GCE

Geology

H414/03: Practical skills in geology

Advanced GCE

Mark Scheme for November 2020

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Annotations available in RM Assessor

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	Error carried forward
	Level 1
	Level 2
	Level 3
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Abbreviations, annotations and conventions used in the detailed Mark Scheme (to include abbreviations and subject-specific conventions).

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IGNORE	Statements which are irrelevant
ALLOW	Answers that can be accepted
( )	Words which are not essential to gain credit
__	Underlined words must be present in answer to score a mark
ECF	Error carried forward
AW	Alternative wording
ORA	Or reverse argument

Subject-specific Marking Instructions

INTRODUCTION

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

You should ensure that you have copies of these materials.

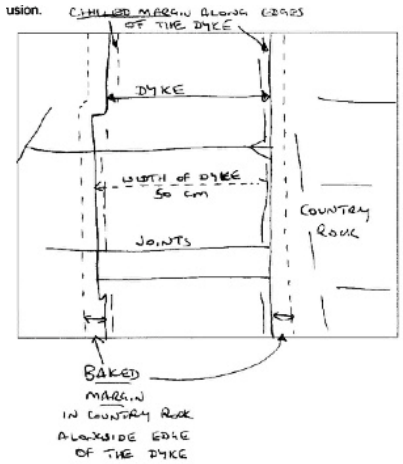
You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

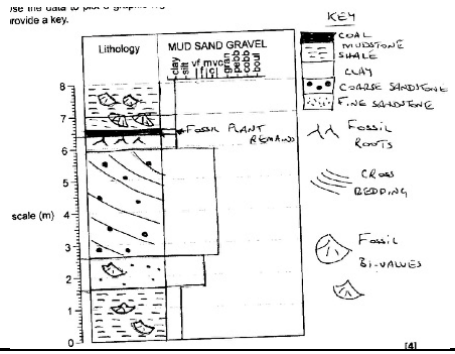
Question			Answer	Mark	AO element	Guidance
1	(a)	(i)	Schistosity / Schistose banding ✓ Gneissosity / Gneissose Banding ✓	1	1.1a	**ALLOW** foliation
1	(a)	(ii)	Gneiss ✓ Schist ✓	1	1.1a	
1	(b)	(i)	A – Four equal sized arrows from top, bottom, left and right / four equal sized arrows in any direction but the arrows should be 90 degrees apart OR no arrows to signify contact metamorphism and no pressure AND B – some attempt to show understanding of principle stress directions ✓	1	2.1b	**ALLOW** arrows that are different sizes to indicate maximum and minimum on B **ALLOW** 2 maximum stress arrows from EITHER top and bottom OR top left and bottom right OR top right and bottom left on B **DO NOT ALLOW** 2 maximum stress arrows from the left and right on B **ALLOW** less than 4 direction arrows on A if B is correct **ALLOW** on B 2 maximum stress arrows if labelled correctly
1	(b)	(ii)	A ✓	1	1.1a	**ALLOW** B as correct ONLY if the arrows on fig 1.2 show a maximum stress direction for A and no maximum stress direction for B OR no maximum stress directions for A or B
1	(c)		muscovite ✓ parallel ✓ quartz ✓	3	1.1a	

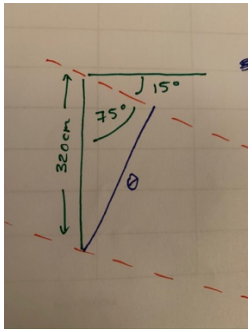
Question			Answer	Mark	AO element	Guidance
2	(a)*		Refer to marking instructions on page 5 of mark scheme for guidance on marking this question. **Level 3 (5–6 marks)** A detailed evaluation and judgement of igneous rock identification including texture, crystal size and mineralogy and how they can be used in the field. Answers may include reference to crystal shape in relation to cooling *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** A detailed discussion of igneous rock identification including texture, crystal size and mineralogy and possibly how they can be used in the field. A full evaluation may not be included and / or not all of the identifying properties discussed. *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** A discussion of igneous rock identification including at least one of texture, crystal size or mineralogy. *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* **0 marks** *No response or no response worthy of credit.*	6	3.1c 2.1b 1.1c	**AO3.1c: Evaluates geological information, ideas and evidence** discusses issues with reference to igneous rocks, for example: silica % cannot be identified in the field / difficult to identify if rocks have been exposed and weathered / fined grained igneous rocks have crystals that are too small to measure / have interlocking crystals **AO2.1b: Apply knowledge and understanding of geological skills and techniques** recognises that some difficulties occur, for example: some minerals may be difficult to identify **AO1.1c: Demonstrates knowledge and understanding of geological ideas** Silicic or felsic / light coloured / leucocratic / quartz / feldspars / micas Intermediate / medium colour / mesocratic / hornblende / amphibole / biotite / feldspars Mafic / dark coloured / melanocratic / augite / pyroxene / feldspars / olivine Ultramafic / olivine / augite / pyroxene Glassy / obsidian Intrusive / plutonic / coarser Extrusive / finer / too small to see / vesicles / amygdales Porphyritic / vesicular / amygdaloidal / equigranular OR equicrystalline / ophitic fine grained (<1mm) medium grained (1mm-5mm) coarse grained (>5mm) rocks are crystalline

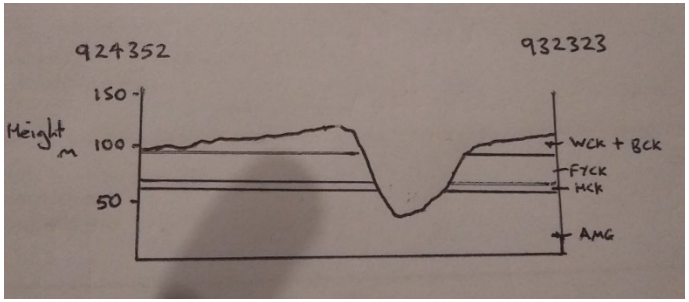
Question			Answer	Mark	AO element	Guidance
						the crystals might be different sizes and shapes / euhedral / Subhedral / anhedral the crystals may be different colours **DO NOT ALLOW** answers which explain why the rock is not sedimentary or metamorphic

Question			Answer	Mark	AO element	Guidance
2	(b)	(i)	Porphyritic texture / large pink crystals / phenocrysts surrounded by smaller crystals / feldspar phenocrysts ✓ Groundmass / mixture of black, white and clear crystals / different minerals / 2 named minerals from quartz, mica and feldspar ✓ Subhedral and anhedral crystals ✓	2	3.1a	**ALLOW** Euhedral **ALLOW** well-formed and moderately well-formed crystals
2	(b)	(ii)	Accurately measures the crystals 26 +28+24+18+27 mm✓ Calculate mean crystal size: 25 mm answer should be converted to mm✓	2	1.1d	**ALLOW** +/- 2mm **ALLOW** +/- 2mm **ALLOW** a correct mean calculation in cm if the 5 crystals had been measured in cm as ecf
2	(b)	(iii)	Granite ✓	1	3.1b	
2	(c)	(i)	Dyke ✓	1	1.1b	
	(c)	(ii)	*Any three:* Baked margin identified in country rock AND chilled margin identified in dyke ✓ Dyke AND country rock identified / (contact) metamorphic rock ✓ Joints within the igneous rock OR within the country rock✓ Any valid measurement indicated on sketch ✓	3	1.1b	

Question			Answer	Mark	AO element	Guidance
3	(a)	(i)	4270 kg/m^3 ✓✓✓ OR 85.343 / 19.97 = 4.274 ✓ 4.274 x 1000 = 4273.56 ✓	3	2.1b	**AWARD** 3 marks for correct answer **ALLOW** 2 marks max for incorrect sig. figs OR errors in one of the stages
3	(a)	(ii)	samples may contain fractures / porosity which reduces the density ✓ mineral sample may not be pure / different minerals might be present ✓	1	3.1f	**DO NOT ALLOW** answers referring to human error
3	(a)	(iii)	avoid water spillage **AND** slip hazard **OR** water getting into electrical sockets / electrical equipment ✓	1	1.1d	**DO NOT ALLOW** if not related directly to experiment e.g. do not credit falling over bags / tying back hair / general lab safety
3	(b)	(i)	Mineral A: Galena AND Mineral C: Calcite AND Mineral D: Magnetite ✓	1	3.1b	Need all three for mark
3	(b)	(ii)	Tastes like salt / soluble in water / carry out density test to identify <u>low</u> density ✓	1	1.1c	
3	(c)		Use reference material e.g. fingernail / copper coin / steel nail / glass OR mineral from Moh's hardness kit to scratch surface of unknown mineral ✓ <u>Harder</u> reference material / mineral scratches surface AND <u>softer</u> material / mineral leaves no scratch / a streak on the surface ✓ Quotes accurate hardness values for identified materials / minerals AND unknown mineral ✓ Repeat tests to confirm answer ✓	3	1.1d	**ALLOW** 1 mark max for a general reference to use of different named hardness items to ascertain hardness

Question			Answer	Mark	AO element	Guidance
4	(a)	(i)	Bed thickness plotted correctly ✓ Lithology indicated in column two using correct symbols e.g. stipples for sandstone, brickwork for limestone etc ✓ Grain sizes plotted correctly ✓ Key provided to show features **OR** log annotated with features (fossils and sedimentary structures) ✓	4	2.1b	**ALLOW** one incorrect plot for thickness **OR** grain size for maximum marks **ALLOW** a max of 3 marks if the log is drawn 'upside down' 
		(ii)	Identification of a deltaic / delta environment / associated with delta location / meandering river with islands ✓ Shallowing up sequence described / progradation of delta / coarsening upward sequence ✓ Reference to low energy pro delta/ bottom set beds at the start / end of the sequence referring to fine grained sediment / marine fossils ✓ Thinly bedded sandstones indicate an increase in energy / delta front / fore set beds ✓ Cross bedded sandstone indicates higher energy water / delta top / channel lag deposit / top set beds / distributary channel / uni- directional current ✓ Presence of coal / rootlets / plant remains means land / relative sea level fall / islands / swamps / delta top / top set beds✓ Cyclothem identified and explained / recognises sea level changes / sequence begin again ✓ Diachronous boundaries / vertical succession of facies representing sedimentary environments that once existed side by side and migrated over one another / Walther's Law explained ✓	4	3.1e	**ALLOW** a description beginning with the youngest event if the log was inverted in 4ai
Question			**Answer**	**Mark**	**AO element**	**Guidance**

4	(b)	(i)	Direction of water flow determined / cross bedding is preserved on the leeward side / more steeply dipping side of the ripple / cross bedding points in the direction of flow ✓ Compass aligned with flow direction and dial turned to line up red arrows and trend read off at the top ✓	2	3.1b	Mark diagrams as text.
		(ii)	T = 309cm ✓✓✓ Apparent thickness: 320cm Angle of dip (α): 15° True thickness (T) cosine α =T/VT therefore: T = VT x cos 15 T = 320 x 0.966 T = 309.12cm ✓✓✓	3	2.1b	Sin = opposite / hypotenuse Sin 75 = θ / 320 Sin 75 X 320 = θ true thickness Sin 75 X 320 = true thickness = 309.09 cm  **ALLOW** range of 309 - 309.12

