RECOGNISING ACHIEVEMENT

GCE

Geology

Advanced GCE **A2 7884**

Advanced Subsidiary GCE **AS 3884**

Report on the Units

June 2008

3884/7884/MS/R/08

Oxford Cambridge and RSA Examinations

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This report on the Examination provides information on the performance of candidates which it is hoped will be useful to teachers in their preparation of candidates for future examinations. It is intended to be constructive and informative and to promote better understanding of the syllabus content, of the operation of the scheme of assessment and of the application of assessment criteria.

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

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Any enquiries about publications should be addressed to:

OCR Publications
PO Box 5050
Annesley
NOTTINGHAM
NG15 0DL

Telephone: 0870 770 6622
Facsimile: 01223 552610
E-mail: publications@ocr.org.uk

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REPORT ON THE UNITS

Chief Examiner's Report

General Comments

The examinations this session performed well with no problems and a wide range of marks on all the units. There were no questions that did not have full marks from some candidates. The performance of candidates was good on all units with examples of excellent work. On all papers there were quite a few very high scoring scripts that displayed sophisticated understanding of the topics in the OCR specification.

This was the first occasion that the AS papers (2931, 2832, 2833) were marked online. This meant that it was not possible to gain an impression of variation by centre. It did highlight some of the issues below as it was easy to look at large numbers of the same part question. It was possible to read extra answers written in margins or extra sheets so that no part of any candidates work was ignored. However it would be easier if candidates who cross out an answer and rewrite it elsewhere make this clear.

There are still areas where candidates could improve marks just by careful reading of the wording on the exam paper. The initial sentence in many questions contains valuable information for candidates that will help them give correct answers. There is a tendency for candidates to ignore this sentence and then give answers that are impossible for the context of the question. The descriptive stem of a question usually sets the scene for the question and gives vital information which is being ignored by some candidates.

Alternatively they ignore the command word eg *explain* and simply *describe*. This type of answer cannot be given full marks however detailed it is. Any *explain* question requires candidates to give a *reason* or to *say why* in order to gain the marks. Some candidates struggle with higher demand questions that ask for explanations, interpretations or comparisons and resort to writing lists which fail to show their knowledge and understanding of the subject matter.

Teaching tip
Candidates should be encouraged to learn the meaning of "command words" in questions – a description requires more detail than a statement. Part questions are used to help develop the question so it is worth candidates reading the whole question through before starting to answer the first part to avoid overlap in their answers.
<u>**Common command words:**</u>
Define – specify the meaning.
Describe – set out the characteristics.
Explain – set out reasons.
List – give a number of points with no elaboration.
State – express in unequivocal terms.

The correct use of the technical terms given in the specification is always essential and correct spelling of these terms is important. Misspellings like genial spines, the antisyncline, the desecration cracks as well as variations on porphyritic and amygdaloidal, bituminous and pygidium are common and can affect marks. Deserts are still desserts while metamorphism transforms into metamorphosised. Where a term such as *lithosphere* is used in the question but then spelt incorrectly in the answer it again suggests that candidates do not always read the question carefully. There are a number of similar terms commonly used where poor spelling and / or handwriting can mean that it is not clear to the examiner which term is being used.

Many candidates are now performing better on the topics and skills which have proved a problem in the past including structural geology. In order for diagrams or sketches to be given credit they must be clear with the features to be labelled clearly identifiable. This is true for all papers. Graphs need to be drawn accurately with clearly labelled axes. At times answers look hurried or careless.

Teaching tip
Candidates should be encouraged to practice drawing accurate, fully labelled diagrams. They should use a sharp pencil and ruler and take care to be neat. It takes the same time to draw, say, five neat simple lines as it does to draw five sketchy or scruffy ones. Time can be saved by avoiding intricate shading. Conventional rock symbols such as dots for sandstone and bricks for limestone can be used in place of shading. Boundaries should be clear – a solid line for a rock boundary, a dashed line for the water table, a wavy line for an unconformity, etc. Label arrows should touch the item being identified and not end in mid air.

A growing concern is the lack of understanding of scales used on all maps and diagrams but especially thin section drawings. A conglomerate and a sandstone can look identical unless the scale is considered. A variety of scales are used from bar scales to x1 or x2. The confusion for a minority of candidates is increased by confusing the units especially mm and cm so that answers were incorrect by a factor of 10. Teaching the use of scales and how to interpret them could be a useful topic for all the units.

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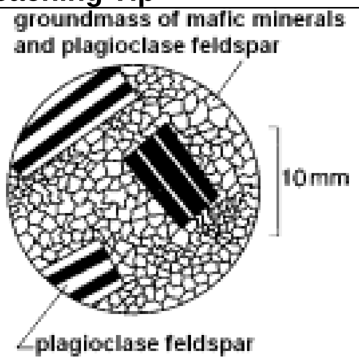
<td>
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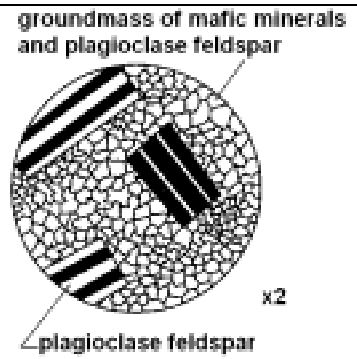
<td>
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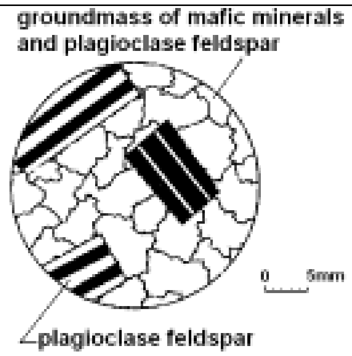
<td>
</td>
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<tr>
<td>fine grained groundmass with crystals <1 mm is porphyritic basalt</td>
<td>medium grained groundmass with crystals 1– 5 mm is porphyritic dolerite</td>
<td>coarse grained groundmass with crystals >5 mm is porphyritic gabbro</td>
</tr>
</table>

Published mark schemes do have a range of alternative answers that markers can accept, but this format is not for use by candidates in an examination. However candidates should not be giving more than one answer where a single property or term is required. Answers may be contradictory. Only the first answer given is marked where a specific term or feature is required.

2831 Global Tectonics and Geological Structures (Written Examination)

General Comments

Difficulty level - "appropriate"

Slightly harder than last year. No obvious problem with running out of time.

The overall quality of the papers this year seemed to be very varied. The overall paper marks ranged from 0 to 55 out of the maximum 60 marks. There was a good spread between the two.

Candidates tended to do well in the extended prose question on seismology with even weak candidates gaining half marks. The structural questions did prove challenging for many which is a retrograde step. An unexpected weakness was the characteristics of oceanic and continental crust.

Comments on Individual Questions

Q No **(sub)**

1) There were mixed responses to this question with a wide range of marks. The best candidates were able to give detailed explanations of the evidence for sea floor spreading and were able to provide detailed diagrams of the faults found at mid ocean ridges. The structural geology aspects of the question did prove challenging.

(a)(i) Answered well by most candidates

(ii) Understood by most candidates, however, some just described the heat flow rather than giving an explanation

(iii) Less well done than with heat flow, a significant number had the gravity the exact opposite. Gravity is a more difficult concept than heat flow.

Teaching Tip
As a rule both heat flow and gravity mimic the shape of the land which makes it easier for candidates to remember (page 27 of the OCR geology coursebook)

(iv) As many had difficulty with the gravity anomaly they found it difficult to give an appropriate explanation.

Teaching Tip
In the case of plate margins the gravity anomaly is mainly linked to the distance from the surface to the centre of the Earth. Trenches therefore form negative gravity anomalies and mountains form positive anomalies. (page 27and 38-40 of the OCR geology course book)

(v) The vast majority of candidates knew that the arrows diverged

(b) Candidates tended to be good at describing the observations but not explaining how the observations provide evidence for sea floor spreading. Evidence for sea floor spreading could be an extended prose question and candidates should be able to describe and explain the evidence. (page 26 - 29 of the OCR geology course book)

(c) Many candidates calculated the rate of spreading correctly but a significant number had the decimal place in the wrong place or did not show the working as requested. (page 29 of the OCR geology course book)

(d)(I & iii) Most students knew about transform faults but relatively few realised that normal faults occur at mid ocean ridges as well.

(ii & iv) The diagrams tended to lack accuracy and the labels were poor so many candidates gained 1 mark but few gained 2

Teaching Tip
Candidates should know what types of fault occur at the various plate margins. Candidates should also be able to draw fully labelled diagrams of all the fault types (pages 51-52 of the OCR geology course book).

2) Aspects of this question were well understood, particularly the features of the destructive plate margin, although the diagrams were often poorly drawn. It was surprising how few candidates knew the characteristics of oceanic and continental crust.

(a)(i) The majority of candidates were able to draw recognisable cross sections of the destructive plate margins. However, students should be encouraged to take a little more care with the drawings so that they are more realistic. The oceanic trench, fold mountains and active volcanoes were usually located in an appropriate place. Candidates had more difficulty with the Benioff zone which was often given as a point rather than a zone and should be on the upper surface of the subducting plate. The Moho was most frequently in an incorrect location or left out completely. Candidates should be aware that the Moho is located at the boundary between the crust and mantle.

(ii) The majority of candidates drew two correct converging arrows

(b) Deformation processes that form mountains were little understood by many candidates. They should be aware that it is a combination of folding and reverse (thrust) faults. Both these processes are a result of compressive stresses and cause shortening and thickening of the crust. (page 40 of the OCR geology course book)

(c)(i) It was surprising how poorly the responses were to this question. Candidates must be familiar with the detail of the density, depth, composition and age of both oceanic and continental crust.

Teaching Tip
The table below from the mark scheme must be understood by all candidates.

characteristic	oceanic crust	continental crust
average density (g/cm^3)	3.0 g/cm^3 +/- 0.1	2.7 – 2.5g/cm^3
average depth (km)	7 km +/- 3 km	35 km +/- 5 km
average composition	basic / basaltic / mafic / any basic rock	acid / intermediate / granite / granodiorite / felsic / andesite / rhyolite / any appropriate acid or intermediate rock
age range	Jurassic to Present 0 – 200 Ma +/- 20 Ma	Precambrian to Present 0 – 4000 Ma / >1,000 Ma

Candidates must be aware that where the average is required then a single answer is expected rather than a range. When, however, candidates were asked for an age range, many just gave a single answer. Therefore candidates must be careful with the rubric of the question. (page 35 of the OCR geology course book)

(ii) Many candidates knew about gaining information from boreholes or mining, but relatively few could describe geological mapping or collecting of surface rocks for analysis.

(iii) Many candidates were aware of using seismic surveys to locate the base of the crust (Moho) and so work out the thickness of the crust. Fewer candidates could explain how arrival times are used to indicate where waves are refracted and reflected at the Moho.

3) As is often the case, many candidates found this structural geology question the most challenging

(a) Candidates showed a good understanding of the appropriate terminology of the asymmetrical synform. Fewer students indicated that it was an overfold. Students should be encouraged to add as much detail as they can to the description including angles and direction of dip of the limbs (page 54 of the OCR geology course book).

