will be assessed. The plan may be part of the Scheme of Work or a separate document.
- Planning allows for the development as well as the assessment of skills within Practical Endorsement.
- Teacher and Candidate Records are maintained and updated regularly.
- 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?
- Centres are not frightened to mark work 'not achieved' where necessary. We do not expect to see every student getting every criterion each time they are assessed! Indeed, when this happens there will be legitimate concerns about whether the work has been appropriately assessed. There should be a progression. The key question is, 'Is the student competent by the end of the course?'
- Centres have read and acted upon recommendations from previous monitor reports.

Comments on individual questions/sections

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
Assessment of this CPAC requires the student to correctly follow written instructions to carry out an experimental technique or procedure. If a teacher feels it is necessary to intervene and correct a student's technique etc. then the student should not be awarded the CPAC.

This is a difficult CPAC for a monitor to comment upon remotely. In the vast majority of the cases the monitor accepted the teacher's judgement unless there was strong evidence to suggest the CPAC was incorrectly awarded.

CPAC 2
This is the most difficult CPAC for candidates to evidence since it involves higher level skills. 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. 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 end of the first year of the A level course

This skill may be evidenced as a student plan to carry out a procedure and then adapts their approach as necessary. There are a number of places that this skill can be assessed but many centres find field work to be a good place to do this. The 'Lab based fieldwork exercise' referred to earlier in this report lays out an approach which allows candidates to generate suitable evidence towards most aspects of this CPAC. Obviously students must be first have opportunity to develop the skills before they can be expected to carry them out independently.

The monitoring team have also seen candidates asked to complete extension activities to practical work (e.g. to SP20 – students plan how to investigate how heat flow depends upon grain size). Incidentally this is a good activity to evidence 2c which can be difficult to do in geology. 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.

A simple written risk assessment is the easiest and best way of evidencing this aspect of the skill.

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 or field books. They should not be written on to scraps of paper and copied up later. Please **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. If you give the student a table, then CPAC4 must not be awarded. Where necessary, remove table templates 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 **mus**t have appropriate headings and units, where relevant. The units must be written in the table column head and not in the body of the table. If units 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? We still notice that some centres are too lenient on this. If mass and volume readings are not always consistently recorded by candidates, then do not award the criteria. 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? Please set suitable standards at the beginning of the course. It does not matter if a student did not always achieve a criterion.

CPAC 5
This important higher-level skill should be assessed from early on in the course. There is no shortage of suitable assessment opportunities

CPAC 5 has two elements:
(a) Uses appropriate software and/or tools to process data, carry out research and report findings.
(b) Sources of information are cited demonstrating that research has taken place, supporting planning and conclusions.

CPAC5(a) There should be evidence of learners processing data using graphs and calculations. Centres should require candidates to use software (e.g. Excel) to draw graphs on a number of occasions. SP19 and 20 are good places to use Excel to generate 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. Students will need to be shown how to use Excel to correctly title graphs etc.

Good quality graphical logs and rose diagrams also can be assessed under CPAC5(a).

Processing data also involves carrying out calculations. SP19 is an example of an excellent place to assess this with the opportunities it gives to carry out statistical analysis.

CPAC5(a) also includes 'carry out research and report findings'. The report does not need to be long; it may simply the conclusion they draw from their data. However, it is not appropriate to award this CPAC for a one-word answer. A conclusion requires a reasoned response to the data observed.

CPAC5(b) Candidates must show evidence of referencing sources of information. This aspect of CPAC is still not getting enough attention from many centres and is generally still the poorest evidenced in student work. Just a few centres are to be commended for having candidates demonstrating referencing on multiple occasions; a few of these even using the Harvard System (which exceeds our requirements for this CPAC).

Opportunities for assessing referencing **must** be built in from early in the course. The information referenced may be for data or a quote; the information may come from a textbook, journal, website, EDUQAS mineral data sheet (e.g. a density value from an Eduqas mineral data sheet), map etc.

A few centres, and therefore candidates, still confuse referencing with a bibliography. There are important differences.

Summary of key points

Practical Endorsement should be a servant to the subject. If Practical Endorsement is done well then it should assist in making 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. Make sure that there are ample opportunities for candidates to evidence all aspects of each CPAC statement. We do not expect candidates to achieve CPAC statements every time practical work is assessed. Where CPAC is met every time by all students then that is an indicator that a centre may not be appropriately assessing.

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. Consult the Eduqas 'lab-based fieldwork activity' for ideas on producing evidence.

Ensure that candidates are engaged with Practical Endorsement. PE and its assessment should be explained at the beginning of the course. In addition, candidates must be clearly informed which CPAC that are assessed in a particular practical session.

If you teach geology with another member of staff, review your assessment of CPAC together. This is a requirement that is noted in the monitor's report.

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, if you were not visited in 2022 expect a visit in the next academic year. Be prepared. Read your previous report and ensure that you have acted upon any recommendations.

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