Question			Answer	Mark	AO element	Guidance
5	(a)	(i)	Plotting of relevant beds on both sides of the valley ✓ Plotting of beds dip close to horizontal ✓ Extrapolation of Jurassic beds under Cretaceous indicated ✓ Key / correct labelling of rocks present ✓ Accurate location of drift deposits ✓	3	2.1b 3.1c	Dip arrows of 3° and 8° occur close to the line of section. **ALLOW** a dip on the cross section between 0° - 10° 
5	(a)	(ii)	(Principle of) superposition ✓	1	2.1a	
5	(a)	(iii)	926335 ✓	1	2.1a	**ALLOW** some margin of error in location of AMG within grid square 9233
5	(b)	(i)	5.67 years ✓	1	2.1a	3 400 000 / 600 000 **ALLOW** 5.7 OR 5.66 recurring
		(ii)	200,000 tonnes per hectare ✓	1	2.1b	3 400 000 / 17

Question			Answer	Mark	AO element	Guidance
5	(b)	(iii)*	Refer to marking instructions on page 5 of mark scheme for guidance on marking this question. **Level 3 (5–6 marks)** A detailed analysis of the geological issues that may be encountered. A reasoned conclusion based on identification of relevant features from the map and evaluation of risk, linking to detailed application of understanding of the geological hazards is given. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** An analysis of the geological issues that may be encountered. A conclusion based on identification of relevant features from the map and linking to application of understanding of some geological hazards is given. Achieved if there is no clear conclusion but the geology is detailed and reasoned *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** A discussion of the geological issues that may be encountered. A conclusion may not be provided **OR** where a conclusion is provided, may not clearly link to relevant features from the map or an understanding of geological hazards. *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.*	6	3.1a 3.1c 3.1d	**AO3.1a Analyse information, ideas and evidence** Analyse geological information on map - mainly low lying land near site identified Identification of water as a potential issue in quarrying relating to swelling clays **AO3.1c Evaluate geological information, ideas and evidence** Geological issues include: • loss of a finite resource • variable proportions of sand and gravel affecting economic viable • volume of resource • changes to groundwater flow / lowering of the water table • flood risk at the site as low lying / impermeable rock in places • soft unconsolidated material some with high porosity / high permeability • pollution to groundwater • issue of potential instability in quarry sides • potential presence of faults leading to instability issues Environmental issue; • increased traffic on minor roads could lead to road damage / subsidence / load bearing strain on roads **AO3.1d Make judgements** Gives geological reasons why the quarry should or should not be allowed planning permission, matched with reasoned observations to include reference to location and environmental issues

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			0 marks *No response or no response worthy of credit*			
5	**c**		extreme depth would make mining difficult ✓ possible collapse / subsidence due to relatively weak overlying sedimentary rocks ✓ waterlogging / flooding due to porous sandstones and chalks ✓ possibility of ancient buried faults / faults could be re-activated making mining dangerous ✓ Faults could cause displacement of the coal seam and make extraction more difficult / could allow water into the potential mine ✓	**2**	**3.1e**	**IGNORE** non-geological factors

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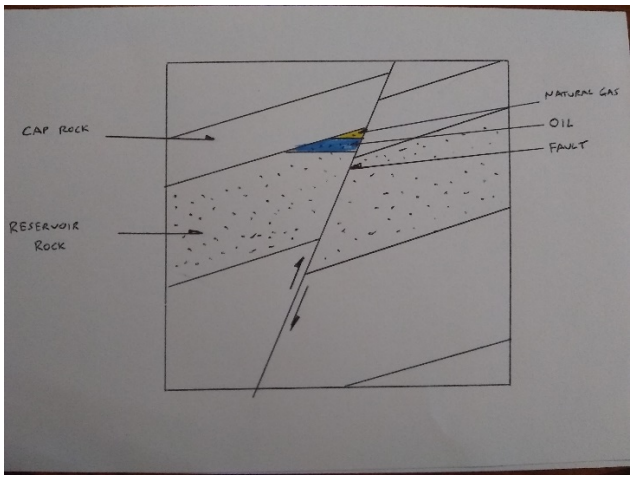
1	(a)	i	55-60(cm) ✓	1	AO2.1b	+/- 5cm as there is a slight variation in throw between different beds
1	(a)	ii	45(°) ✓	1	AO2.1b	+/- 5°
1	(a)	iii	25(%) ✓✓ Overall length of crust before faulting = 200cm Overall length of crust after faulting = 250cm $\frac{250}{200}$ =1.25 Therefore extension is 25% **OR** 50cm +/- 5 cm ✓✓	2	AO2.1b	**ACCEPT** answers given in cm **ACCEPT** Measurement to show the extension of rocks along the fault is in the region of 1.5cm as measured on the photo for 1 mark
1	(b)	i	Appropriate diagram showing a fault trap ✓ **AND** Any three correct labels: ✓✓✓ Cap rock Reservoir rock Fault plane Oil and/or Gas	4	AO1.1c	**DO NOT ALLOW** Impermeable rock instead of Cap rock **OR** Permeable rock instead of Reservoir rock 

Question			Answer	Mark	AO element	Guidance
1	(b)	ii	Description of how Oil and Gas can be destroyed if the temperature increases above 200°C OR Loss of Oil and Gas by erosion and removal of overlying caprock OR Loss of Oil and Gas by migration along an unsealed fault plane / fault movement can increase permeability along fault plane	1	AO1.1a	**DO NOT ALLOW** Migration up fault without reason
1	(b)	iii	Any **two** oil traps from: Lithological trap Anticline trap Unconformity trap Salt Dome trap ✓✓	1	AO1.1a	**DO NOT ALLOW** Fault trap **ALLOW** Antiform trap
1	(c)	i	Labels correct on both axes **AND** Units correct on x and y-axis **AND** sensible scales used ✓ ALL points plotted correctly **AND** line of best fit included ✓	2	AO2.1	**ALLOW 1** mark max if axes are reversed. A**LLOW** 1 plotting error if line of best fit is included **ALLOW** if 6 accurate points are plotted but no Line of Best Fit **DO NOT ALLOW** no line of best fit with only 5 points correctly plotted

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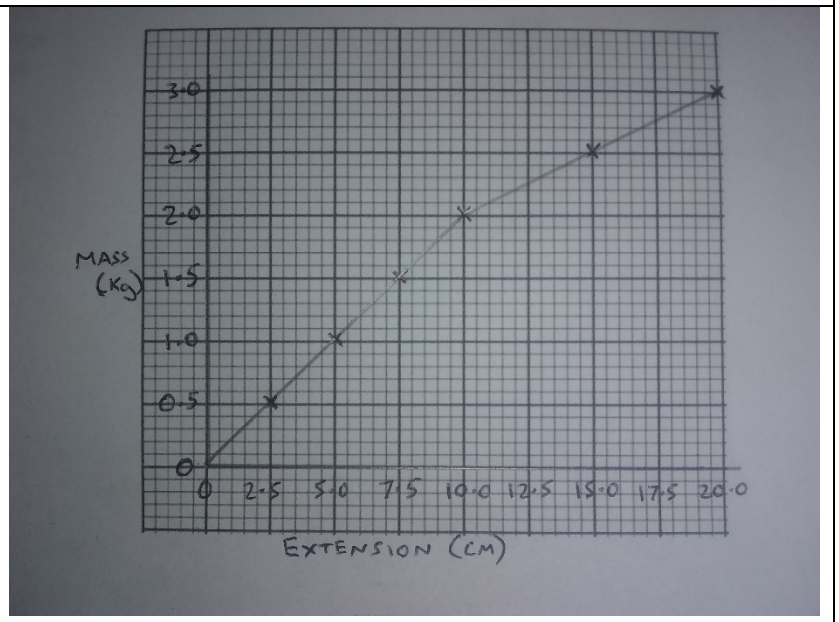
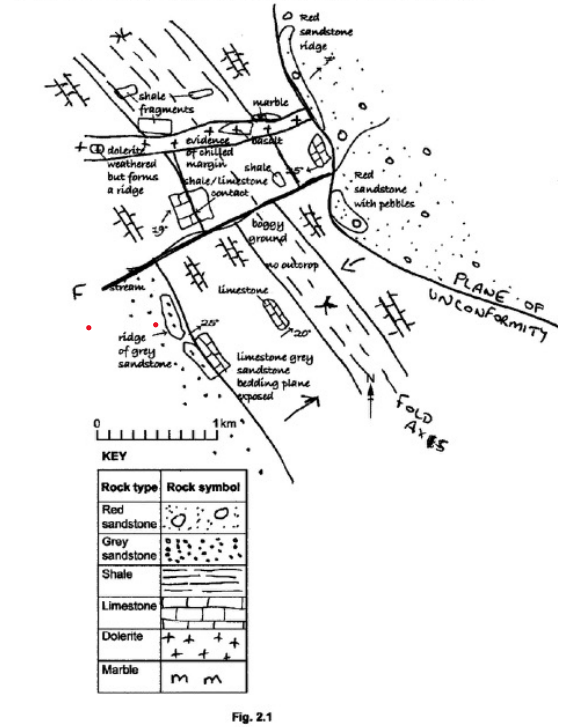
						
1	(c)	ii	Elastic deformation labelled correctly in the zone below 2Kg and 10cm ✓ Elastic limit labelled correctly at 2Kg and 10cm ✓	2	AO2.1b	**DO NOT ALLOW** Elastic deformation to be labelled with one arrow to a single point it MUST be shown as a range, for all or part of the line, using brackets or arrows
1	(c)	iii	A line drawn below the initial plotted line, clearly labelled **T** ✓	1	AO3.1f	If the axes are drawn the wrong way round the line T should plot above the line of points already plotted

Question			Answer	Mark	AO element	Guidance
1	(c)	iv	The measurement of extension in cm for each mass was accurate to ± 0.05cm ✓ **OR** Uncertainty is an estimate attached to a measurement which characterises the range of values within which the true value lies ✓	1	AO2.1a	**ALLOW** examples e.g. for 0.5kg Mass, the extension is a figure between 2.45cm and 2.55cm.
1	(c)	v	Stress is the term used to describe the forces applied to a rock (by Earth movements or the weight of overlying rocks) ✓ **OR** Stress is the force (per unit area) acting upon a rock ✓	1	AO2.1b	**ALLOW** reference to an external force acting upon a rock

Question			Answer	Mark	AO element	Guidance
2	(a)		~~B~~oundaries between rock types ✓ Suitable key with correct symbols for rock types ✓ *Any two from:* Correctly drawn fault along the stream ✓ Dyke marked in the North part of the map orientated East-West ✓ Clear indication of the fold structure (synform / syncline) with dip arrows or labels ✓ Metamorphic marble drawn next to dyke ✓ Plane of unconformity / unconformable Sandstone ✓	4	**AO2.1b** **AO3.1a**	**ALLOW** some difference in the positions of the boundaries from the drawn map providing outcropping areas are correctly drawn **OR** a correct more complex solution. **ALLOW** one plotting error of rock type on key **ALLOW** different widths / lengths of dyke providing the orientation is roughly east-west