(b)(i) Many candidates knew what stress is or described both stress and strain as relating to a force. Many candidates talked about *pressure* rather than *force* when discussing stress. Relatively few candidates knew that strain was the resultant deformation (fold or fault) caused by the stress. (page 46-47 of the OCR geology course book).

(ii) Very few candidates deduced that the main stress was from the right hand side and the vast majority had it coming from the left.

(iii) It was thought that the oolith deformation might prove to be a difficult question but a significant number of candidates realised that they would be stretched into an ellipse at the hinge and be a relatively undeformed circle in the limbs.

> **Teaching Tip**
> Candidates should be familiar with how ooliths and fossils can be used to indicate amount of strain. (page 47 of the OCR geology course book).

(c)(i) Candidates struggled with defining competent although a greater proportion recognised that the limestone was the competent rock.

(ii)

> **Teaching Tip**
> Candidates should be aware that competent rocks tend to maintain their thickness when being folded and tend to deform in a brittle rather than ductile manner. The existence of 3D minerals like quartz (in sandstone) or calcite (in limestone) discourages the formation of cleavage. (page 58-59 of the OCR geology course book).

(d) Many candidates knew that joints and faults were both fractures in rocks although many struggled to find the words to describe the differences. Put simply, a fault is a fracture where there is relative movement along the fracture. Joints are fractures where there is no relative movement. (pages 49-50 of the OCR geology course book).

(e) The answer to this question has been improving slowly with each time it is asked. Many knew that domes and basins are often circular or elliptical on a geological map. Many also drew appropriate dip arrows (encourage candidates to draw at least 4 dip arrows / structure). Few students put the oldest rocks in the core of a dome and the youngest in the core of a basin. (page 56 of the OCR geology course book).

4) The extended prose was often well answered with a significant number of candidates gaining full marks. Indeed some candidates had gained full marks in the first half of the answer.

Many candidates knew about primary and secondary waves and the relative speeds of the 3 types of wave. Many also knew about longitudinal and transverse waves and that L waves were restricted to the Earth surface and so were of no use in working out the internal structure of the Earth.

Few candidates knew about the physical characteristics of the rocks which control the velocity of the waves such as incompressibility, rigidity and density for P waves and rigidity and density for S waves.

Most candidates knew about the P and S wave shadow zones although the angles were variable. It is worth the candidates being able to draw accurate Earth cross sections showing the paths of P and S waves, refraction of P waves at the outer core and S waves stopping at the outer core.

Relatively few students discussed the evidence for the inner core being solid with P waves speeding up and the P wave that goes straight through the Earth arriving at the opposite side faster than expected.

QWC Generally very good this session probably helped by the generally good answers. Most knew the technical terms and structured the answer in a clear fashion.

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

General Comments

There was the usual wide range of performance from candidates some of whom had a sound grasp of geological terms and concepts and produced some high quality answers to the questions. There were very few responses that could not be scanned for use online and graphs and diagrams were generally clear and easy to read. Candidates appear to have been well trained to use black and white lines and symbols rather than colour shading. There was no evidence that the paper could not be completed on time.

Comments on Individual Questions

Question 1

Although this was the first time that a hazard map has been used as a resource, candidates generally had no difficulty in interpreting it, or the map of deposits. Drawing sediments to scale was sometimes found to be challenging, although this has been the subject of questions in the past.

1 **(a)(i)** A range of descriptions was offered. Most of them correctly involved flows of mud or mixtures of water and fine grained pyroclastics. Some candidates mistakenly described them as avalanches or landslides.

(ii) There were some general answers stating that the paths of lahars were linked to topography, but that did not go on to mention slopes, valleys or depressions. It was necessary to do this; *topography* on its own being not sufficient. Fewer candidates mentioned the analysis of deposits from previous events.

Teaching Tip
Risk analysis can be taught by using a planning simulation, using a map of either a real or made up volcanic island (Vulcano or Stromboli make good examples). The main geological features of the island can include; parasitic cones, main crater, caldera, old lava flows, former pyroclastic flows, ash deposits, geysers, thermal springs etc. together with relevant climatic data such as prevailing wind direction, presence of snow and ice and topographic details such as river valleys. This can be done on an A3 sheet.
The island contains only one settlement at present, but due to the growth of tourism there is a proposal to locate a hotel and holiday village there. The task for the 'planners' is to locate the development in a relatively low risk area (using the historical data to draw an annotated risk map) and to suggest monitoring methods that could be put in place to allow the possibility of early warnings to the residents should an eruption be thought imminent (scope for tilt meters, seismographs, gas correlation spectrometers etc.) The choice of location and the monitoring should be briefly justified in order to demonstrate an understanding of the usefulness of the methods employed and their link to the geology.

(b) A minority of candidates used the data on the map showing that the base was covered by ash deposits that were between 5 and 10cm thick. They were quite good at imagining a range of disastrous effects, some of which were not borne out by the map, for instance being covered by pyroclastic flows or suffering a rain of volcanic bombs or even lava flows. Overall a range of sensible suggestions, consistent with the map, were offered.

Teaching Tip
Volcanic Hazards
To appreciate the social and economic effects, the danger to life and property and the impact on climate change of volcanic activity students can carry out some research that can be used to create a display, or as material for a presentation, possibly including a set of Power Point slides. There is a wide range of resources on the Internet as well as in books and articles. Five sources are given below.
www.cet.edu/ete/modules/volcanoes/vclimate.html
www.earthobservatory.nasa.gov/Study/Volcano/
www.earthbulletin.amnh.org/D/3/1/index.html
'Volcanoes: Special Report' in The Geographical Magazine, March 2007
'Super Eruptions. Global Effects & Future Threats' London 2005: Geological Society

(c) Information in the question that the volcano was at a destructive plate margin, and the map showing the nature of the deposits was enough to tell most candidates that the eruption was explosive and that the high viscosity lava would solidify near the vent. Some thought that any lava would be low viscosity but still said it would not flow far.

(d)(i) Many candidates thought that sorting was partly to do with grain shape as well as grain size and were not content to answer based on size alone. This was quite a common misunderstanding. There was also some confusion between well sorted sediments and those showing graded bedding.

(ii) Drawings were generally satisfactory although some candidates wasted time by drawing very many small grains. Drawing fewer larger grains saved time, the scale being the critical factor that determined whether or not the size was correct. It was scale that proved more challenging, with many candidates not adding a scale to the sketch.

(iii) This question called for the use of technical terms, which many were able use successfully. Words like *sharp, large* and *mixed* are not technical and did not gain marks. Offering two terms such as *angular / sub angular* is not a good strategy because the examiner cannot select the correct technical term on behalf of the candidate. A single answer is needed from candidates. Most mark schemes do use a range of alternative answers but these are for the markers and should not be copied by candidates.

Teaching Tip
Hazard Maps
You can make up your own questions based on hazard maps. There are many available on the internet. Try www.maf.govt.nz/mafnet/rural-nz/emergency-management/volcanoes/volcano-erruption-impact and select option 3 from the list of contents for hazard maps of New Zealand.
Ask students to do a web search for volcano hazards maps, print out a couple of interesting ones, and bring them to a lesson, being prepared to discuss them.
If you want a practical activity that allows you to make your own hazard map using simple materials go to
http://volcano.und.edu/vwdocs/Online/haz.html

Question 2

2 There were many successful answers to this question. In general the more difficult aspects appeared to be explaining the varying width of the aureole on the map and calculating the average rate of cooling of the country rock.

(a)(i) A large majority of candidates stated *contact* or *thermal* metamorphism and gained the mark, although there was a noticeable minority who opted for *regional* metamorphism.

(ii) The fact that there would be heat only was not always clearly stated. A number of candidates tried to cover all options by referring to heat and pressure. The lack of mineral alignment was only mentioned by some candidates. The result was that many gained one rather than both marks for this part of the question.

(iii) Some answers did not provide a good definition of *metamorphic aureole* because they used the words *metamorphic* or *metamorphism*. Using terms that you are being asked to define is not sufficient. To show understanding of the *metamorphic* part of the term candidates needed to refer to *altered*, *changed* or *baked* areas of country rock as part of their definition.

(iv) Better candidates gained this mark. It was available by suggesting that the dip of the contact was steeper to the north or by referring to the lower thermal conductivity of sandstone. Some candidates had a general idea that it was something to do with the rock types but did not mention thermal properties or suggest that sandstone requires higher temperatures to metamorphose.

(v) E and F were usually correctly identified. Schist and gneiss were occasionally offered for C and D.

(b)(i) Most gained full marks here although a few drew bar graphs instead of line graphs whilst some plotted the points but did not join them to form a line. There were a few graphs where the line did not pass through the points, which was essential to gain all of the marks.

(ii) This was successfully answered by most candidates. A few did not offer any response.

(iii) Calculations were shown in most cases and were credited with a mark. There was the usual difficulty in correctly placing the decimal point. This resulted in a lost mark for quite a few candidates.

(c) Logical answers by most candidates, who could see that larger bodies would take longer to cool.

Teaching Tip
Foliation and Pressure
To demonstrate that pressure is needed to produce mineral alignment use match sticks or lengths of dried spaghetti to represent platy minerals. Drop them onto the bench so that they fall randomly. Use two rulers either moving in from opposite sides, or from top to bottom and squeeze the 'crystals' so that they line up perpendicular to the direction of stress.

Question 3

3 There were many good answers to this question. Whilst most candidates correctly identified the sill from the diagram they did not always find it easy to explain why.

(a)(i) There were few incorrect choices here with large numbers able to recognise a sill from the diagrams. However, giving a *reason* for the choice was less straightforward. The main problem was that rather than giving reasons why H was a sill, many preferred to say why G was a lava flow. This did not answer the question which was about the sill.

(ii) The formation of xenoliths was often very capably explained and seems to be generally well understood. Rather than the fragments being detached or derived from country rock there was a certain amount of 'scraping' involved in some less clear explanations.

(iii) Quite a few candidates attempted to explain the formation of vesicles rather than simply define the term. Often they described vesicles as forming when air is trapped, however, many did know that they were produced by trapped gas. It was sufficient to define the vesicles as small holes found in lavas without explaining how they formed.

(iv) It was well known that gas bubbles rise to the surface, but there were far fewer answers that explained this by saying that it was because pressures were lower at the Earth's surface that allowed the bubbles to rise.

(v) A mistake that some made was to suggest that the red colouring was to do with a chilled or baked margin. Many were able to suggest oxidation and some mentioned soil formation. Less precise responses said that the lava contained iron, whereas more accurate answers referred to iron minerals.

(b)(i) Well recognised as baked margins by most, although some suggested metamorphic aureoles and a few thought they were chilled margins.

(ii) Sometimes pressure was included in the answer, perhaps because candidates feel it is safer to mention it rather than temperature alone. Most knew that baking produced alteration due to heat, but there was a noticeable minority that also included pressure.
There is a teaching tip on metamorphic aureoles and baked margins in the Jan 2007 report.

(c)(i) Most were clearly able to define discordant bodies by stating that they cut across the beds.

(ii) Almost everyone gained this mark. A few had *concordant* and *discordant* the wrong way round.

(iii) In this question, candidates who reversed the definitions in (i) and (ii) could gain the mark for classifying when their answer was consistent with their earlier definition. This ensured that they did not lose marks twice for the same error. The sill and dyke were correctly named more frequently than the transgressive sill and the batholith.

> **Teaching Tip**
> Fizzy Lava
> Use an unopened bottle of cola, lemonade or other carbonated drink. What does it have in common with magma? Answer, they are both liquid! The similarity between the bottle and the rocks surrounding a magma chamber is that they both contain the liquid and stop it from escaping – the liquid is under pressure. When magma escapes to the surface to become lava it is released from the pressure of surrounding rocks. Release the pressure on the drink by unscrewing the cap and see what happens. Provided the drink hasn't gone flat there will be a stream of bubbles rising to the surface when the pressure is released. The same process produces vesicles in lavas.

Question 4

4 This question was well answered by many candidates and the full range of marks was awarded. Written communication was usually clear. Candidates appeared not to have run out of time and most of them used diagrams to illustrate their answers. The essay discriminated between candidates quite effectively and a wide range of marks was seen.

A few candidates lost two potential marks by not defining weathering. Most did this capably at the outset. In a few cases there was some confusion between weathering and erosion with some candidates suggesting that rocks were eroded by weathering.

Frost shattering was chosen by almost everyone and the process was very well known and effectively described with useful diagrams that made the process clear. Many candidates knew that water expands by 9% on freezing. They were very confident in describing this process which has clearly been well taught and well learnt.

Exfoliation was the next most frequent choice and occurred in almost as many answers as frost shattering. It was usually explained in the context of thermal expansion and contraction. Sometimes a mark was lost here if candidates did not make it clear that there was a wide diurnal temperature range involved. Some mentioned environments where the temperature changed, but this could of course be seasonal variation and was not sufficiently precise. However most did know about the daytime and night time temperature changes in desert environments and were able to demonstrate good understanding of the process. There were fewer examples of responses describing exfoliation due to pressure release but again these were generally well learnt and described with useful diagrams. The onion skin analogy was frequently and effectively used and there were some interesting cosmetic ideas involving exfoliating creams, although this kind of exfoliating involves the removal of surface layers, not just separation so it is not an exact analogy.

There was a little less confidence when it came to the chemical processes. Carbonation was more frequently described than hydrolysis. Acid was part of most answers. Sometimes it was *acid rain* sometimes it was *carbon in the rain* that made it acid. Better answers included information about carbonic acid and the fact that rainwater containing CO_2 becomes acid. There was not the same secure knowledge here as with frost shattering for example. Only very few candidates attempted a formula as part of their descriptions. Most referred to reaction with or dissolving of limestone. Terms like *honeycomb weathering* did not effectively describe the process.

Hydrolysis was the least well known of the processes. There was some confusion between hydrolysis (decomposition and reaction with water) and hydration (the addition of water to a mineral). Sometimes hydrolysis was stated as the process and then carbonation was described. Many candidates, however, took us to the coast with stirring accounts of a range of marine erosion processes, very often involving hydraulic action with waves compressing the air in fractures within rocks.

2833 Economic and Environmental Geology

General Comments

There were some excellent scripts and these candidates demonstrated very good subject knowledge and were able to express themselves clearly and concisely using good technical terminology. Performance at the top end was excellent with some candidates gaining more than 40 marks out of 45. However, a significant minority appeared unprepared for the exam and there was evidence that some Centres had not covered all the content of the specification. There was no evidence that time was an issue – almost all candidates attempted the extended question and there were no notes on scripts claiming exhaustion for this third paper in the session.

In addition:

- Some candidates need to pay far more care and attention to the quality of their written communication. Poor handwriting and spelling continue to be issues for some candidates and they should be encouraged to learn the correct spelling of key geological words and terms.
- There were some excellent diagrams of springs at unconformities and oil traps, but many candidates lost marks due to inaccuracies and no or poor labelling.

Comments on Individual Questions

1 The quality of responses to this question on dams and springs was variable – it was either done very well or done very badly!

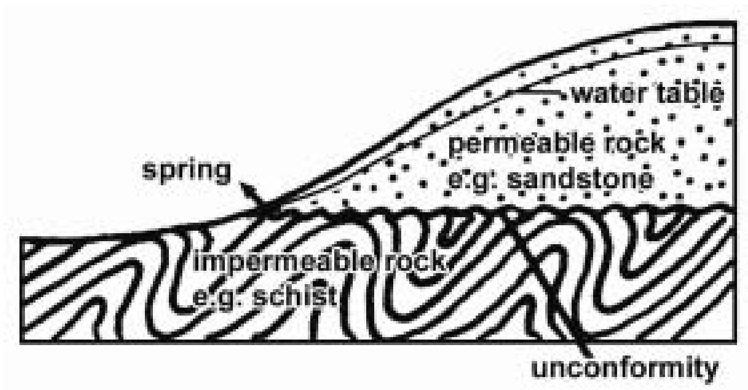
(a)(i) What should have been a straightforward starter question on the stability of dam foundations was done rather badly. Although some candidates produced very good answers to score the maximum 2 marks, many candidates failed to notice the word *foundations*. These candidates gave answers about water leakage which should have been saved for part (ii) or discussed the stability of the valley sides which was not relevant. Some failed to use correct terminology such as *dip* or *foliation*, while others merely wrote lists without descriptions, for example stating there was a fault without describing the problem it would cause.

(ii) The reasons why water would leak from the reservoir were well known. The most popular correct answers were that water would leak through the permeable sandstone and conglomerate or down the fault. It is pleasing that many candidates used the term *permeable* in their answers.

(iii) The majority of candidates attained 1 mark for explaining why there were concerns that seismic activity may start as the reservoir fills with water, but few gained both marks. Many correctly stated that water would add weight or increase the pressure on the rocks, but few discussed the idea of water lubricating the fault and reducing friction.

(b)(i) As expected, only the strongest candidates gained all three marks available for drawing a diagram to show how a spring can occur at an unconformity. The quality of some candidates' diagrams or labels was so poor it was not possible to award them any marks. Silly mistakes were made such as drawing an artesian well not a spring; having impermeable rocks on top of permeable rocks; and not relating the spring to the position of the water table or the boundary between rock types. Some confused the spring with one that forms as a result of lithology or faulting. However, many of these managed to obtain one or two marks for the correct position of the spring at the boundary of permeable and impermeable rock types or for the position of the water table.

Teaching tip
Candidates should be encouraged to practise drawing labelled diagrams of the spring types listed in the specification. Springs occur at the "triple point" of the surface, water table and rock boundary.



(ii) Responses to this part question asking for a scientific reason why some people prefer to drink bottled spring water were variable. The most common correct answers were the water has been naturally filtered through the pore space of rocks or that the water contains dissolved minerals. Vague answers such as it has cleaner image or is purer or has not been polluted were not accepted. Many candidates appear to be unaware that groundwater supplies can be polluted by contaminants entering aquifers from recharge zones.

(c) This was the first time this part of the specification on how water supplies can be renewable and sustainable has been tested and on the whole candidates answered the question well. Although there was confusion about the difference between the two terms, many candidates achieved at least one mark by showing an understanding that the rate of use needs to be equal to or less than the rate of recharge to be sustainable. Less commonly did candidates obtain the second mark as few discussed recharge by rainwater as part of the water cycle. A small number clearly misunderstood the question and wrote answers focusing on hydroelectric power as a renewable energy resource.

2 The straightforward part questions allowed all but the weakest candidates to show their understanding of how ore deposits form. Geophysical and geochemical exploration techniques, however, were poorly known.

(a)(i) This question asking for a description of how magnetite is concentrated in a layer just above the base of the intrusion was answered correctly by the majority of candidates. However, some candidates carelessly described magnetite sinking down through rock rather than magma! There was also confusion with other ore deposit types such as residual and secondary enrichment and a small number of candidates left the answer blank.

(ii) Surprisingly, this part question on how a magnetic survey could be used to determine the extent of the ore deposit was not done very well. Many candidates appeared to have no knowledge of geophysical exploration techniques or erroneously described gravity surveys, electrical resistivity or even seismic surveys. Some managed to achieve one easy mark by stating magnetite is magnetic, but few used correct technical terms such as it would produce a positive magnetic anomaly. The use of a magnetometer was less well know and poorly spelt! Some candidates said a large magnet or compass could be used to find the ore. Few referred to plotting data on a map to delineate the size of the ore body.

(iii) About 50% of candidates correctly shaded the soil geochemical anomaly going across the slope overlying and/or down slope of the magnetite rich layer. A common error was to shade the lower chilled margin.

(iv) Geochemical exploration techniques were poorly known and only the strongest candidates were able to explain the reason for the geochemical anomaly. A significant number left this part question blank. Very few candidates appeared to be aware that soil is formed by weathering of the underlying rock, so if the underlying rock contains magnetite then magnetite grains will be present in the resultant soil. In addition, there was very little understanding that the soil would then creep down slope under the influence of gravity so iron values immediately overlying and down slope of the magnetite rich layer would contain anomalous values.

(b)(i) The location of placer deposits was well known and most candidates gained the two marks available for correctly shading and labelling where deposits of cassiterite could be found along the river profile. A few candidates mistakenly shaded downstream of the dyke rather then upstream of it and others hedged their bets by labelling three or more sites which earned a maximum of 1 mark.

(ii) Most candidates gained the mark for stating a property of magnetite that allows it to form placer deposits. The most common correct property given was magnetite is dense. Others correctly stated magnetite is hard or chemically unreactive/insoluble. A minority were confused and said it dissolves or is light so it can be transported in water.

(iii) The majority of candidates gained at least one of the two marks available for describing how placer deposits form, but it was disappointing that a number of candidates gave no response. Most gained marks for stating that dense ore minerals are deposited where the current velocity slackens and there is insufficient energy for them to continue to be transported. Fewer were aware of the origin of the ore minerals from weathering and erosion of pre-existing mineral veins exposed at the Earth's surface or that these processes separate the ore minerals from the gangue minerals.

3 Question 3 produced variable responses and, while there were some very good answers, there were also a number of poor answers particularly to the part questions about geothermal energy and coal. It was pleasing that there were some excellent answers to the extended question on traps for oil and gas with some high quality diagrams.

(a) Although most candidates were able to correctly calculate the geothermal gradient at 50°C/km, it was surprising that a number of candidates made no attempt at this simple calculation. Common mistakes were answers of 20 and 0.05°C/km, the latter resulting from a failure to convert metres into kilometres.

Teaching tip
Temperature is 100°C at 2000m. Assume the surface temperature is 0°C.
Convert metres into kilometres = 2000 ÷ 1000 = 2km.
Divide the temperature by depth in kilometres to get the geothermal gradient
= 100 ÷ 2 = 50°C/km.