Question			Answer	Mark	AO element	Guidance
						6 The sketch map below, **Fig. 2.1**, is taken from an A Level Geology student's field notebook.  Fig. 2.1
2	**(b)**		**Any three from:** Erosion / Weathering Transportation Deposition / sedimentation Compaction / lithification / cementation / diagenesis ✓	**1**	**AO2.1a**	

Question			Answer	Mark	AO element	Guidance
2	(c)		Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question. **Level 3 (5–6 marks)** Gives a detailed outline of the steps required to produce an accurate graphic log, linking rock types to detailed application of knowledge and understanding of Deltaic environments, their associated sediments and deltaic structure, as well as geological fieldwork techniques, including the need for safe working practices. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** Gives an outline of some of the steps required to produce a graphic log, linking to the demonstration of some knowledge of Deltaic environments and their associated sediments and structure as well as geological fieldwork techniques including some reference to safe working practices. *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** Gives a basic outline of some of the steps required to produce a graphic log, there are links to demonstrate some knowledge of Deltaic environments and geological fieldwork techniques, but these are relatively basic. Only one of the two sections may be covered (either fieldwork technique or knowledge of deltaic environments) *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.*	6	**AO1** **AO2** **AO3**	**AO1.1 - Demonstrate knowledge and understanding of geological skills and techniques** • discusses safe working practices in the field especially if in a coastal location • reports on trends in orientation • fossils mentioned but not identified • reference to beds and bedding planes • Describes how to use a compass clinometer to take dip and strike readings. • Describes how to use a compass clinometer to take dip and dip direction readings. • Describes how to measure flow directions using sedimentary structures or linear data commonly found in a deltaic environment. • Able to link rock types and sedimentary structures to deltaic sequences. E.g. Delta top channel sandstones with asymmetrical ripples, seat earths and coal. Delta front sandstones with marine fossils and symmetrical ripples, siltstones. Pro delta limestone or shale **AO2.1b - Apply knowledge and understanding of geological skills and techniques** • bed thickness measured accurately and consistently using appropriate equipment. • uses standard symbols • sketches sedimentary structures • Links the Rock types and structures seen to the associated parts within a deltaic sequence.

Question			Answer	Mark	AO element	Guidance
			0 marks *No response or no response worthy of credit.*			• Recognises repeated beds such a deltaic cyclothem sequence. • 3 S's: grain size; shape; sorting • 3 C's: colour; composition and cement **AO3.1a, b and c – Analyse, Interpret and Evaluate geological ideas, information and evidence** • Able to link rock types and sedimentary structures to deltaic sequences. E.g. Delta top channel sandstones with asymmetrical ripples, seat earths and coal. Delta front sandstones with marine fossils and symmetrical ripples, siltstones. Pro delta limestone or shale **AO3.1d – Make judgements** • Able to make the judgement that the rock types are linked to a deltaic sequence. **AO3.1e – Draw conclusions** • Able to conclude that the sequence described is of Deltaic origin.

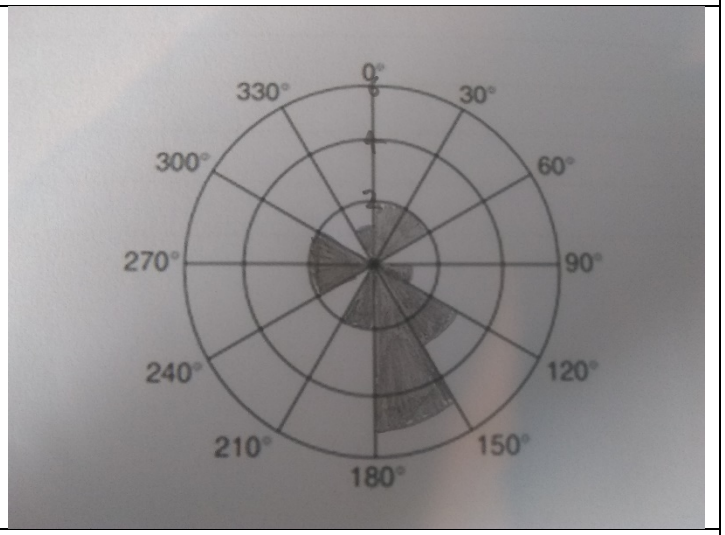
<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Mark</th><th>AO element</th><th>Guidance</th></tr>
<tr><td>3</td><td>(a)</td><td>i</td><td>Asymmetrical ripples ✓</td><td>1</td><td>AO3.1b</td><td>DO NOT ALLOW ripples</td></tr>
<tr><td>3</td><td>(a)</td><td>ii</td><td>Flute casts are deepest AND widest at their proximal end/closest to their source/ get narrower AND shallower with distance from their source/distal end ✓

Flute casts are erosional features scoured / eroded by a turbidity current / eddy current as it flows across the seabed / fine grained sediment from previous flows ✓
OR
As the turbidity current loses energy coarse sediment / sand sized sediment is deposited in the eroded cast which helps to preserve it ✓</td><td>2</td><td>AO1.1b</td><td>ALLOW answer as an annotated diagram</td></tr>
<tr><td>3</td><td>(b)</td><td>i</td><td><table><tr><th>Orientation (Degrees)</th><th>Number of observations</th><th>Orientation (Degrees)</th><th>Number of observations</th></tr><tr><td>1-30</td><td>2</td><td>181-210</td><td>2</td></tr><tr><td>31-60</td><td>2</td><td>211-240</td><td>0</td></tr><tr><td>61-90</td><td>0</td><td>241-270</td><td>2</td></tr><tr><td>91-120</td><td>1</td><td>271-300</td><td>2</td></tr><tr><td>121-150</td><td>3</td><td>301-330</td><td>0</td></tr><tr><td>151-180</td><td>5</td><td>331-360</td><td>1</td></tr></table>✓✓</td><td>2</td><td>AO2.1b</td><td>ALLOW as a tally chart instead of numbers

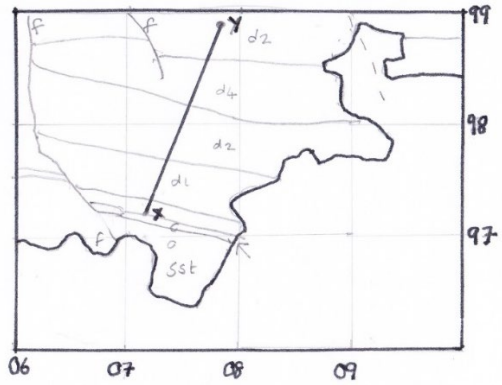
ALLOW 1 mark if there is one error</td></tr>
<tr><td>3</td><td>(b)</td><td>ii</td><td>Suitable scale clearly marked along one of the spokes of the rose diagram ✓

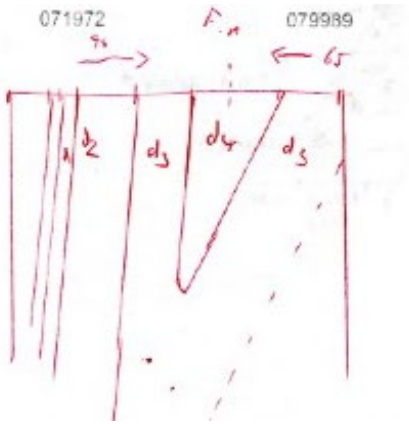
Data plotted correctly ✓</td><td>2</td><td>AO3.1a</td><td>DO NOT ALLOW Diagram plotted equally on both sides.

ALLOW ECF</td></tr>
</table>

Question			Answer	Mark	AO element	Guidance
						
3	(b)	iii	Main direction SSE/SE ✓	1	AO3.1b	**ALLOW** answers given as a compass direction e.g. SSE-Between 151 – 180 (degrees)
3	(b)	iv	Between 151 – 180 degrees ✓	1	AO2.1b	
3	(c)		**Level 3 (5–6 marks)** Gives a detailed description of a practical design and procedures which demonstrates good knowledge and understanding of geological ideas. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** Gives a description of a practical including some of the necessary procedures. Some knowledge of geological ideas is demonstrated. *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** Gives a simple description of a practical including a simple procedure which demonstrates a basic knowledge of geological ideas.	6	AO1 AO3	**AO1.1a - Demonstrate knowledge of geological ideas** • Links flow direction to formation of Turbidity currents • States preserved sedimentary structures formed by same processes. **AO1.1c - Demonstrate understanding of geological ideas** • Links Turbidites with formation of graded bedding • references sedimentary structures and way up criteria **AO3.1f - Develop and refine practical design and procedures** • recognises need for repetition

Question	Answer	Mark	AO element	Guidance
	There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant. **0 marks** *No response or no response worthy of credit.*			• discusses safe working practices • discusses experimental procedure • simple experiment only • example of simple equipment using aquarium, sloped tube / pipe clean washed sand and water • method described • recognises error • recording of data discussed. • Needs reference to introduction of a sediment laden flow, maybe from another container to be poured into the main flume/pipe

Question			Answer	Mark	AO element	Guidance
4	(a)		A labelled fault in the correct position dissecting the shale and limestone in 0699 - 0798 ✓ A labelled fault at the correct position in the sandstone and marl in 0697 ✓ The surface geological boundary between the Old Red Sandstone and younger sediments offset at the fault ✓	3	AO3.1a AO3.1b	**ALLOW** rock types as labels or drawn as a key with appropriate symbols **ALLOW** plotting tolerance of 0.2 Km (5mm) using map scale **ALLOW** fault in 0698 – 0699 to be labelled as dissecting the shale and limestone if it is not labelled for affecting the sandstone and marl 

Question			Answer	Mark	AO element	Guidance
4	(b)		Beds on the NE limb dip SW at 63 - 65 degrees ✓ Beds on the SW limb shown on the map to dip NE 95 once plotted should be just beyond vertical ✓ 3 or more beds on the cross section clearly labelled using the codes from the map insert or suitable symbols ✓	3	**AO2.1b** **AO3.1c**	**ALLOW** a tolerance of ± 5 degrees in the dip of the strata on either side of the fold structure. **ALLOW** a dip of 85-90 degrees as overturned beds may cause some confusion 

Question			Answer	Mark	AO element	Guidance
4	(c)		Any one Geophysical technique **AND** explanation from: Gravity survey (using a Gravimeter) to measure small variations in the Earths gravitational field strength **AND** A positive anomaly could be due to the presence of dense, metallic ore minerals (e.g. Haematite or Magnetite) ✓✓ Magnetic survey (using a magnetometer) to measure small variations in the Earth's magnetic field strength **AND** A positive anomaly could be due to a mafic / ultramafic intrusion containing cumulate ore deposits **OR** the presence of the mineral Magnetite ✓✓ Electromagnetic (EM) Surveys measuring ground conductivity (by the process of electromagnetic induction) **AND** Positive EM anomaly could indicate conductive materials such as metallic mineral ores ✓✓ Electrical resistivity survey measuring the resistivity of the ground (by passing an electric current between two electrodes) **AND** A lower resistivity could indicate metallic mineral ores in the ground ✓✓	**2**	**AO1.1c** **AO1.1d**	
4	(d)		Lydstep point is predominantly composed of Limestone **AND** Limestone could be chemically weathered to form caverns / voids leading to surface subsidence ✓ mitigation technique such as using reinforced raft foundations / isolating foundations of buildings from the movement of the surface with layers of PVC / sand ✓	**2**	**AO1.1d** **AO2.1b**	**1 mark for identification of the cause of subsidence** **AND** **1 mark for the mitigation method**

			Fault and Gash Breccia present at part of the headland **AND** could act as line of weakness and cause subsidence / the fault could be re-activated and the weak gash breccia could collapse causing subsidence ✓ mitigation technique could be to grout the fault to seal and strengthen it / add rock bolts across the weakened rocks of the fault zone to help stabilise them ✓			
5	**(a)**		A: Mafic ✓ B: Silicic ✓ C: Intermediate ✓ D: Ultramafic ✓	**2**	**AO3.1e**	**ALLOW** older terminology, if correctly used 2-3 correct = 1 mark 1 correct = 0 mark
5	**(b)**		**Any 4 from:** Coarse crystals / crystals over 5mm in size AND Slow cooling / time/plutonic cooling allowed large crystals to form ✓ OR Insulation effect of rock surrounding a deep intrusion keeps the Nucleation rate low, resulting in fewer crystals but larger sized crystals✓ Composed of different minerals from both parts /sides of Bowens Reaction Series / 3 named minerals from Olivine, Augite / Pyroxene or Biotite Mica, (from the Discontinuous reaction series) or Ca rich plagioclase (from the Continuous Reaction Series) ✓ Some minerals crystallised in order of the discontinuous part of Bowens reaction series with Olivine first then Augite/Pyroxene ✓ OR Olivine forms first but reacts with the surrounding magma and changes slowly to Augite/Pyroxene/ reaction of early formed Olivine which is out of phase with the magma to form augite/pyroxene/ reaction rims form ✓	**4**	**AO1.1a** **AO2.1b**	**ALLOW** most crystals are over 5mm in size **DO NOT ALLOW** the use of the term grains instead of crystals **ACCEPT** reverse argument discussing cooling rates for small crystals as long as reference is made to some crystals being larger

			Ca rich Plagioclase feldspar forms (from the continuous reaction series) shortly after olivine begins to form/ at a similar time to olivine / does not react with the magma/ continually changes composition as the magma changes/ forms zoned crystals ✓			
5	**(b)**	**ii**	**Any 1 from:** interlocking crystals increases the strength of igneous rocks ✓ as there are no spaces in between crystals they cannot be compressed / produce a strong rock ✓ there are few planes of weakness as all crystal faces are in contact with the neighbouring crystal ✓	**1**	**AO2.1a**	

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www.ocr.org.uk

GCE

Geology

H414/03: Practical skills in geology

A Level

Mark Scheme for June 2022

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

It is also responsible for developing new specifications to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support, which keep pace with the changing needs of today's society.

This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

MARKING INSTRUCTIONS

PREPARATION FOR MARKING

RM ASSESSOR

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *RM Assessor Online Training*; *OCR Essential Guide to Marking*.

2. Make sure that you have read and understood the mark scheme and the question paper for this unit.

3. Log-in to RM Assessor and mark the **required number** of practice responses ("scripts") and the **required number** of standardisation responses.

MARKING

1. Mark strictly to the mark scheme.

2. Marks awarded must relate directly to the marking criteria.

3. The schedule of dates is very important. It is essential that you meet the RM Assessor 50% and 100% (traditional 50% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.

4. If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone, email or via the RM Assessor messaging system.

5. Work crossed out:

   Crossed Out Responses
   Where a candidate has crossed out a response and provided a clear alternative then the crossed out response is not marked. Where no alternative response has been provided, examiners may give candidates the benefit of the doubt and mark the crossed out response where legible.

Rubric Error Responses – Optional Questions
Where candidates have a choice of question across a whole paper or a whole section and have provided more answers than required, then all responses are marked and the highest mark allowable within the rubric is given. Enter a mark for each question answered into RM assessor, which will select the highest mark from those awarded. *(The underlying assumption is that the candidate has penalised themselves by attempting more questions than necessary in the time allowed.)*

Multiple Choice Question Responses
When a multiple choice question has only a single, correct response and a candidate provides two responses (even if one of these responses is correct), then no mark should be awarded (as it is not possible to determine which was the first response selected by the candidate).
When a question requires candidates to select more than one option/multiple options, then local marking arrangements need to ensure consistency of approach.

Contradictory Responses
When a candidate provides contradictory responses, then no mark should be awarded, even if one of the answers is correct.

Short Answer Questions (requiring only a list by way of a response, usually worth only **one mark per response**)
Where candidates are required to provide a set number of short answer responses then only the set number of responses should be marked. The response space should be marked from left to right on each line and then line by line until the required number of responses have been considered. The remaining responses should not then be marked. Examiners will have to apply judgement as to whether a 'second response' on a line is a development of the 'first response', rather than a separate, discrete response. *(The underlying assumption is that the candidate is attempting to hedge their bets and therefore getting undue benefit rather than engaging with the question and giving the most relevant/correct responses.)*

Short Answer Questions (requiring a more developed response, worth **two or more marks**)
If the candidates are required to provide a description of, say, three items or factors and four items or factors are provided, then mark on a similar basis – that is downwards (as it is unlikely in this situation that a candidate will provide more than one response in each section of the response space.)

Longer Answer Questions (requiring a developed response)
Where candidates have provided two (or more) responses to a medium or high tariff question which only required a single (developed) response and not crossed out the first response, then only the first response should be marked. Examiners will need to apply professional judgement as to whether the second (or a subsequent) response is a 'new start' or simply a poorly expressed continuation of the first response.

6. Always check the pages (and additional objects if present) at the end of the response in case any answers have been continued there. If the

candidate has continued an answer there then add a tick to confirm that the work has been seen.

7. Award No Response (NR) if:
   - there is nothing written in the answer space

   Award Zero '0' if:
   - anything is written in the answer space and is not worthy of credit (this includes text and symbols).

   Team Leaders must confirm the correct use of the NR button with their markers before live marking commences and should check this when reviewing scripts.

8. The RM Assessor **comments box** is used by your Team Leader to explain the marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.**

   If you have any questions or comments for your Team Leader, use the phone, the RM Assessor messaging system, or email.

9. Assistant Examiners will send a brief report on the performance of candidates to their Team Leader (Supervisor) via email by the end of the marking period. The report should contain notes on particular strengths displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.

10. For answers marked by levels of response:

Read through the whole answer from start to finish, using the Level descriptors to help you decide whether it is a strong or weak answer. The indicative scientific content in the Guidance column indicates the expected parameters for candidates' answers, but be prepared to recognise and credit unexpected approaches where they show relevance. Using a 'best-fit' approach based on the skills and science content evidenced within the answer, first decide which set of level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer.

Once the level is located, award the higher or lower mark:

The higher mark should be awarded where the level descriptor has been evidenced and all aspects of the communication statement (in italics) have been met.

The lower mark should be awarded where the level descriptor has been evidenced but aspects of the communication statement (in italics) are missing.

In summary:

The skills and science content determines the level.

The communication statement determines the mark within a level.

Level of response questions on this paper are **1c and 2d**

11. Annotations available in RM Assessor

Annotation	Meaning
	Correct response
	Incorrect response
	Omission mark
	Benefit of doubt given
	Contradiction
	Rounding error
	Error in number of significant figures
	Error carried forward
	Level 1
	Level 2
	Level 3
	Benefit of doubt not given
	Noted but no credit given
	Ignore
	Blank page

12. Abbreviations, annotations and conventions used in the detailed Mark Scheme (to include abbreviations and subject-specific conventions).

Annotation	Meaning
DO NOT ALLOW	Answers which are not worthy of credit
IGNORE	Statements which are irrelevant
ALLOW	Answers that can be accepted
( )	Words which are not essential to gain credit
__	Underlined words must be present in answer to score a mark
ECF	Error carried forward
AW	Alternative wording
ORA	Or reverse argument

13. **Subject-specific Marking Instructions**

INTRODUCTION

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

You should ensure that you have copies of these materials.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

Question			Answer	Mark	Guidance	AO
1	(a)	i	**B** Conglomerate **C** Greywacke **D** Mudstone	2	All three correct = 2 marks ✓✓ Two correct = 1 mark ✓ None or One correct = 0 mark **ALLOW** For Rock D Shale or Clay	3.1b
1	(a)	ii	Grey mineral = Quartz ✓ White mineral = Feldspar **OR** Plagioclase (Feldspar) **OR** Orthoclase (Feldspar) / Potash Feldspar / K Feldspar ✓	2		3.1b
1	(a)	iii	Sketch showing large grains at the base fining upwards ✓ **Two** labelled features on the sketch from the following: ✓ Graded bedding / fining upwards / arrow showing decreasing grain size / labels to indicate the idea of coarser grains at base and finer at the top **OR** Sub rounded / Sub angular clasts / Angular **OR** Dark / Light clasts **OR** Matrix / Clay matrix **OR** Accurately drawn scale	2	1 mark for sketch showing graded bedding 1 mark for two accurate labelled features indicated with a line / arrow / bracket to indicate the feature ACCEPT ORA	2.1b

1	(b)	i	Concentric layers / laminations ✓ Nucleus / central fragment of shell/grain ✓ Crystalline cement / (calcite) cement ✓ Oolith ✓	2	**ALLOW** Grain-supported **ALLOW** Sparite **ALLOW** dissolution grain boundaries	2.1b
1	(b)	ii	**FIRST CHECK ANSWER IN TABLE** **If answer = 0.9mm award 2 marks** Grain A = 0.9 mm, Grain B = 0.9 mm, Grain C = 1.0 mm, Grain D = 0.6 mm, Grain E = 0.8 mm, Grain F = 0.9 mm Mode = 0.9 mm ✓✓	2	**ALLOW** +/- 0.1 mm for Grain diameters **ALLOW 1 mark for all 6 correct measurements BUT incorrect Mode** **ALLOW** variations in the Mode answer which take into account the tolerances allowed for the measurements (0.8-1.0mm) **ALLOW ECF** if mode calculation is correct for wrong grain measurements for 1 mark 1 mark max if no units	2.1b
1	(b)	iii	**FIRST CHECK ANSWER ON ANSWER LINE** **If answer = 10x award 2 marks** $magnification = \frac{size\ of\ image}{size\ of\ real\ object}$ ✓ $\frac{10\ mm}{1\ mm}$ ✓	2	**ALLOW** if "x" not indicated	1.1d 2.1b

<table>
<tr><td>1</td><td>(c)*</td><td></td><td colspan="4">Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.
In summary:
Read through the whole answer. (Be prepared to recognise and credit unexpected approaches where they show relevance.)
Using a ‘best-fit’ approach based on the science content of the answer, first decide which of the level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer.
Then, award the higher or lower mark within the level, according to the Communication Statement (shown in italics):
○ award the higher mark where the Communication Statement has been met.
○ award the lower mark where aspects of the Communication Statement have been missed.
• The Science Content determines the level.
• The Communication Statement determines the mark within a level.</td></tr>
<tr><td></td><td></td><td></td><td>Level 3 (5-6 marks)
A detailed description of the <u>similarities</u> and differences that allow bioclastic and reef limestones to be identified in the field. Characteristics of each limestone will be linked to possible environments/ conditions of deposition in named sedimentary basins.
There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.