(b)(i) There were some very good descriptions of how geothermal energy could be extracted from the site shown on the diagram. In common with previous years, geothermal energy appears to be a poorly known area of the specification and many candidates struggled to express themselves clearly. The most common correct answer was that hot water or steam is pumped up to the surface and used to drive turbines. Some candidates had no idea that geothermal energy involves the extraction of hot water or steam from the ground and seemed to be under the impression that heat is conducted up metals rods to the surface! The source of the heat from radioactive decay of heat producing elements was not well known and very few candidates discussed re-injection of water to maintain pressure and/or use of artificial fracturing to increase permeability.

(ii) About half of the candidates gained the mark by stating that dissolved salts would either corrode or precipitate out and block the pipes in the geothermal energy plant. The most common incorrect answers were that the pipes would get too hot and melt or that they would burst!

(c)(i) The coal series was not well known. A significant number of candidates did not give any answers and others just wrote *coal*. Of those that had the right idea, many let themselves down with poor spelling such as *liginite* or even *litmus* for *lignite* and *bitimus* or *bitumen* for *bituminous coal*. One incorrect letter was allowed but candidates should be encouraged to spell geological words correctly – *bitumen* and *bituminous coal* are completely different things!

(ii) Again a significant number of candidates gave no response to this part question asking for the name and description of the process responsible for the reduction in volume as coal rank increases. Of those that correctly named the process as *compaction / diagenesis / lithification* or *coalification*, few then gained the second mark for correctly describing the process. Most were unaware that load pressure from the weight of the accumulating overburden during burial is responsible for compressing the peat and coal leading to a reduction in volume.

(iii) In contrast to parts (i) and (ii), there were some very pleasing responses to this part question asking for a description of two other properties that change as the rank increases. The increase in carbon content and calorific value on burning were well known, as was the reduction in volatiles, gases and water. Other correct answers included *increasing hardness, density* or *reflectance*. Regrettably, some candidates penalised themselves by stating that the carbon content, colour, density or hardness changed, but did not state *how* it changed.

(d)(i) For a standard topic, the process by which oil and gas form in a source rock was poorly known and only the strongest candidates gained both marks. Not many candidates could even recall that the starting material is plankton and others confused the process with coal formation. The best answers described the maturation process by which plankton is converted to kerogen and hydrocarbons during burial and compaction over millions of years. Others correctly referred to the process requiring temperatures of 50 to 200°C and anaerobic conditions. Just stating the rock is subjected to heat and pressure is not specific enough.

(ii) The definitions of *reservoir rock* and *cap rock* were well known with most candidates attaining both marks. Some candidates lost marks by not using the term *impermeable* when referring to the cap rock.

(e) There were many excellent answers to the extended question on oil and gas traps that obtained the maximum 7 marks with ease. It was especially pleasing to see so many accurate and fully labelled diagrams. Anticline, fault and salt dome traps appeared to be best known, but others correctly drew unconformity and lithological traps. Some candidates lost marks by drawing horizontal beds and were then not able to draw the oil and gas horizontal. Others got the sequence of water, oil and gas in the trap the wrong way round. Weaker candidates let themselves down with poor diagrams and little or no labels, while others appeared to only know one trap type and a few confused oil traps with aquifers and artesian basins for water supply.

Common errors included:

- Fault traps - not showing the beds above and to the sides of the reservoir rock on both sides of the fault or not drawing dipping beds.
- Salt domes - labelling oil and gas within the salt dome and calling the salt dome a batholith, clearly confusing diapirs of rising salt with those of rising magma!
- Anticlines – drawing synclines or labelling them antisynclines.

2834 Palaeontology (Written Examination)

General Comments

While there were a small number of outstandingly good scripts, many candidates appeared poorly prepared for the examination and were unable to answer even simple recall questions such as those on classification or morphology of fossils.

The extended question on the differences between regular and irregular echinoids was better answered than the extended question on the morphological changes of graptolites during the Lower Palaeozoic.

Some candidates made significant errors in their use of technical terminology, spelling, punctuation and grammar and a minority of candidates' handwriting was so poor it was very difficult to decipher their scripts.

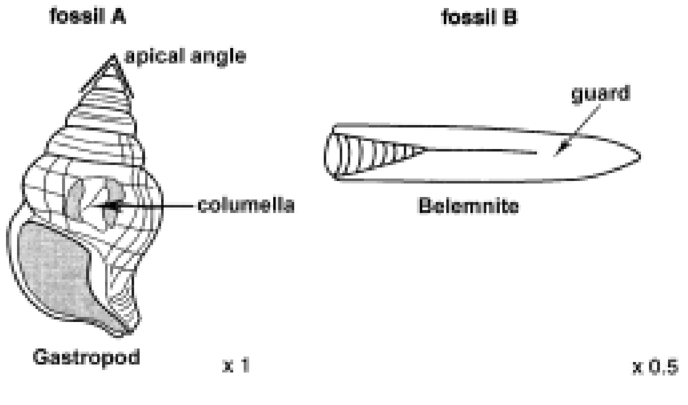
Comments on Individual Questions

1 The quality of responses to this question on classification, morphology and mode of life of gastropods, belemnites and trilobites was for the most part good and was the best answered on the paper.

(a)(i) Most candidates knew gastropods and belemnites belong to the Phylum *Mollusca*. Only a small number incorrectly stated *Cephalopoda*.

(ii) Again the vast majority of candidates realised fossil A was a gastropod and fossil B was a belemnite/cephalopod. A small number had no idea and gave wild guesses including graptolite or brachiopod.

Teaching tip



(iii) This part question asking for labelling of the guard, apical angle and columella on fossils A or B proved to be a good discriminator. Most candidates were able to correctly label the belemnite guard, some were able to label the gastropod columella, but only the strongest candidates labelled the apical angle correctly. Candidates that merely labelled a point at the top of the gastropod (the apex) as the apical angle were not awarded the mark – they had to show clearly that it is the angle between the two sides.

(iv) The mode of life of a belemnite was well known but many candidates wrote repetitive answers saying it was *nektonic / pelagic / free swimming* for only one mark. Few described other aspects of the belemnite mode of life such as it moved by jet propulsion squirting water out of its funnel, or used tentacles like a modern day squid or octopus, or that it was an active predator. Weaker candidates contradicted themselves by writing a list of every conceivable mode of life such as it was *nektonic, planktonic and benthonic*! Some even thought belemnites were infaunal. *Nektonic* was frequently spelt incorrectly as *ne**c**ktonic*.

(b)(i) Most candidates were able to identify some of the trilobite fragments, but few got all three correct. Some candidates were not specific enough, for example identifying fragment C as the *cephalon* rather than the *free cheek / genal spine* or fragment E as the *thorax* rather than a *thoracic segment*. Candidates who identified E as a *(jointed) leg* were also given credit.

(ii) Only the strongest candidates gained both marks for explaining why trilobite fossils are often found as fragments. Many incorrectly stated trilobites lived in high energy conditions and very few used the correct term segmented to describe the trilobite body. The most common correct answers were that the segments disarticulate as the soft tissue decays and that trilobites grew by ecdysis.

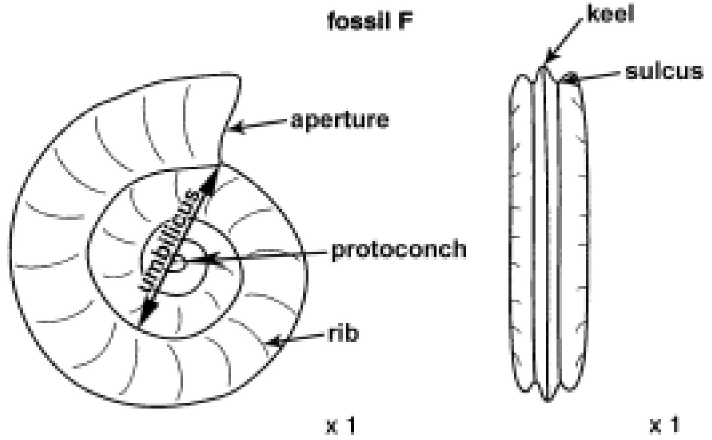
(iii) Many candidates were able to give correct descriptions and explanations of two features of trilobites that enabled them to live on the sea floor. The most common correct responses were that they had many legs to allow locomotion on the sea floor and that they had a wide cephalon or genal spines which stopped them sinking into soft sediment. Others discussed the flexible thorax and ability to enroll, or the position of the mouth on the underside allowing scavenging of detritus on the sea floor. Unfortunately those that discussed trilobite eyes often failed to use the word *compound* and those that discussed the hard outer shell failed to use the word *exoskeleton*. Weaker candidates did not appear to understand the word *feature* and wrote about trilobite mode of life without relating it to morphology.

2 All but the weakest candidates were able to show some knowledge of ammonites, but the geological ranges of different cephalopods and the reason why ammonites are often found in black shales and may be pyritised were poorly known. Many candidates struggled to recall the geological ranges of different cephalopods.

(a)(i) The positions of the umbilicus, keel and sulcus on an ammonite were not well known. Many candidates failed to accurately label the keel and sulcus on the right hand view – the keel is a ridge on the venter, the sulcus is a groove on the venter. The umbilicus was even less well known with many candidates erroneously labelling the protoconch. The umbilicus is the depression enclosed by the last whorl and consequently must be shown as a zone rather than a point.

(ii) It was surprising that many candidates did not gain an easy mark for labelling one other morphological feature on the ammonite. Sadly, many candidates did not realise that the diagram was an external view and incorrectly labelled septa. Those who labelled the ribs as suture lines did not achieve the mark either as suture lines on an ammonite would be complex and frilly. Another common error was labelling the *ribs* as *growth lines* suggesting confusion with bivalve morphology.

Teaching tip



(b)(i) This part question asking for the suture types, geological ranges and suture diagrams of different cephalopods produced a varied response but few, if any, candidates achieved all 5 marks. Many candidates were able to correctly identify the simple suture diagram for a nautiloid, but a significant number could not recall that the two missing suture types were ceratitic and ammonitic. It was surprising that more candidates knew of the last appearance of the goniatites in the Permian than knew of the last appearance of the ammonites in the Cretaceous. Given that ammonites became extinct in the K-T mass extinction event at the end of the Cretaceous this should have been an easy mark.

(ii) Most candidates were aware that cephalopod sutures became more complex over time to increase the strength of the shell, possibility to reduce the risk of implosion at greater depths. However, some candidates were unable to express themselves clearly or did not give enough detail to achieve the mark.

(c)(i) The reasons why ammonites are often found in black shales and may be pyritised was not well known. Some candidates correctly suggested that as ammonites were nektonic they would have fallen through the water column on death to settle on the sea bed and this would require relatively low energy conditions. Very few gained a second mark for describing the conditions required for pyritisation and answers not worthy of credit merely stated the sediment or water had to be *rich in pyrite*. Some candidates knew that the environmental conditions needed to be anoxic, but very few appreciated the role of sulphur-fixing bacteria in the generation of pyrite.

(ii) Although there were some very good answers explaining that derived fossils are fossils that have been eroded out of the original rock in which they were fossilised and then transported and re-deposited in a younger rock, some candidates did not give sufficient detail to attain both marks. A number of candidates thought a derived fossil was one found in a different environment to the one it lived in suggesting confusion with death assemblages.