Level 2 (3-4 marks)
A detailed discussion of some of the similarities and / or differences that allow bioclastic and reef limestones to be identified in the field. Characteristics of each limestone may be linked to possible environments/ conditions of deposition in named sedimentary basins.
There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.

Level 1 (1-2 marks)
A briefer discussion of some similarities and/ or differences that allow bioclastic and reef limestones to be identified in the field.</td><td>6</td><td>AO3.1c Evaluate geological information, ideas and evidence
Evaluation will focus on differences that allow these two limestones to be differentiated
Fossil content: both may contain brachiopods, bivalves, crinoids and gastropods, but reef limestones contain corals as the main framework builder, as well as possible echinoderms
Significant differences in bedding with bioclastic limestones being bedded and reef limestones being unbedded due to the nature of the coral growth
Environment of deposition could be very similar (shallow carbonate seas) but energy conditions may vary and would be reflected in the state of fossils: broken/ whole

AO2.1a Apply knowledge and understanding of geological ideas
chemical and biological processes that produce the sediments that form carbonate sedimentary rocks
diagnostic properties (grain size, cement, mineral composition and fossil content, and sorting)
formed from fossils or fossil fragments, including examples such as brachiopods, bivalves, crinoids and gastropods</td><td>3.1c
2.1a</td></tr>
</table>

			There is an attempt at logical structure with a line of reasoning. The information is in the most part relevant. May not include information on the environment of deposition +/- Basins **0 marks** *No response worthy of credit.*		may have matrix (micrite) or cement (sparite) Named sedimentary basins could include: Welsh Basin – Silurian reef systems of the Wenlock and Aymestry limestones Jurassic Basins – Jurassic bioclastic Corallian limestone	
2	**(a)**		Porphyritic / coarser crystals surrounded by finer ✓ Phenocrysts / Large / coarse pink / Orthoclase / K-feldspar/ Potash ✓ Medium grey / glassy / colourless quartz ✓ Coarse white Plagioclase / Orthoclase / K feldspar / potash feldspar / feldspar (phenocrysts) ✓ Finer / darker Biotite (mica) (groundmass) ✓ Coarse / medium crystals are subhedral /euhedral ✓ Groundmass is anhedral ✓	3	**ALLOW** 1 mark for general comment about coarse crystals /phenocrysts surrounded by finer crystals /groundmass ALLOW quartz referred to as Groundmass	2.1b

2	(b)		***Plutonic;*** Coarser / larger / euhedral / subhedral crystals form first by slow cooling **OR** Coarser / larger crystals formed at depth / plutonic / magma chamber **OR** Magma insulated at depth so crystal growth / nucleation is slow **OR** Magma containing large crystals intruded upwards through crust ✓ ***Hypabyssal;*** Finer / smaller crystals / groundmass formed later / cooled more quickly **OR** Finer / smaller groundmass formed nearer the surface / hypabyssally /after intrusion **OR** Magma not insulated so crystal growth / nucleation rate is quick **OR** crystals anhedral as they grow to infill spaces ✓	2	**1 mark** MAX for reference to crystals forming Plutonically **1 mark** MAX for reference to crystals forming later/ Hypabyssally MUST have reference to magma cooling in 2 different places for 2 marks **ALLOW** Two stages of cooling for 1 mark providing there is further detail linked for either plutonic OR hypabyssal cooling OR general comment about larger crystals taking longer to form than smaller	3.1b

Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.

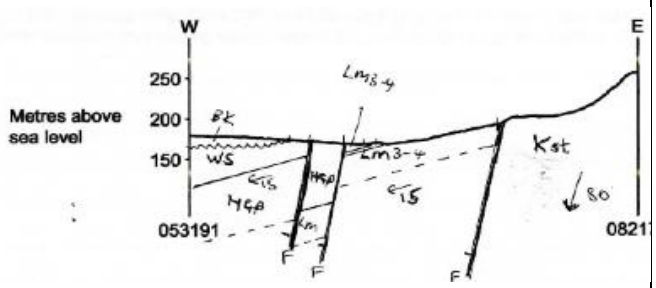
In summary:
Read through the whole answer. (Be prepared to recognise and credit unexpected approaches where they show relevance.)
Using a 'best-fit' approach based on the science content of the answer, first decide which of the level descriptors, **Level 1**, **Level 2** or **Level 3**, best describes the overall quality of the answer.
Then, award the higher or lower mark within the level, according to the **Communication Statement** (shown in italics):

- award the higher mark where the Communication Statement has been met.
- award the lower mark where aspects of the Communication Statement have been missed.

• The science content determines the level.
• The Communication Statement determines the mark within a level.

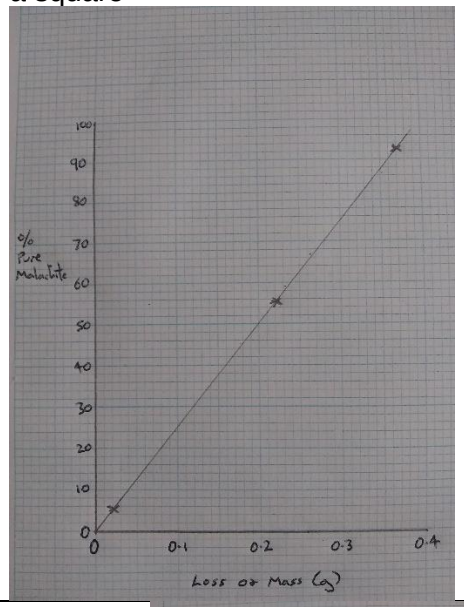
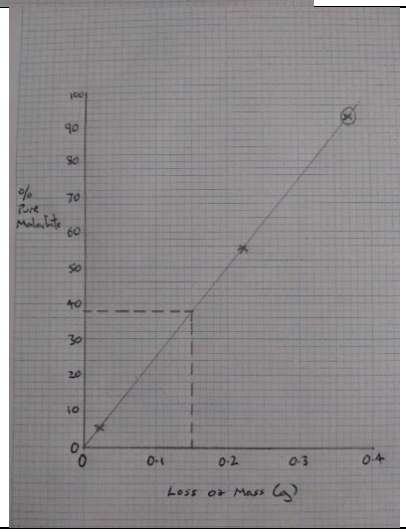
2	**(c)***		**Level 3 (5-6 marks)** A detailed description of how magmatic evolution may change the composition of the magma. Should include reference to minerals formed, rock types and include magmatic processes *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3-4 marks)** A description of how magmatic evolution may change the composition of the magma. Should include some reference to minerals formed OR rock types OR magmatic processes *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1-2 marks)** Some basic description of how magmatic evolution may change the composition of the magma. May make only brief mention of minerals or rock types. May not make reference to named processes	6	**AO1.1c Demonstrate understanding of ideas** Response refers to the various processes in which magma can evolve and links these ideas to the change in magma composition; • slow changes as the melt crystallizes (fractional crystallisation). • High temperature (early formed) minerals such as Olivine and Pyroxene use Iron and Magnesium (depleting the melt) • Bowen's reaction series (both continuous reaction series and Discontinuous reaction series) • magma mixing • Gravity settling of dense early formed minerals such as Olivine to form a cumulate layer. • melting/ partial melting of surrounding rocks (assimilation) • Filter pressing of overlying crystals on top of liquid which depletes it in elements incorporated in early formed minerals and enriches it in felsic minerals	1.1c 2.1a

			There is an attempt at logical structure with a line of reasoning. The information is in the most part relevant. **0 marks** *No response worthy of credit.*		• Magmatic Crystallization forming zoned / layered intrusions (e.g. The Palisades sill, The Skaergaard Intrusion and Hekla Volcano) • Zoned intrusion can have mafic edges / base and Silicic centre / top **AO2.1a Apply knowledge and understanding of geological ideas** • Knowledge that early formed crystals will deprive the magma of certain elements **ACCEPT** ideas about the possible tectonic setting of a silicic magma at convergent plate margin settings.	

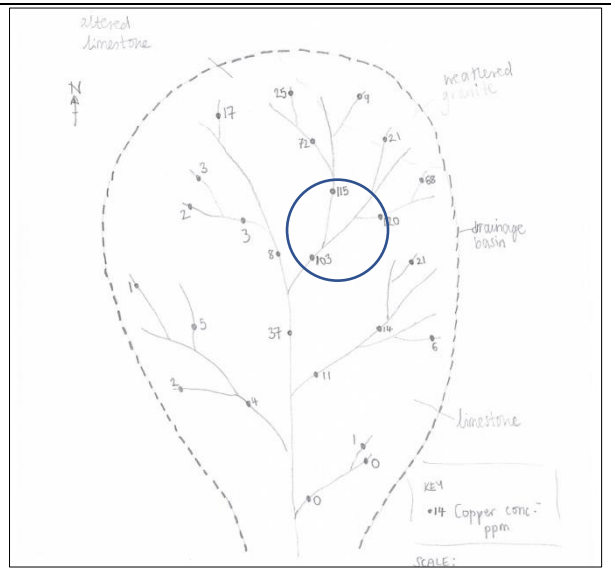
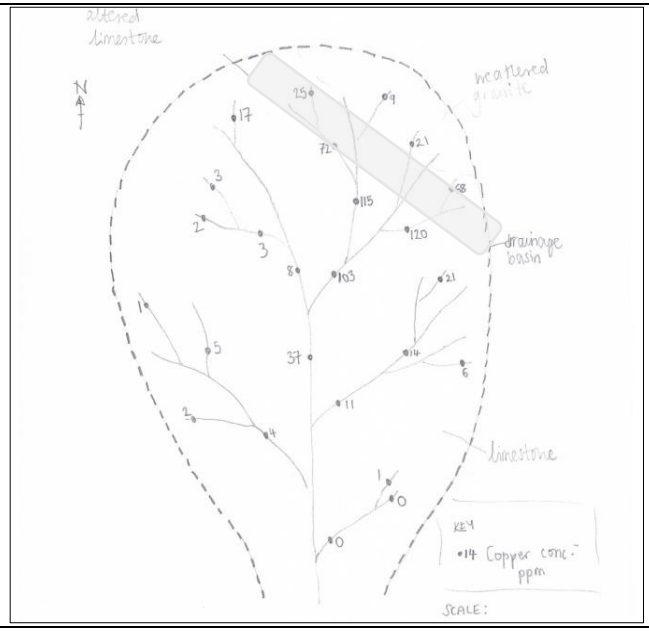
3	**(a)**	**(i)**	ALLOW ANY 3; Correct angle of dip in the Carboniferous beds to the centre and west of the section (Dip arrow shows 15° tolerance +/- 5°) ✓ Two normal Faults dipping / downthrown to west in western part of section ✓ Beds between and on west side of the two faults showing displacment in line with downthrows to the west ✓ Unconformity at base of Brockram / rock in extreme west ✓ Fault drawn between Kst and LM3-4 (see lower cross section)✓ Localised dip of 80° in the Kst indicated✓ 3 or more beds labelled either on section or in a key ✓	3	**ALLOW** the boundary between Kst and LM3- 4 to be shown as a faulted contact (diagram below) **OR** to be shown as conformable  **ALLOW** the colours of the rocks shown on the map for the labelling mark **ACCEPT** faults drawn vertically	2.1b 3.1c
3	**a**	**(ii)**	**FIRST CHECK ANSWER ON ANSWER LINE** **If answer = 270.(0262385) m) award 3 marks** True thickness of bedding plane = (h cos θ) + (L sin θ) ✓ Apparent thickness (L) = 950m OR Height difference(h) = 25m OR Angle of dip = 15° ✓	3	**ALLOW any correctly rounded number for full marks.** **If answer is different check the values obtained for h and L using the tolerances below;** **ALLOW** Apparent thickness (L) +/- 5m Height difference (h) +/- 2m	2.1b

			(25 x cos15) + (950 x sin15) ✓ 24.15 + 245.88 = 270.03 ✓		**ACCEPT;** for tolerance; (23-27 x cos15) + (945-955 x sin 15) **ACCEPT; answers within the tolerance of;** **22.22 + 244.58 = 266.8** **26.08 + 247.17 = 273.26**	
3	**a**	**(iii)**	Vertical / Up down relative movement / Dip Slip faults / Normal faults / Reverse fault ✓ Younger beds are downthrown / downthrown towards west / SW / NW ✓	2	**ACCEPT** explanation that the West side of the faults are the downthrown sides and that these are the hanging walls **ALLOW** reference to left / right instead of West / East	3.1b
3	**b**		Align with faults ✓ Linear ✓ Parallel with each other ✓ Perpendicular to the thrust fault / fault bounding LwF / Kst ✓ Trend is NW-SE or N-S ✓ Restricted to rock LwF ✓	2		3.1a
3	**c**		092191 **OR** 090186 ✓	1	**ALLOW a**ny correct grid reference for an area with similar linear metal ores along faults e.g. in squares 0919, 0920, 0819 and 0317 but answer must be 6 figure GR	3.1b

3	**d**		Reinforced raft foundations ✓ **AND** To strengthen the foundations so that subsidence does not occur / to ensure structure moves as a unit ✓ **OR** PVC/ sand layers to isolate foundations from surface movement ✓ **AND** To strengthen the foundations so that subsidence does not occur ✓ **OR** Backfilling of mine ✓ AND To provide support to the mine/ stops subsidence / void / stope ✓ OR Drain water / regrade / vegetate / add retaining walls **AND** To stables waste / spoil heaps **OR** Pump out methane **AND** To stop build of explosive gas	2	One mark for strategy One mark for development of the idea **ALLOW** Two ideas without development for 1 mark	1.1c 2.1b

4	**a**		Correctly drawn and labelled axes ✓ All three points correctly plotted ✓ Line of best fit drawn ✓	3	**ACCEPT** points plotted with a tolerance of +/- half a square 	2.1b
4	**b**		Correct plot circled (Sample C) ✓	1		3.1d

4	**c**		38% ✓	1	**ALLOW** tolerance +/- 1% ecf using line of best fit	3.1b
4	**d**		Inaccuracies of measuring the mass/ volume ✓ Some powdered sample was lost between measuring mass and reacting with hydrochloric acid / some sample stuck to the paper ✓ Beaker already had chemical inside that interfered with the reaction ✓ Impurities may be present which may influence reaction / release CO_2 OR sample may be weathered / altered	1	**ALLOW** the reaction may not have been completed after 6 minutes ALLOW any reference to random or systematic errors ALLOW any ref to the balance not being calibrated	3.1f
4	**e**		Sample B ✓ Sample B has a grade of 5% / has a value closest to the grades of the 5 highest copper ore deposits in the world shown in the table ✓ OR Sample C ✓ Samples C has a much higher grade than the open pit copper deposits in the table / would be economically more valuable ✓	2	1 mark for sample and 1 mark for explanation	3.1a 3.1d

5	a	i	Correct area circled to include at least TWO of the 103,115 and 120 values ✓	1		3.1a
5	a	ii	Correct area shaded upstream of anomalous readings but downstream of weathered granite ✓	1		3.1a

	a	**iii**	**FIRST CHECK ANSWER IN TABLE** **If answer = 588.24ppm award 2 marks** Concentration factor = Concentration of metal in Ore Average crustal abundance **OR** 4 / 0.0068 ✓ = 588.24ppm ✓	2	Max one mark if answer not given to 2 d.p.	2.1b
5	**b**		**Two Issues stated and explained:** Surrounding geology/ rock types ✓ **AND** Reference to weak / friable rocks & issue with mine stability / weakened due to weathering affecting stability / hardness of rock / how easy the rock is to work ✓ Lateral / vertical rock type changes **AND** Issues with variable hardness / stability / cost / ease of working ✓ Porosity and permeability issues ✓ **AND** Porous / permeable rocks may cause flooding into the mine ✓ Structures / faulting / joints / folds ✓ **AND** could affect type of mine used / stability / reactivation of faults / joints allowing water ingress OR Reference to angle / direction of dipping beds & stability issues ✓	4	2 Marks max should be awarded for each issue; 1 mark for stating the issue, 1 mark for explanation Max 2 marks for issues stated with no development	3.1a 1.1c

			Type of mineralisation / veins being concentrated ore / porphyry deposits being dispersed ore / zonation of mineralisation / grade of the ore ✓ **AND** Economically unviable to mine due to presence of gangue minerals / difficult to mine / purity of deposit affecting grade ✓ Associated toxic elements present ✓ **AND** Economic costs of land decontamination & pollution control ✓ Water management / drainage / pumping of mine workings ✓ **AND** Reserves unable to be mined / Economic cost of pumping water out of the mines ✓ Cost of extraction / cost of subsequent reclaimations / planning restrictions / cost of planning / strip ratio / depth of overburden / depth of deposit ✓ **AND** costs incurred affect profit ✓ Change to cut off grade ✓ **AND** Affects how much of the ore can be mined / lower grade deposits can become viable / global ore prices / ORA ✓ Size of deposit ✓ **AND** Small / dispersed deposits may not be (economically) viable / not valuable enough for the costs involved in extraction		**ACCEPT** ORA	

5	**c**		Powdered ore mixed with water ✓ Mineral is made water repellent/ hydrophobic (using a specific chemical) ✓ Air is pumped through liquid/ slurry ✓ Hydrophobic particles attach to bubbles ✓ Bubbles rise to the top to form a froth rich in the required mineral ✓ Bubbles and mineral scooped / skimmed / collected from surface for processing ✓	max 2		2.1b

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GCE

Geology

H414/03: Practical skills in geology

A Level

Mark Scheme for June 2023

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

It is also responsible for developing new specifications to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support, which keep pace with the changing needs of today's society.

This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

MARKING INSTRUCTIONS

PREPARATION FOR MARKING
RM ASSESSOR

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *RM Assessor Assessor Online Training*; *OCR Essential Guide to Marking*.

2. Make sure that you have read and understood the mark scheme and the question paper for this unit. These are posted on the RM Cambridge Assessment Support Portal http://www.rm.com/support/ca

3. Log-in to RM Assessor and mark the **required number** of practice responses ("scripts") and the **number of required** standardisation responses.

   YOU MUST MARK 10 PRACTICE AND 10 STANDARDISATION RESPONSES BEFORE YOU CAN BE APPROVED TO MARK LIVE SCRIPTS.

MARKING

1. Mark strictly to the mark scheme.

2. Marks awarded must relate directly to the marking criteria.

3. The schedule of dates is very important. It is essential that you meet the RM Assessor 50% and 100% (traditional 40% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.

4. If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone or the RM Assessor messaging system, or by email.

5. **Crossed Out Responses**
   Where a candidate has crossed out a response and provided a clear alternative then the crossed out response is not marked. Where no alternative response has been provided, examiners may give candidates the benefit of the doubt and mark the crossed out response where legible.

   Rubric Error Responses – Optional Questions
   Where candidates have a choice of question across a whole paper or a whole section and have provided more answers than required, then all responses are marked and the highest mark allowable within the rubric is given. Enter a mark for each question answered into RM assessor, which will select the highest mark from those awarded. *(The underlying assumption is that the candidate has penalised themselves by attempting more questions than necessary in the time allowed.)*

Multiple Choice Question Responses

When a multiple choice question has only a single, correct response and a candidate provides two responses (even if one of these responses is correct), then no mark should be awarded (as it is not possible to determine which was the first response selected by the candidate).

When a question requires candidates to select more than one option/multiple options, then local marking arrangements need to ensure consistency of approach.

Contradictory Responses

When a candidate provides contradictory responses, then no mark should be awarded, even if one of the answers is correct.

Short Answer Questions (requiring only a list by way of a response, usually worth only **one mark per response**)

Where candidates are required to provide a set number of short answer responses then only the set number of responses should be marked. The response space should be marked from left to right on each line and then line by line until the required number of responses have been considered. The remaining responses should not then be marked. Examiners will have to apply judgement as to whether a 'second response' on a line is a development of the 'first response', rather than a separate, discrete response. *(The underlying assumption is that the candidate is attempting to hedge their bets and therefore getting undue benefit rather than engaging with the question and giving the most relevant/correct responses.)*

Short Answer Questions (requiring a more developed response, worth **two or more marks**)

If the candidates are required to provide a description of, say, three items or factors and four items or factors are provided, then mark on a similar basis – that is downwards (as it is unlikely in this situation that a candidate will provide more than one response in each section of the response space.)

Longer Answer Questions (requiring a developed response)

Where candidates have provided two (or more) responses to a medium or high tariff question which only required a single (developed) response and not crossed out the first response, then only the first response should be marked. Examiners will need to apply professional judgement as to whether the second (or a subsequent) response is a 'new start' or simply a poorly expressed continuation of the first response.

6. Always check the pages (and additional objects if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there, then add a tick to confirm that the work has been seen.

7. Award No Response (NR) if:
   - there is nothing written in the answer space

   Award Zero '0' if:
   - anything is written in the answer space and is not worthy of credit (this includes text and symbols).

Team Leaders must confirm the correct use of the NR button with their markers before live marking commences and should check this when reviewing scripts.

8. The RM Assessor **comments box** is used by your team leader to explain the marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.**
If you have any questions or comments for your team leader, use the phone, the RM Assessor messaging system, or e-mail.

9. Assistant Examiners will send a brief report on the performance of candidates to their Team Leader (Supervisor) via email by the end of the marking period. The report should contain notes on particular strengths displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.

For answers marked by levels of response:

Read through the whole answer from start to finish, using the Level descriptors to help you decide whether it is a strong or weak answer. The indicative scientific content in the Guidance column indicates the expected parameters for candidates' answers, but be prepared to recognise and credit unexpected approaches where they show relevance. Using a 'best-fit' approach based on the skills and science content evidenced within the answer, first decide which set of level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer.

Once the level is located, award the higher or lower mark:

The higher mark should be awarded where the level descriptor has been evidenced and all aspects of the communication statement (in italics) have been met.

The lower mark should be awarded where the level descriptor has been evidenced but aspects of the communication statement (in italics) are missing.

In summary:

The skills and science content determines the level.