(iii) Many candidates appreciated that derived fossils would produce an incorrect date but few stated that the rock would appear *older* than it is.

3 Many candidates displayed good knowledge of brachiopods and bivalves but only the strongest were able to draw accurate, fully labelled diagrams of the various bivalves. Surprisingly many candidates were unable to describe how bivalves burrow or feed while they are in a burrow.

(a) Most candidates gained some marks by circling the correct options in the table to show which features were found in brachiopods only, bivalves only or both, but many did not attain all 5 marks.

(b)(i) There were some excellent fully labelled diagrams showing the internal morphology of a burrowing bivalve which gained the maximum 4 marks with ease. Candidates were able to gain marks irrespective of whether they drew a deep burrowing bivalve such as *Solen*, or a shallow burrowing bivalve such as *Venus*. Unfortunately some candidates failed to notice the word *internal,* while others failed to notice the word *burrowing* which limited their marks. Others contradicted themselves by labelling features found on brachiopods.

(ii) This straightforward question asking for a description of how bivalves burrow into sediment was surprisingly poorly answered. Very few candidates even used the term (muscular) *foot* in their answer, while even fewer were able to describe how the foot swells and contracts to pull the shell down or how contractions of the adductor muscles expel water from the valves causing liquefaction of the surrounding sediment.

(c)(i & ii) While there were some very good descriptions of how bivalves filter feed using their inhalant and exhalant siphons, others were confused with brachiopods and discussed use of the lophophore. A common mistake was describing the use of one rather than two siphons and some even said bivalves use their foot to feed!

Many candidates struggled with this part question asking for diagrams and descriptions of how epifaunal bivalves are adapted to live (i) on a soft substrate and (ii) on a hard substrate. Some did not appear to understand the word *epifaunal* and penalised themselves by drawing and describing infaunal bivalves. Diagrams were very poor and in many cases had no labels worthy of any marks. For part (ii) some candidates confused bysally attached and cemented forms often describing both adaptations in one sentence, while others were confused with brachiopods and wrote about pedicle attachment. Many did not give sufficient detail to gain the second mark available for the description which could have been either for detail of the adaptation or for a good explanation of the reason for the adaptation. Candidates should be encouraged to practice drawing fully labelled diagrams of bivalves with all the modes of life listed in the specification – *attached, sessile, vagrant, swimming, freelying, shallow infaunal* and *deep infaunal.*

4 This question on dating rocks and mass extinctions proved to be a good discriminator. There were some very good answers that achieved full marks but plotting a radioactive decay curve or describe how volcanic ash can be used to date rocks were problematic.

(a)(i) A significant number of candidates were unable to plot the radioactive decay curve for potassium-argon. Of those that gained two marks for correctly plotting 4 half-lives, some did not gain the third mark as they did not add a *curve* but instead joined from point to point with a ruler.

(ii) Error carried forward from the graphs ensured that most candidates achieved the mark for quoting the age of a rock for which 80% of the parent material remained. However, some carelessly did not specify the units as millions of years and lost the mark.

(iii) Although the term half-life was well known, some candidates penalised themselves by not using the term *parent* in their answer or by not specifying the amount of decay, i.e. the time for *half* the *parent* isotope to decay to its daughter product.

(iv) About half of the candidates gave uranium-lead as another radioactive isotope and its decay product that can be used for absolute dating of rocks. Many had incorrect mass numbers but these were ignored. Candidates who stated either *uranium* or *lead* did not achieve the mark, nor did those who suggested carbon dating could be used. Carbon-14 has too short a half life to be used for dating most geological materials. There were a number of wild guesses such as magnesium or aluminium dating!

(b)(i) Most candidates achieved at least one mark for describing the differences between absolute and relative dating. *Absolute dating* was well known but *relative dating* less so – some candidates merely stated it is comparing one rock relative to another without any further detail. The best answers gave specific examples of relative dating such as using superposition, the law of cross cutting relationships or included fragments to determine which rock is older.

(ii) This part question asking how volcanic ash can be used to date rock was answered rather poorly. Few candidates suggested that ash is deposited over a wide area at the same time and even less were aware that ash can be used for chronostratigraphy as it contains elements suitable for radiometric dating. Unfortunately, many candidates missed the point and just stated that the rocks underneath the ash layer would be older than it and those above the ash layer would be younger.

(c) Most candidates were able to attain some marks for describing and explaining two possible reasons for mass extinction events. A meteorite impact and large scale volcanic activity were the two most common correct reasons given. While there were some excellent descriptions and explanations, some candidates let themselves down with poor English and failed to use good technical terminology. Many gave repetitive answers citing ash and dust causing either an *impact winter* or a *volcanic winter* but did not give specific details of the causes of climatic change. Others digressed into the evidence for mass extinction events which did not answer the question.

5 **The two extended answer questions on the morphological changes of graptolites** during the Lower Palaeozoic and the differences between regular and irregular echinoids produced a range of responses. At the top end there were some excellent answers which were well written and illustrated with detailed, accurate, and fully labelled diagrams. Others let themselves down with a lack of detail and appropriate A2 level terminology. The echinoids question was answered better than the graptolites question.

(a) This standard essay on graptolite evolutionary changes was not done especially well. While there were a few excellent answers to the question, many candidates struggled to use correct morphological terminology, failed to organise their answer in a logical sequence, and produced very poor, unlabelled diagrams that were not worthy of credit. Many candidates had not learnt the correct technical terms to describe graptolite morphology, others got the evolutionary changes the wrong way round, and only the strongest candidates were able to recall the correct geological time periods or names of graptolite genera. Some answers merely consisted of a number of diagrams with arrows in between – these answers failed to *describe* the changes and did not achieve any credit for quality of written communication. Some diagrams were so poor it was not possible to award them any marks.

(b) Reponses to this question asking for a description of the differences between regular and irregular echinoids were pleasing. The wide range of valid possible answers covering morphology, mode of life and age differences benefited well prepared candidates and at the top end there were many superb, well illustrated answers which gained the maximum 11 marks. The best answers gave a point by point comparison of the differences between the two orders, but candidates that gave good separate descriptions of regular and irregular echinoids were still able to attain maximum marks. There were 5 marks available for diagrams of which some candidates took full advantage. Good use of diagrams for morphological questions always helps candidates as they serve as a reminder for written descriptions and comparisons. Most answers concentrated on the morphological differences between the two orders, but stronger candidates also compared mode of life and it was very impressive that some candidates were even able to recall correctly their stratigraphic ranges. Weaker candidates did not know the morphology of echinoids in sufficient detail, were unable to produce suitable labelled diagrams, and struggled to make any creditworthy comparisons between the two groups. One or two were under the impression that regular echinoids are extinct!

Teaching tip
The difference between regular and irregular echinoids can be summarised in a table:

(b)

Regular echinoids	Irregular echinoids
Morphology	
• hemispherical / dome shaped test	• heart shaped test
• 5-fold radial symmetry	• bilateral symmetry
• anus on top in apical system with no sub-anal fasciole	• anus has moved out of apical system to posterior and has sub-anal fasciole with cilia to waft waste away
• mouth central on oral surface with Aristotle's Lantern jaws	• mouth has moved towards anterior and has no jaws
• no labrum	• has labrum
• no anterior groove	• has anterior groove
• large tubercles and bosses with spines	• small or no spines
• no plastron	• has plastron
• has extended ambulacra	• has petaloid ambulacra

Mode of Life	
• benthonic, epifaunal and vagrant	• infaunal burrower
• grazer and scavenger	• filter feeder
• rocky shore, high energy dweller	• soft sediment, low energy dweller
• has long spines used for defence and locomotion	• has short spines for digging
• tube feet are mainly used for respiration, movement and attachment	• tube feet are mainly used for respiration, passing food to mouth and maintaining burrow
• waste is dispersed into the water	• has sanitary burrow
Stratigraphic range	
• Palaeozoic to present	• Mesozoic to present

2835 Petrology (Written Examination)

General Comments
The examination paper this session gave a full range of responses, with a large variation amongst centres. There were thus many excellent scripts utilising technical terms very effectively and clearly demonstrating a clear understanding of the relevant subject matter and concepts. However there was an inconsistent performance across the questions that led to some promising performances being marred by underachievement on some questions. In this A2 examination it is essential that answers include sufficient detail and not just a general statement. This paper is synoptic on the three AS modules and it was clear that some candidates had not revised the AS material.

Comments on Individual Questions

1 This question on diagenesis and metamorphic processes led to a wide range of marks with few candidates scoring maximum marks. Knowledge and understanding of the aluminium silicates and ternary phase diagrams is noticeably improving, although the understanding of metamorphic reactions remains weak in all but a small number of centres

(a)(i) Most candidates recognised that there was an increase in temperature and pressure from rock A to rock B thus giving an increase of grade. This often, however, led to rock A being mistakenly described as metamorphic. Any sequential list was worthy of credit but maximum marks required reference to a shale becoming a slate. A number of candidates incorrectly referred to Rock A as mudstone, failing to recognise that pressure would align the clay minerals.

(ii) There was a large range of responses describing the processes of lithification that cause the reduction in water content. Only the more able candidates referred specifically to load pressure and reduction in pore space, weaker candidates described *water being forced out.*

(iii) The majority of candidates recognised heat as the additional factor required for the formation of rock B.

(b)(i) The majority of candidates were unable to explain the relationship between diagenesis and heat and pressure; responses were often vague and the relationship rarely linked. The question was specifically looking for reference to a distinct increase in temperature and pressure. All too often candidates described at length the various types of metamorphism without answering the question directly.

(c) The knowledge of and understanding of phase diagrams and the aluminium silicates is continuing to improve and there were some good responses to this part question.

(i) Over 50% of candidates were able to give the term *polymorphism,* common incorrect responses referred to *isomorphism*.

(ii) *Clay minerals* was rarely correctly cited as the parent of the metamorphic minerals although the term *aluminium silicate* was often used.

(iii) The majority of candidates were able to read from the triple point, the specific temperature and pressure conditions required for all three minerals to co-exist.

(d)(i) This part question proved to be surprisingly difficult for a large number of candidates, with many failing to attempt it at all. Candidates are expected to be able to draw temperature gradients from given data at this level

(ii) Identifying the minerals from the temperature gradient proved easier and *error carried forward* allowed many candidates to score marks.

(iii) The more able candidates were able to relate minerals to rock types; weaker candidates referred to *igneous and metamorphic rocks*, failing to relate temperature and pressure conditions to mineral content.

(e)(i) Knowledge of metamorphic reactions was limited to only the more able candidates. This part question led to some blank responses. Incorrect answers included reference to evaporation, while the majority failed to explain why the reaction was reversible

(f) The majority of candidates were able to name mylonite as a product of dynamic metamorphism and explain how it formed along fault planes under high pressure conditions.

2 Sedimentary environments are either well known or poorly understood resulting in a wide range of marks, many of these being centre-specific.

(a)(i) The vast majority of candidates were able to recognise rock D as chalk and rock E as coal. Rock C proved to be more of a challenge and only the more able candidates named it as *arkose*. The common incorrect response was *desert sandstone.* Candidates clearly failed to read the description and the reference to potash feldspar. Incorrect responses to rock D included the too general *limestone* instead of the type, and for rock E *lignite* which is brown coal unlike *bituminous coal* which is black.

(ii) If a candidate had correctly identified the arkose correctly, the subsequent environment proved straightforward with maximum marks achieved. If a desert sandstone was identified in (a), *error carried forward* allowed candidates to score marks for a description of a suitable environment.

(iii) The majority of candidates were able to describe the likely environment for the formation of the bituminous coal although there was still some confusion between equatorial and tropical conditions. Reference to anaerobic conditions was frequently made but rapid burial was often omitted. The synoptic link to AS content was clearly evident here.

(b) A large number of candidates were able to distinguish between quartz and calcite, although only on a small number of occasions did answers refer to *crystals* as the question required. Many referred to reaction with dilute hydrochloric acid and hardness which are diagnostic properties but not the crystal itself. *Shape* was the key feature although reference to cleavage and or fracture was an acceptable response. The quality of the diagrams on the whole was very poor; crystal shape being a physical property that seems to be less well known. Some candidates described the differences between quartz and calcite-rich sediments rather than the minerals themselves.

(c) The majority of candidates were able to identify the minerals correctly, although occasionally these were placed the wrong way round. Weaker candidates failed to recognise that the minerals were in fact evaporites.

Teaching Tip:
Cards can be used with diagnostic mineral properties, students using the properties to identify an unknown mineral. One card can be produced for each mineral on the specification. This could be done as a lesson starter, or as a plenary. The technique would work just as well as a power point slide, one per mineral – Who Am I?

(d)(i) Responses to this part question were very centre specific. There were some excellent answers, but quite a bit of confusion with playa lakes and sabkhas. The quality of diagrams was very variable. Many candidates were unable to relate order of appearance with solubility or got the order reversed. There was some confusion othe relationship between *evaporation* and *precipitation.*

(ii) This part question was rarely answered correctly with *recycling* being a popular incorrect response. Only a small number of candidates referred to *replenishment*, *sediment cover* and the correct *evaporate sequence.*

(iii) The majority of candidates scored only one mark, with reference to arid / desert conditions, with only the more able candidates being able to describe what specifically a desert is, in terms of evaporation exceeding precipitation.

3 There were some varied responses to this question which focussed on igneous processes and products, with a number of candidates achieving maximum marks.

(a)(i) Although the majority of candidates could explain why the central part of the sill crystallised last, only a small number were able to interpret the diagram. The most common incorrect response was*150m right at the centre of the sill.*

(ii) The responses to this part question were on the whole excellent, with most candidates recognising olivine as an early forming mineral and how when crystallised, its density led to it sinking to the base of the sill. There was some excellent use of technical terminology with *cumulate, cumulus layer, gravity settling, differentiation* and *fractional crystallisation* being cited.

(iii) Naming of the basic igneous rocks as basalt and dolerite respectively was achieved by a large number of candidates. Occasionally, weaker candidates got these the wrong way round or named *acidic* instead of *basic* rocks.

(iv) The recognition of the metamorphosed sandstone as *metaquartzite* was well known.

(b)(i) This part question proved to be an effective discriminator and only the more able candidates were able to recognise the relationship between metal oxide and specific minerals. Weaker candidates thought that the oxides were minerals and not part of the mineral composition and this often led to answering the question at a tangent. The significance of the chilled margin as representing the original magma composition was only rarely recognised as was the significance of magmatic differentiation to explain the changes

(ii) The change in silica percentage in the olivine rich layer again proved to be an effective discriminator for the more able candidates. Correct responses referred to olivine being a mafic mineral and requiring less silica. Common misconceptions confused silica percentage with quartz content, and weaker candidates discussed quartz presence or absence rather than the silica content *per se*. Reference was often made to quartz as a low temperature mineral forming last, which although correct in itself, was not a correct response to the question.

(iii) The majority of candidates were able to explain why composition would not vary in a thin sill by describing the significance of time for fractional crystallisation. Candidates were able to score marks by referring to *time* for one mark and *speed* for another.

(c) Although a relatively straightforward question, there were very few maximum marks for this part. There was only limited reference to calcium rich anorthite forming at high temperatures and sodium rich albite at low temperatures. Only the more able candidates could explain calcium rich plagioclase at the top of the bottom of the sill and sodium rich plagioclase in the centre / area that crystallised last. Weaker candidates often got the calcium and sodium the wrong way round.

4 This question was generally poorly answered with a large number of candidates showing a limited understanding of the environmental processes associated with glacial transportation and deposition. Responses to this question were often centre-specific. Candidates rarely discussed the bed sequence as a whole and thus were unable to link the units together, and as a result responses lacked cohesion. The reference that four of the five beds were Pleistocene was a big clue that was not used by the majority of candidates.

(a)(i) The origin of unstratified layer L was not well known with only a small number of candidates recognising this as a glacial deposit. When correctly identified, candidates often referred to *moraine, glaciers, till* and *boulder clay*. Many candidates explained the origin as a high energy flash flood.

(ii) The origin of beds J and K led to more accurate responses, with a large number of candidates recognising the deposits as fluvial. Many though, failed to link the two units in terms of varying energy conditions. If candidates had recognised the sequence as *glacial* in origin, reference to fluvioglacial and meltwater streams was often made.

(iii) Considering how few candidates recognised the sequence as glacial, a surprisingly large number interpreted the alternating clays and silts as varves and correctly described seasonal deposition in relation to energy conditions. A significant number confused high energy meltwater with low energy still water.

(iv) Many candidates failed to answer this part question adequately and failed to recognise the synoptic link with Module 2834. Often chronostratigraphy was given as the correlation method with lithostratigraphy used as an explanation and vice versa. Weaker candidates left this part question blank or just described varves as a correlation method.

(b)(i) Although many candidates recognised the striations and partially understood their origin, all too often *ice* was given as the explanation. Often material contained within the ice was omitted in the explanation and thus the candidates failed to achieve any marks.

(ii) The responses to this part question were varied, many candidates recognised the significance of ice travelling over the Silurian beds and picking up material as it passed, but only occasionally was the second mark obtained by referring to rapid deposition and erratics.

(iii) Many candidates failed to recognise the synoptic link with Module 2833 and often confused consolidated with unconsolidated deposits. It proved easier to achieve the two marks available by describing the foundation as unsuitable and giving valid reasons. A small number of candidates thought the sequence suitable but found two reasons difficult to give.

Teaching Tip:
Sedimentary environments are topics that can be used for group presentations. Small groups of students are given a specific environment such as glacial or beach. They plan, research and present their findings to their peers in the form of a power-point presentation, including a handout. General group understanding is monitored through an open group discussion at the end of the presentations.

5 Long answers give candidates an opportunity to provide detailed answers with diagrams and explanations. The organisation of the answers needs to be logical and structured in order to obtain the marks for the Quality of Written Communication (QWC). There was a wide range of responses with a large number of candidates achieving 20+ marks.

(a) The quality of responses to this extended answer varied: many candidates were able to describe acidic igneous rocks in terms of *mineral composition* and *texture* but failed to discuss *origin* in detail or vice versa. A minority of candidates confused acidic and basic rocks and as a result failed to score many of the marks available for origin or mineral composition.

The majority of candidates were able to describe quartz as an essential mineral of acidic igneous rocks, and the more able candidates referred to sodium rich plagioclase, potash feldspar and mica. Marks were often lost for a general comment on feldspar or plagioclase feldspar without any specific detail. Weaker candidates described olivine as an essential mineral of acidic rocks. Some candidates correctly discussed silica percentage but this was not asked for and as a result no credit was given.

Textures were generally well understood and described, with some good clear labelled diagrams used to illustrate points of origin. A variety of textures was allowed including *porphyritic, vesicular, crystal grain size* and *flow banding*. Weaker candidates had a tendency to describe the origin of some metamorphic textures.

The response to the origin of igneous rocks were often centre specific with some excellent quality answers. Often though, candidates referred to only one plate tectonic setting when in fact there are two and as result found obtaining maximum part marks difficult.

Oceanic-continental collisions were commonly described with reference to the change from an intermediate to acidic composition. Care needs to be taken to refer to *partial melting* rather than melting in its broadest sense. There is the clear possibility to discuss differentiation by a variety of processes. Only occasionally was reference made to the specific type of volcanic activity associated with this plate margin.

Continental-continental collisions were often omitted, and if discussed, the answers were often general and vague, lacking in any real substance. Key omissions include reference to diapiric action and partial melting due to the geothermal gradient crossing over the mantle melting temperature at a shallower depth.

The quality of diagrams on the whole was disappointing with very few clear annotations. Students should be encouraged to give clear labelled diagrams because often diagrams can be marked as text.

(b) There were some excellent responses to this question proving that sedimentary structures are an accessible topic from the specification, as well as synoptic to the AS course. Well prepared candidates could clearly describe the origin of a variety of sedimentary structures whether as palaeocurrent indicators or way-up structures. The most common error was not in general understanding but failing to read the question that required *four* structures. Some candidates lost marks when they described the same structure twice, when the question clearly asked for *two different structures*. There were some good labelled diagrams showing origin, palaeocurrent direction and way-up characteristics.

The key for each structure was origin, detail and labelled diagram. Cross bedding is a structure most candidates are familiar with and as a result of its use as a palaeocurrent indicator is well understood. Its use as a way-up structure is more difficult to describe but the key is a truncated upper surface, easily shown diagrammatically.

Two common misconceptions with flute casts are current direction and origin. The former often being quoted incorrectly as moving in the opposite direction. Candidates must remember that a flute opens *down* current. Another common error is origin: *strong currents* are responsible for the hollow and not material carried by the current itself.

Desiccation cracks, although on the whole well described, must include reference to hot / arid conditions, shrinkage, and subsequent infilling of the cracks.

Candidates need to be clear which structures are required from the specification, and occasional reference was made to *non sedimentary* structures which led to marks being lost.

The quality of annotated diagrams was on the whole encouraging and a marked improvement on those of recent years.

2836 Geological Skills (Written Examination)

General Comments

The Geological Skills examination is synoptic so requires knowledge of all the other units. Many candidates will not have sat AS units since the previous summer session and basic knowledge of material covered in these units was again a problem such as confusing the syncline for an anticline. A good knowledge of structural geology from 2831 is vital for identification and sketches of structures as well as the geological history of a map. The skills for this paper need to be practised, so teaching skills such as sketching from photographs is essential preparation for this examination. The skills listed in the specification include graphic logs, geological maps and geological histories.

There was a very wide range of scripts, from excellent with the highest mark of 58 out of 60 through to very weak scripts with marks of less than 10. Every question showed the complete range of marks showing that no part question was inaccessible. However there were major differences between centres at the question level. Most scripts were reasonably legible and were awarded full QWC marks. There was no evidence of lack of time for completing the paper and few candidates made use of extra paper or left many questions blank.

Some candidates lost marks through not reading all the information in a question carefully enough, resulting in not using the information accurately. The information at the start of each question – often above a diagram - is essential for correct answers and many candidates ignore or do not read this part of the question.