The communication statement determines the mark within a level.

Level of response questions on this paper are **2(c)** and **5(d).**

10. **Annotations**

Annotation	Meaning
	Correct response
	Incorrect response
	Omission mark
	Benefit of doubt given
	Contradiction
	Rounding error
	Error in number of significant figures
	Error carried forward
	Level 1
	Level 2
	Level 3
	Benefit of doubt not given
	Noted but no credit given

Annotation	Meaning
I	Ignore
BP	Blank page

11. **Subject Specific Marking Instructions**

Abbreviations, annotations and conventions used in the detailed Mark Scheme (to include abbreviations and subject-specific conventions).

Annotation	Meaning
I	alternative and acceptable answers for the same marking point
✓	Separates marking points
DO NOT ALLOW	Answers which are not worthy of credit
IGNORE	Statements which are irrelevant
ALLOW	Answers that can be accepted
( )	Words which are not essential to gain credit
__	Underlined words must be present in answer to score a mark
ECF	Error carried forward
AW	Alternative wording
ORA	Or reverse argument

13. **Subject-specific Marking Instructions**

INTRODUCTION

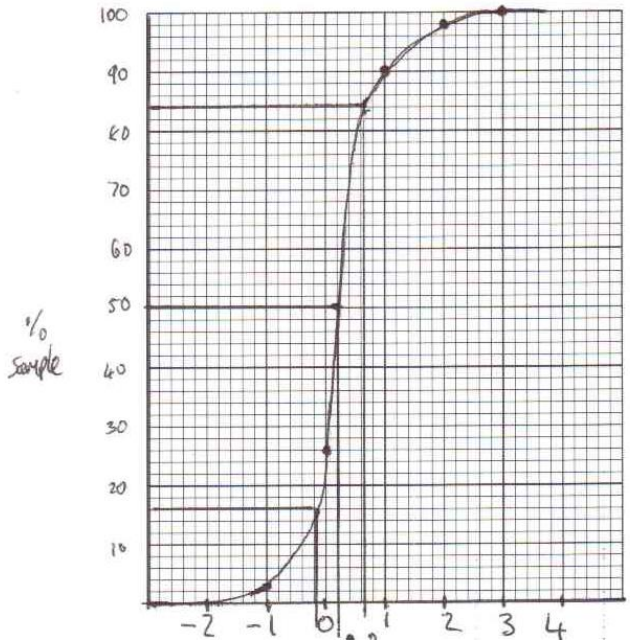
Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

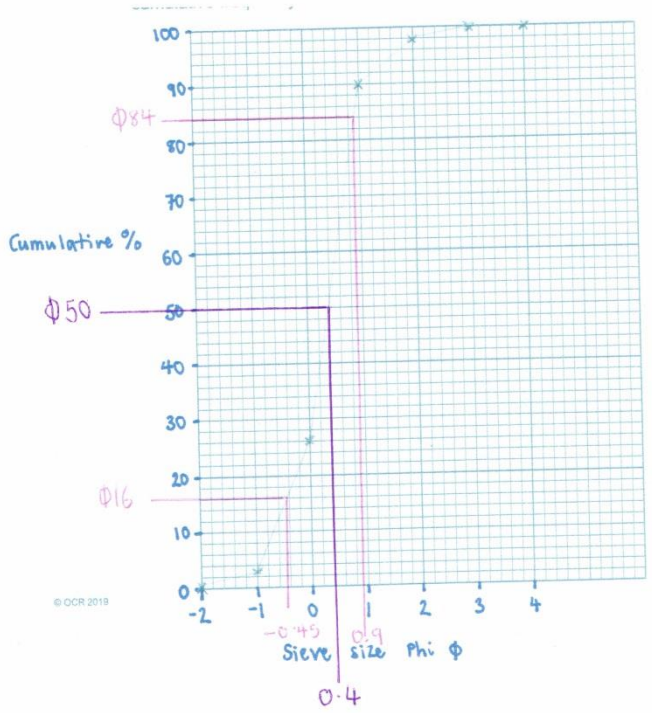
- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

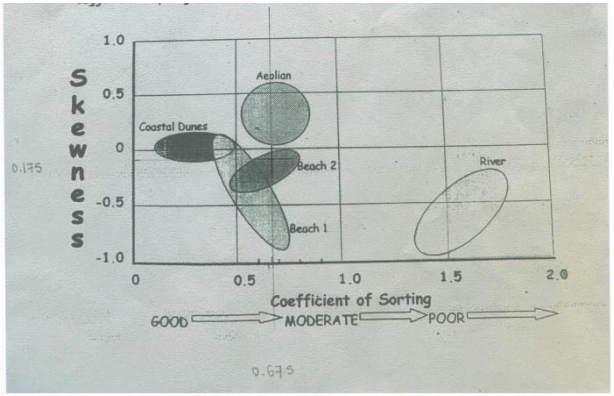
You should ensure that you have copies of these materials.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**.

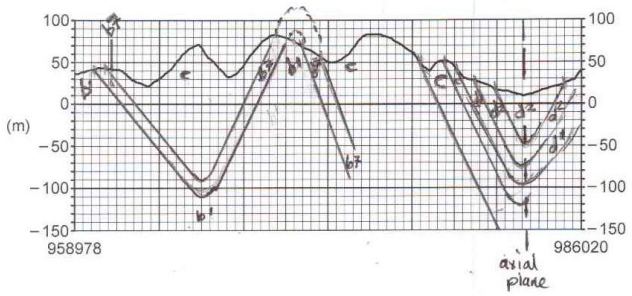
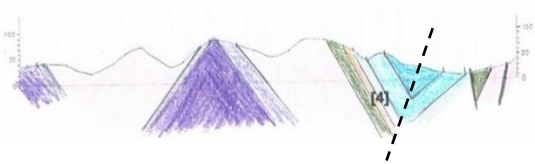
Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

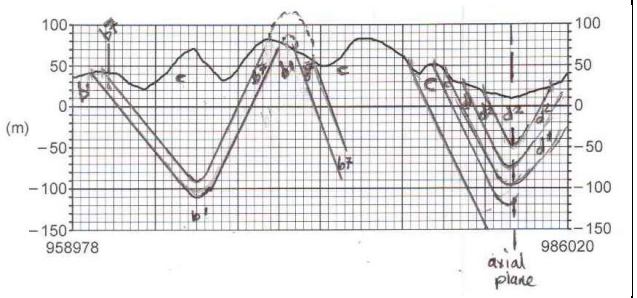
Question			Answer	Marks	Guidance	AO Element
1	(a)		x axis and y axis correctly labelled ✓ Points correctly plotted ✓ Line correctly drawn ✓	3	ALLOW; Tolerance +/- 0.5 of a square for points ALLOW; max 1 wrong plot for 1 mark 	2.1b

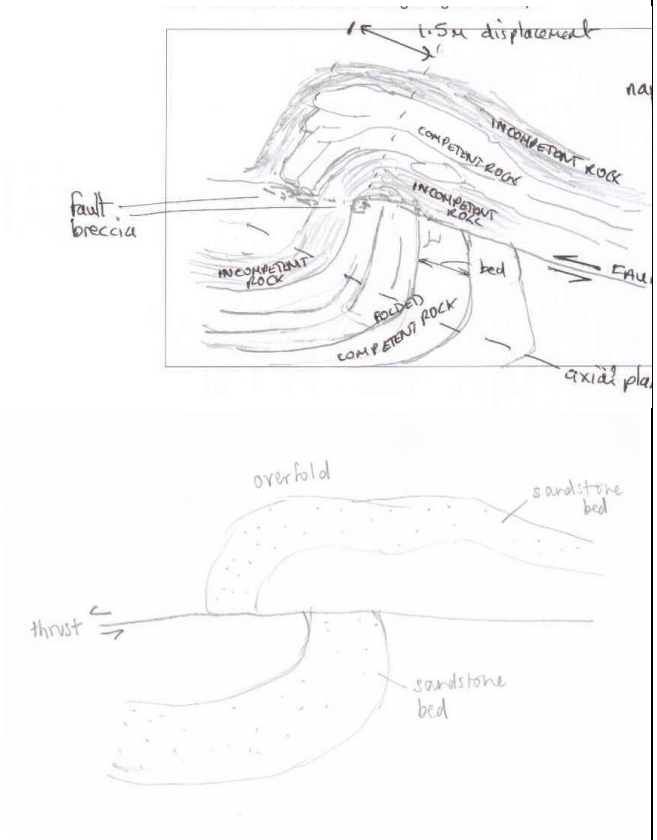
Question			Answer	Marks	Guidance	AO Element
1	(b)		**First check the answer on the answer line.** **If answer = -0.175 award 2 marks** $\frac{(0.9 + (-0.45)) - (2 \times 0.4)}{2}$ ✓ $= \frac{0.45 - 0.8}{2}$ $= \frac{-0.35}{2}$ -0.175 ✓	2	 **ALLOW answer between -0.2 and -0.15 (as phi 16 can be read as -0.4 or -0.5)** **ALLOW tolerance of +/- 0.1 on phi values** **ALLOW ECF** if plotting was wrong but answer to calculation is correct **ALLOW ECF** if the values used for phi 16, 50 and 84 differ to those shown on the left BUT are correct from the candidates graph in Que 1a	2.1b

Question			Answer	Marks	Guidance	AO Element
1	(c)		Beach 2 ✓	1	 **ALLOW** Aeolian OR Beach 1 ONLY as ECF if calculation is incorrect in 1b but the environment plotted is correct for that value	3.1b
1	(d)		*Any 3 from:* Medium sand / arenaceous / 0.125- 2mm ✓ Sub-rounded / rounded / well rounded / texturally mature ✓ Quartz rich / lacks less stable mineral grains e, g, feldspar / mature composition ✓ shells (fragments) ✓	Max 3	**ALLOW** reference to grain size having some coarser material / pebbles **ALLOW ECF** if the answer to 1c was Aeolian and appropriate Aeolian features are described IGNORE sorting and skewness as in question	2.1a

Question			Answer	Marks	Guidance	AO Element
1	(e)		Only a single sample analysed ✓ Doesn't take composition / grain shape of the sediment into account ✓ Doesn't use fossil content which can help identify the environment of deposition ✓ Sieving is a good way to get quantifiable data to plot an environment ✓ Errors during sieving may lead to inaccurate results & incorrect environment identified ✓	2		3.1c

Question			Answer	Mark	Guidance	AO Element
2	(a)	(i)	Accurate plotting of 3 or more beds within at least 2 fold structures ✓ Key/ correct labelling / correct name or colour annotated for rocks present ✓ Extrapolation of syncline in the NE below ground✓ Drawing of Antiform structure above ground ✓ Correct dip for one of the fold structures; SW Syncline of 55º AND 65º +/- 5º **OR** Anticline 65º and 80º +/- 5º **OR** NE Syncline 70º and 60º +/- 5º ✓ Unconformity drawn / labelled between c (Devonian) and c (Carboniferous) ✓ label alluvium OR draw it is as horizontal ✓	Max 5		2.1b 3.1c
2	(a)	(ii)	Line drawn equating to plane of syncline✓	1		3.1b