Comments on Individual Questions

Question 1

This produced a very good response with particularly high marks for the geological history of the map.

1 (a)(i) Many candidates lost a mark through not *drawing* the plane of unconformity, just indicating a point on or close to it.

(ii) Very few candidates identified the fold as an asymmetrical, plunging syncline and even fewer gave directions as asked in the question. The directions included the east west alignment of the axial plane trace and the direction of plunge to the east. There were three marks for the three components of the fold. Some candidates drew the axial plane on the map even though it was not asked for on this occasion!

(b) The method of *cross cutting relationships* was known by less than half the candidates. Other suggestions included *lithostratigraphy, radiometric dating, law of superposition and chronostratigraphy* illustrating a lot of wild guesses. Where more than one answer was given then the first answer only was marked.

(c) This question required synoptic knowledge of aquifers from the economic geology unit. The candidates who had made the connection with sandstone being an aquifer nearly all related it to porosity and permeability. Calcareous sandstone is a sandstone with a calcium carbonate cement so is unlikely to be an aquifer. Some answers were based on the relative position of the beds rather than their texture

(d) The geological history was very well answered in terms of the order of events with nearly all candidates giving correct responses. The task of getting all the events in the correct order has greatly improved over the years and centres are evidently prepared well. Weaker answers often added a lot of environmental description to the rock types laid down, which was speculative and not required from the question. By filling the space with these descriptions students felt that they had completed the question, but they had only obtained one or two marks. However many answers lacked essential technical detail which lost marks. The detail of uplift and erosion before the unconformable rocks were laid down was not always described.

The invented word *dipped* was again common, but it does not exist in the context of dipping beds. There were many good descriptions of the sequence although the order of laying down the first three sediments was often given in reverse order, and almost all incorrectly placed fault X before fault Y, despite having identified *cross-cutting relationships* as the method of relative dating in part (b). A common misuse of terminology occurred here with faults and new beds described as *intruding* by candidates.

It is worth noting that in order to gain full marks, some detail of each event should have been given, as this answer should be continuous prose and not just a list. The quality of communication mark can not be awarded for lists.

Teaching Tip

Geological histories must always start with the oldest event and end at the youngest. On a practice map, number the beds and events by writing on the map. Start with the oldest as event 1. This works best with a map projected on a screen / IWB as an interactive exercise.

Question 2

This question proved to be the most difficult with the lowest scores, but there were, however, some excellent answers with full marks for all part questions by some candidates.

2 (a) Very few candidates achieved all 3 marks, due to the last part of the question which required a dip arrow and label for the youngest bed. Many candidates got this completely wrong, ignoring the help in the question that stated *- dip to NE at 23 degrees.* Most candidates correctly drew the intrusion, although some lost marks by drawing the chilled margins outside the intrusion. Many candidates did not read the instructions, so few obtained both marks in the majority of centres.

Teaching Tip

To identify the youngest bed and the direction of dip make 3-D models of tilting beds. This could be different coloured layers (beds) of plasticine or multi-layer sandwiches and a sharp knife to cut them at an angle to represent an eroded surface. Remember the rule that “rocks get younger in the direction in which they dip”.

(b)(i) Chilled margins were well explained though poor answers referred to the *origin* as by cooling rather than the *result* as fine grain size.

(ii) Some suggestions were completely wrong here, referring to pressure release or confusing joints with cleavage. Others repeated that the joints were hexagonal and even gave an example with the Giants Causeway, but failed to explain and describe how the joints formed

(c)(i) There were many errors on the mineral identification and many candidates found this question difficult, the vast majority seeming to have just guessed a mineral that they knew, with some giving rocks instead of minerals. Good candidates often got both answers correct. A few wrote *feldspar* on its own without the type as *plagioclase.*

(ii & iii) There was a surprisingly mixed response to this AS question. About half had the correct answer, and those who got it wrong tended either to have no idea whatsoever, or they referred to it as poikilitic, especially if they had seen that the minerals were augite and feldspar.

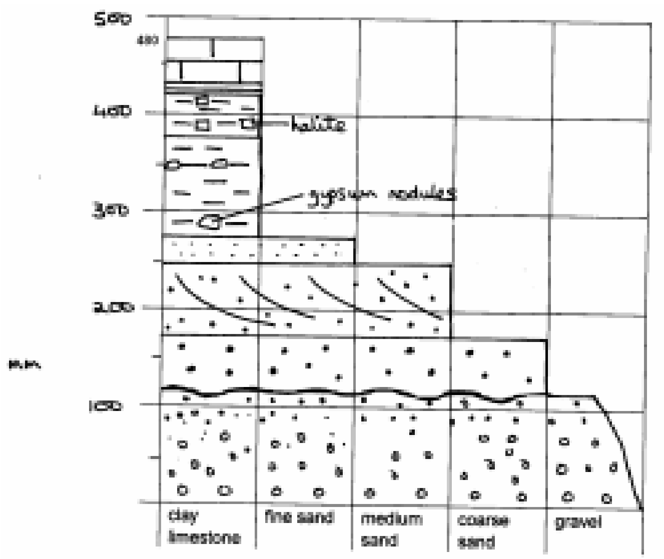
(d)(i) *Amygdaloidal texture* caused some confusion with a number of blank spaces and a wide variety of spellings! It was either known and explained very well, or not at all. Maybe interpreting photos can be tricky, but candidates should not expect to have *porphyritic* twice in one question.

(ii) If they had identified the correct answer in part (i) candidates were generally able to explain fully its formation. A number of candidates were able to pick up some marks here by explaining vesicles and infilling, though they had forgotten the name of the texture.

Question 3

This question was very well done with many excellent graphic logs and detailed analysis giving full marks.

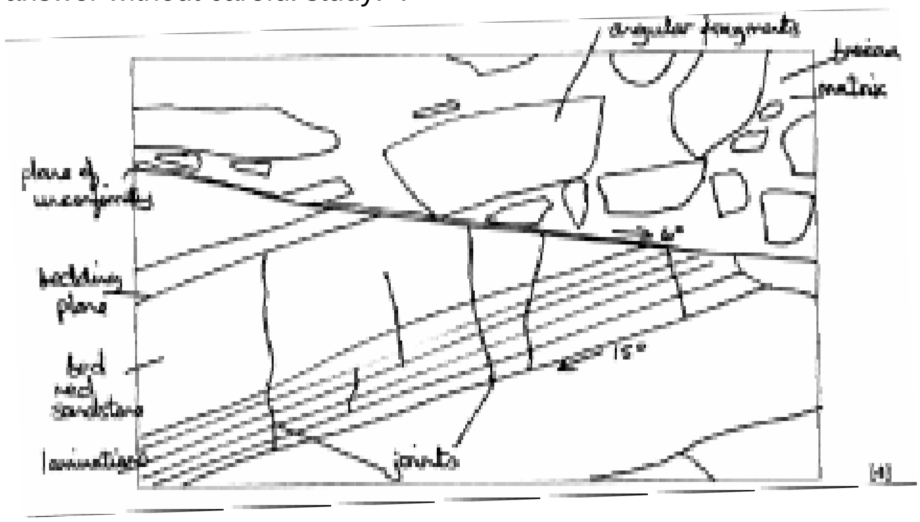
3 **(a)** A scale was not always given on the graphic log and in a few cases a very odd scale was used. Adding up the total thickness of beds first helps to ensure that the scale is appropriate. Conventional symbols for sandstone, limestone and shale should be used on a graphic log, along with an uneven line for erosion surfaces and angled lines for cross bedding. Answers that used the right hand side and those using the centre to show grain **size** were both accepted. Less than 10% of candidates were not able to attempt a graphic log with some drawing bar charts.



(b) Many candidates wrote excellent detailed answers that could have achieved far more than the maximum mark as they had described every environment correctly. *Describe the sequence of environments of deposition* does not mean the same thing as *describe the sequence of events* and answers that only stated the order in which the rocks were laid down could score no marks. Technical terms were asked for, so answers needed to include the correct names for the environments from fluvial to marine. Some candidates repeated *high energy* or *low energy* many times, but these statements could gain a maximum of two marks. There were some helpful clues in the data provided from the red colour – typically terrestrial for mica which is not found in aeolian environments to the large scale cross bedding which is aeolian. Evaporites do not form in rivers.

Question 4

As candidates expect a photo they tend not to read the instructions well and simply answer without careful study. .



(a) There was a very mixed quality of sketches from excellent to weak - some good drawings had almost no relevant labels. Some of the sketches were lacking in detail with few meaningful labels. Artistic skills and shading are not needed and as in the example above it is not necessary to include all the detail for all beds in the sketch.
This question is synoptic on 2831 structural geology but a number of candidates failed to realise that it was an unconformity and tried to draw it as a fold or fault or even an igneous intrusion. (It is the unconformity between the Devonian and the Trias at Kilkenny Bay, Portishead.) The candidates were asked for appropriate dip measurements and it was not possible to gain full marks without this detail. Suitable dip measurements were the plane of unconformity and beds above 6° - 10° while the older red sandstone beds dipped at 15° - 20°. Many answers were outside the acceptable range and in some cases measured from the vertical rather than the horizontal, and in others gave strike directions. More practice is needed on this type of question. Vague use of technical terms such as joints labelled as *cracks* or *fractures* did not gain marks.

Teaching Tip
Using a photograph projected onto a whiteboard is ideal for class work with students finding as many features to label as possible and drawing over the photograph the main features for the sketch. There is a very good range of geological photographs on the internet which allows a lot of skills work to improve this question.

(b) The photograph of a fault breccia was ignored by some candidates who answered from theory and wrote about mylonite. Others ignored the question that told them it was along a fault and identified it as an igneous rock. In order to get full marks reference had to be made to the white mineral which cements the rock fragments together.

(c) This question was often done well but there was a tail end of students who have very little experience of practical work or did not realise that this was a question about the tests that can be used to identify minerals.
Three characteristics can commonly identify a white mineral. The acid used to identify calcite is hydrochloric and not sulphuric.

Question 5

This question was synoptic on 2834 and most candidates were prepared for questions on fossils. Some excellent answers to this question until they reached the part on goniatites! Many candidates will have completed the palaeontology paper just before this one and they are well prepared and informed.

(a)(i) The identification of fossils was very good with many gaining full marks. A few candidates ignored the description and used the term *scleractinian* or just *coral* instead of *rugose coral.*

(ii) Some candidates identified the rock just as *sedimentary* rather than as a *limestone.*

(iii) Good responses with most candidates having a clear appreciation of the shallow marine environment using the corals as the main form of evidence. However just writing a list of *warm, shallow sea* is not a description that will score full marks. The number of lines provided is a good indication of the amount of detail required.

(b) Goniatites are not well recognised – marks were given for the 'special' individual properties that mark it out as a goniatite rather than a description that would fit any ammonoid. The drawings therefore needed to show a simple goniatitic suture rather than complex ammonitic. Some candidates drew a gastropod instead.

2833 and 2836: Coursework

General Comments

This year a lot of the coursework seen was of a high standard and it is clear that many centres are now much more confident at interpreting the mark descriptors. Marks this year did show a significant increase compared with previous sessions and as a result the A/B boundary was raised by two marks. Even with this adjustment, over 39% of candidates still achieved a grade A in 2836.

This year many members of the moderating team had received their packages well before the deadline of May 15th – thank you. It is very helpful at the initial moderating meeting to have a wide range of material to use and it also allows moderators to get through the work more quickly, speeding up the whole administration process and allowing the early identification of any problems.

There were, however, still a few issues. The most common problems this year were missing forms and transcription errors between student cover sheets, coursework summary sheets and MS1 sheets. Many of these were spotted quite early on but a number of centres did not respond to the documentation requests resulting in several calls to the centres involved.

This also applies to the return of CW/AMEND forms which may be sent for a variety of reasons: arithmetic error, errors in copying across marks or invalid order of merits where the moderator disagrees with the rank order of the candidates within a centre. In all these cases, the marks for the whole centre cannot be processed until the signed form is returned. There are clear instructions included on these forms as to what needs changing or sending on and a moderator will include their contact details in case of any queries.

The Centre Authentication Sheet requires the teachers responsible for marking the coursework to sign, stating that the coursework was the candidates' own work. This form must be sent with the coursework, whilst the sheets signed by the candidates should be retained by the centre in case of future queries. Copies of these sheets are despatched to centres in the spring and can also be downloaded from the OCR website.

The general pattern is still for most AS work to be laboratory based such as sieving investigations and lava simulations – that are growing in popularity and complexity - or porosity and permeability experiments.

It should be noted that some centres are still submitting purely computer based research, usually on earthquakes. Unless these are very carefully planned to meet all descriptors, they can often fall short of many of the descriptors, as fair testing, variables to control/vary and safety are often missed for skill P, whilst for skill A the statistical part for A5a is often omitted. Sadly for the candidates involved this can result in large downward reductions especially if two skills are involved.

Some centres do carry out fieldwork. The most successful activities are when the candidates have done a reasonable amount of geology and can make appropriate linkages between the theory and what they are seeing, which usually means later in the spring term. A few centres did their work very early on and it was quite obvious that many candidates had not yet fully gained the skills necessary to make the most of field work observations and techniques, often falling short on some of the higher level descriptors. These candidates may benefit from trial runs to test methods, followed by discussions and amendments to their plans so that they can be more focussed for the real sites to be used.

At A2 most centres carry out fieldwork to a very impressive level. *Cooks tours* of far flung locations can be difficult to use for assessment. They may have a good range of field descriptions but they are very disjointed with little in terms of analysis and mathematical components for A5a. This can give only superficial coursework, and whilst this is excellent for studying geology in the field, a more carefully crafted item for coursework may be needed. Teachers may need to adjust the tour to allow candidates longer at specific sites in order to develop plans, collect data and then carry out worthwhile analysis

Comments on Individual Skills

Skill P

It was noted that many centres are now using this section as a working plan, which is written in advance with preliminary experiments being used and then amended and evaluated for the proper run through. Many centres produced some really excellent evaluations of these initial plans, showing some good considered logic. This gives candidates an ideal chance to identify variables, to state which controls should be put in place, and enables them to evaluate clearly their method and equipment.

Many good predictions, with reasoning for the choices are being put forward, giving geology coursework a scientific approach. Other centres are using hypotheses very well. There is no compulsion to use Null and alternative hypotheses, but centres may wish to do this.

A few centres are still giving all their candidates a vague title which is all they then base their plan upon e.g. “I will study the geology of the Lulworth cove area” is a particularly common one, which fails to allow candidates to fully develop P3a which requires candidates to: *develop a question or problem using scientific knowledge and understanding, identifies the key factors to vary, control or take account of*. If this is not covered, then marks for Skill P could be reduced to 2, as P3a would be incomplete.

Teaching Tip

Before starting the coursework give candidate an A4 sheet, with a variety of questions to help them through the planning stages of skill P. For example, questions could include;

- What hypothesis will you be studying?
- What reasons can you give for this choice?
- What secondary sources will you use to help you research this hypothesis?
- What equipment might you need? Why do you need it?
- Do you need a trial run?
- How do you plan to carry out this method?
- What data will you collect and how many times will you collect it?
-

A quick look through this A4 “crib sheet” will enable the teacher to check that the candidate is on the right lines. It also helps to alleviate the problem of friends having the same hypothesis. A few centres this year had every candidate with exactly the same wording for their hypothesis! This can potentially create plagiarism issues.

P5a still needs both safety and background detail to be included. Many centres are using a preliminary experiment which is fine, as long as it is clearly worked into the plan and not left as a standalone section.

P7a needs evidence of a bibliography or for the candidate to quote sources directly in the text. This information must then be incorporated/and evaluated into the strategy.

P7b still causes problems, but if a preliminary experiment is carried out this becomes much easier to do, as changes to the original plan can be highlighted and reasons for the changes can be justified in terms of increasing the precision and reliability.

Teaching Tip
Get the candidates to use the wording of the mark descriptors eg for P7b they should say how they can make it more reliable and how they can get their results to be more precise.

Skill I
There is evidence of a lot of very good data / information being collected for coursework and this is true for both lab and field based exercises. Computer exercises can struggle here.

Many centres are still sending chunky notebooks. Please either tear out or photocopy the relevant pages as this saves on postage and makes it easier for the work to be understood if only the relevant sheets are included.
Many centres are now including tick sheets to show where candidates are getting marks and more importantly what they are failing to do.

This year there was a major issue which several moderators came up against, where every candidate in a centre was given 7 for skill I when clearly there was a huge range in quality. It was felt by some that not enough explanation was given to justify why 7 was given. In these cases skill I had to be adjusted down, sometimes by quite a lot if there was virtually no evidence of this. There must be evidence that a skill has been attempted. Several centres this year gave some of their candidates 8 for this skill, when 7 is the maximum

Teaching Tip
Many centres use scaled graphic logs for skill I and A. There must be a clear scale up the side of the log for bed thickness and a clear grain size scale.
Some centres were over ambitious and it is not reasonable, and often not safe for candidates to log accurately, or say they did, a cliff of 10m or more in height! A much more accurate log can be carried out when a few metres of rock are involved, as long as there are sufficient lithological changes to be recorded. The other time when logging can work is when beds are inclined and exposed as a section along a coastline or in a quarry (the log in the 2836 report shows use of standard symbols and scales).

Skill A
This skill has improved with many centres planning good opportunities for candidates to score well. However for a few centres there are severe problems, where most candidates were given 7/8 and yet the work was barely reaching descriptors A3a and A3b. This resulted in some large downward adjustments for a small number of centres. A7a and b really cannot be awarded for a simple sentence, for example some centres were giving 7/8 for a candidate taking a coefficient of sorting reading and suggesting it was a desert sand because it was red and well sorted.

Problem descriptors are the same as in previous years; A3a needs graphs, - rose diagrams are acceptable here. Photos alone are not sufficient, though if annotated they can help with A1a, a1b or A3b. A5a requires some advanced mathematical manipulation. Calculation of averages, modes etc is not sufficient and other statistical tests should be employed such as Chi squared, Spearman’s rank correlation or standard deviation. These saw an upsurge in popularity this year, all done to a good standard. However there is no compulsion for statistical tests to be done and there are geology based alternatives

Geological maps are also a good way of covering Skill A, although the plotting of just one or two dips and strikes is not sufficient. If using a photocopy of an OS map, a range of things should be put onto the map which tests the skills of the candidate in applying location rules and by trying to mark on appropriate thicknesses of units etc. One dyke, as was often done at Praa Sands is not sufficient. Strikes can be plotted accurately to north; thickness of beds can be shown measured from the fieldwork carried out in skill I.

Simple to-scale maps on blank pieces of paper or on simple base maps to plot bearings of faults, dykes, sills, thicknesses of sedimentary units etc all work well as the candidate has to employ an accurate mathematical scale.

For A3b through to A7a and b an increasing amount of detail needs to be used. A couple of sentences cannot be awarded level 7 , - it will achieve A3b. A5b requires yet more detail in at least a paragraph, as this will allow the candidate to achieve 5/6 marks out of 8 which equates to upper 60-75%, equivalent of a high grade. 8 should be reserved for work of an exceptional quality which exceeds all of the previous descriptors.

At A2 there is a reminder that synoptic evidence needs to be included. To achieve A7a and b (the same also goes for skill P) there needs to be reference to work from both the AS modules (2831, 2833 and 2833) and the A2 (2834 and 2835).

Skill E

This is still the weakest skill with many candidates giving it much less attention than the other skills. Often there are only brief mentions of the suitability of the methods with a few comments about improvements. It can often look as if the candidate has rushed this section, or been very relieved to get to the end!

Teaching Tip

If the coursework has "answers" make sure that the previous skills have been marked and the correct findings have been discussed, so that the candidates are aware of what errors if any they have made. This makes it much easier to comment upon areas like E5b, the reliability of their evidence and E7b how significant the uncertainties in their evidence were on their final result / findings. This works especially well with sieving, when candidates can make much informed comments about the accuracy of their measurements/method if they know how many out of the 4 or 5 sands sampled they got correct.

Another "crib" sheet could be used to focus their attention onto the crucial areas.

- Which parts of your **method** worked well, why?
- Where any results not what you expected, why? They must use the word *anomalies*!
- Which parts of the method did not work and caused limitations?
- How did errors creep into your data collection?
- How could you improve the method, how could you get more reliable results?
- Did your errors make any impact upon the results gained?

This sheet could again be scrutinised so that the areas can be checked for suitability and to make sure that no descriptors were missed out. This would help to structure Skill E to ensure it gains marks as high as the other skills.

Grade Thresholds

Advanced GCE (Geology) (3884, 7884)
June 2008 Examination Series

Unit Threshold Marks

Unit		Maximum Mark	a	b	c	d	e	u
2831	Raw	60	42	36	31	26	21	0
	UMS	90	72	63	54	45	36	0
2832	Raw	60	48	42	36	31	26	0
	UMS	90	72	63	54	45	36	0
2833	Raw	120	97	85	73	61	49	0
	UMS	120	96	84	72	60	48	0
2834	Raw	90	67	58	50	42	34	0
	UMS	90	72	63	54	45	36	0
2835	Raw	90	59	51	43	36	29	0
	UMS	90	72	63	54	45	36	0
2836	Raw	120	97	85	74	63	52	0
	UMS	120	96	84	72	60	48	0

Specification Aggregation Results

Overall threshold marks in UMS (ie after conversion of raw marks to uniform marks)

	Maximum Mark	A	B	C	D	E	U
3884	300	240	210	180	150	120	0
7884	600	480	420	360	300	240	0

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

	A	B	C	D	E	U	Total Number of Candidates
3884	17.7	40.3	61.3	79.1	91.5	100.0	1143
7884	25.8	50.1	72.8	88.9	97.2	100.0	839

1982 candidates aggregated this series

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

Statistics are correct at the time of publication.

OCR (Oxford Cambridge and RSA Examinations)
1 Hills Road
Cambridge
CB1 2EU

OCR Customer Contact Centre

14 – 19 Qualifications (General)
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Facsimile: 01223 552627
Email: general.qualifications@ocr.org.uk

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