Question			Answer	Mark	Guidance	AO Element
					 **ALLOW** a vertical fold axis as shown in diagram above	
2	**(a)**	**(iii)**	Any **two** points from: Syncline in the NE AND Asymmetrical **OR** Open fold / dips 70 º AND 60 º ✓ Anticline AND Asymmetrical **OR** closed / limbs dip 65º and 80º ✓ Syncline in the SW AND Asymmetrical **OR** Open fold **/** dips 55 º AND 65 º ✓ Unconformity AND Angular OR Devonian dips 75 º Carboniferous 67 º ✓	Max 2	ALLOW synform / antiform Name of structure and a reason needed for 1 mark ALLOW 1 mark max for 2 **different** named structures but no description	2.1a

Question			Answer	Mark	Guidance	AO Element
2	(b)	(i)	Clear sketch of the fold with scale shown scale ✓ Any **TWO** correct labels from; Incompetent AND Competent rocks Fault Plane / thrust fault Fold axis/ fold axial plane Displacement indicated correctly Measurement of fault displacement 2m Nappe Recumbent fold Tension joints Measurement of angle of Fault lane at 25 º +/- 5 º ✓	2		2.1b

Question			Answer	Mark	Guidance	AO Element
2	(b)	(ii)	**Three** responses in correct order from: Set compass to clinometer mode / align dial E/W (so angle measurer swings freely) ✓ Place the clinometer (vertically) on the bedding plane and move around until dip is 0° ✓ Draw a line along the long edge of the clinometer/ draw the strike line (using pencil or chalk) ✓ Hold the compass-clinometer horizontally (to use the compass) and align edge with line ✓ Turn the dial so red arrow and needle line up ✓ Strike should be recorded as three figures in degrees from North / read 3 figure strike bearing from either end of the dial ✓	Max 3	**ACCEPT** correctly drawn and annotated diagram for a maximum of 2 marks	1.1d 2.1a

Question			Answer	Mark	Guidance	AO Element
2	(c)		Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question. **Level 3 (5–6 marks)** Gives a detailed evaluation of a range of geological problems that would affect the quarrying of limestone, linking knowledge and understanding of geological structures. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** Gives an outline of some of the geological problems that would affect the quarrying of limestone, linking some knowledge and understanding of geological structures. *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** Gives a basic outline of some of the geological problems that would affect the quarrying of limestone in the area.	6	<u>Weathering;</u> • Analysis of area where limestones are present and thus sinkholes could be a problem / solution cavities / subsidence • Limestone is prone to Chemical weathering • Increased weathering can cause instability <u>Beds;</u> • Beds should typically be uniform • Impurities within the beds <u>Faulting;</u> • Faulting within the area leading to instability of beds / reactivation of faults • Faulting of the area meaning lateral continuity of the beds is compromised • Faulting can allow water ingress / increasing secondary permeability <u>Folding / dip of beds</u>; • Folded beds potentially make quarrying difficult due to steep dips / instability in steeply dipping beds / problematic for machinery • Instability of quarry walls / steeply dipping beds and dangers during quarrying	2.1a 3.1e

Question			Answer	Mark	Guidance	AO Element
			There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant. **0 marks** *No response or no response worthy of credit.*		<u>Jointing;</u> • Joints can allow water ingress / increasing secondary permeability • Joints can lead to collapse during quarrying / weakening the rock <u>Water;</u> • Level of the water table could lead to flooding of quarries • Limestone is porous and permeable and allows water ingress • Secondary permeability can be increased by chemical weathering <u>Drift deposits;</u> • Presence of overlying alluvial deposits can make quarrying difficult (moving the overburden)	

Question			Answer	Mark	Guidance	AO Element
3	(a)	(i)	Porosity – Volume / percentage of pore space within a rock ✓ Permeability – The rate at which a fluid flows through a rock / concept of interconnected pores allowing movement ✓	2	ALLOW amount of pore space For permeability the concept of a flow of liquid is needed	1.1a
3	(b)	(i)	**Sample B** Explanation to state that <u>porosity</u> in Sample B is higher ✓ This is due to the lack of / no cement around the grains AND so more hydrocarbons can be stored ✓ Explanation to state that <u>permeability</u> in Sample B is higher✓ This is due to the lack of / no cement around the grains AND so more hydrocarbons can be transmitted through the rock ✓	4	ORA	3.1a
3	(b)	(ii)	**First check the answer on the answer line.** **If the answer = 0.001875 $m^3 s^{-1}$ or 1.875 x 10^{-3} $m^3 s^{-1}$ award 3 marks** $Q = 0.00001 \times 1500 \left(\frac{160-110}{400}\right)$ ✓ $m^3 s^{-1}$ ✓	3	**ALLOW** answer given per hour; x 60 for minutes then x 60 for hours = 6.75 m^3/hour **ALLOW** answer given per day; x 24 for hours = 162 m^3/day **ALLOW** for Max 1 mark; correct calculation using $cm^3 s^{-1}$; $Q = 0.001 \times 1500 \left(\frac{160 - 110}{400}\right)$ OR = 0.1875	2.1b

Question			Answer	Mark	Guidance	AO Element
4	(a)	(i)	Shape: rhombic ✓ Cleavage; 3 planes / rhombohedral ✓	2		2.1a
4	(a)	(ii)	Reaction with (dilute) hydrochloric acid ✓ Hardness / Moh's hardness kit ✓	Max 1	**DO NOT ACCEPT** colour or density	2.1b
4	(a)	(iii)	Mass; Use a balance to find and record mass of mineral ✓ Volume; Fill a measuring cylinder/ eureka can to a specified amount with water ✓ Place the mineral into the water and measure the volume of water displaced ✓ Divide mass by volume to give density in g cm^{-3} ✓	Max 2	1 mark MAX should be for determining volume DO NOT ACCEPT mass measured after volume as specimens will be wet giving inaccurate results	1.1b

Question			Answer	Mark	Guidance	AO Element
4	(b)		Accept any **two** points from one type of mineral deposit: <u>Placer deposits;</u> Minerals with high densities are weathered out of mineral veins ✓ Minerals are transported ✓ Minerals are deposited when current velocity drops ✓ Minerals are preferentially deposited in one place (normally with unconsolidated sediment) ✓ As placer deposits Gold / Cassiterite ✓ <u>Magmatic Segregation;</u> Ultramafic OR Mafic magma begins to slowly crystallise / cools at depth in a magma chamber ✓ High density metallic minerals form first / crystals are denser than the magma / high temperature metallic minerals crystalise out first ✓ High density metallic minerals slowly sink to the base of the magma chamber / gravity settling / sink to form cumulate layers / sink to form metal rich layers ✓ Layers of platinum / chromite ✓	Max 2	**ACCEPT** Sites of deposition such as meander bends, plunge pools, upstream of projections, downstream of confluences and beach deposits as example of placer deposits	1.1b

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Mark</th><th>Guidance</th><th>AO Element</th></tr>
<tr><td>5</td><td>(a)</td><td></td><td><u>Energy levels;</u>
3 or 4 Energy levels correct ✓
5 or 6 energy levels correct ✓✓

<u>Sea levels;</u>
5 or 6 sea levels correct ✓</td><td>3</td><td>MAX 2 marks for energy levels

<table>
<tr><th>Bed</th><th>Thickness (m)</th><th>Rock description</th><th>Features visible</th><th>Energy level (Low, med, high)</th><th>Sea Level (Low, Med High)</th></tr>
<tr><td>1</td><td>1.00</td><td>Well-bedded shale
Pale grey</td><td>Marine brachiopods and Bivalves</td><td>L</td><td>H</td></tr>
<tr><td>2</td><td>1.20</td><td>Siltstone
Laminated
Coarsening upwards from clay to silt</td><td>Contains bivalve shells
Some bioturbation visible</td><td>L</td><td>m</td></tr>
<tr><td>3</td><td>1.70</td><td>Uneven base
Coarsening upwards from fine to medium sandstone</td><td>Small scale Cross - bedding visible throughout bed
Some scattered plant material</td><td>M</td><td>M</td></tr>
<tr><td>4</td><td>0.20</td><td>Silty mudstone
Reddish-brown colour</td><td>Contains plant roots towards the top of the bed</td><td>L</td><td>L</td></tr>
<tr><td>5</td><td>0.10</td><td>Black, shiny</td><td>None</td><td>L</td><td>L</td></tr>
<tr><td>6</td><td>0.75</td><td>Well bedded shale</td><td>Marine Brachiopods, well preserves and intact</td><td>L</td><td>H</td></tr>
<tr><td>7</td><td>1.00</td><td>Laminated siltstones</td><td>Bioturbation and trace fossils (burrows)</td><td>L</td><td>m</td></tr>
</table>
</td><td>1.1b
2.1b
3.1b</td></tr>
</table>

Question			Answer	Mark	Guidance	AO Element
5	(b)		Asymmetrical ripples ✓ Unidirectional flow / current flow indicated on diagram by an arrow from west to east / current described as being from West to east ✓ Recognition of grains carried up the Stoss / shallow slope AND then fall down the Lee / Steep slope ✓ Explain how a compass could be used to measure the bearing of the ripples ✓	2		3.1b
5	(c)		<u>Climate;</u> High rainfall / high temperatures / humid climate ✓ Tropical climate ✓ Equatorial regions ✓ <u>Paleoenvironment;</u> Requires a highly productive ecosystem / rapid plant growth / dense forest ✓ Deposition on land / terrestrial / delta top / swamp / anoxic environment ✓ Plant material accumulates / rapid burial / delta or channel switching causes burial ✓	Max 3	MAX 2 marks from either Climate or Palaeoenvironment section	3.1b

Question			Answer	Mark	Guidance	AO Element
5	(d)		Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question. **Level 3 (5–6 marks)** Gives a detailed evaluation, linking knowledge and understanding of the different possible causes of sea level change and linking them **to cyclothem deposition/ deltaic environments** *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** Gives an evaluation, linking knowledge and understanding of the possible causes of sea level change and linking them to cyclothem deposition **OR** a detailed evaluation of SL change and tectonic processes *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.*	6	**Deltas;** Causes of repeated cycles could relate to • isostatic change caused by subsiding deltaic sediments or by tectonics • global eustatic change can lead to changes in deltaic environments • migration of delta channels/ delta switching • changes in rate of sedimentation • Increase in sedimentation allows the delta to build out into the sea • Decrease in sedimentation results in the delta being inundated by the sea **Sea Level changes** • Difference between eustatic and isostatic change • Examples of Eustatic change • Examples of Isostatic change e.g. Scotland / Scandinavia • Resulting in raised beaches / sinking e.g. SE England • Uplift of land masses causing initial SL fall • Uplift resulting in increased amount of weathering, erosion and transport and increased sedimentation in basin and falling SL • Reasons for uplift	resulting in raised beach

Question			Answer	Mark	Guidance	AO Element
			Level 1 (1–2 marks) Gives a basic evaluation, with basic knowledge and understanding of the possible causes of sea level change / tectonics and may attempt to link them to cyclothem deposition. *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* **0 marks** *No response or no response worthy of credit.*		• Climate change e.g. thermal expansion of sea water / polar ice caps • Greenhouse and Icehouse conditions • Wilson cycle **<u>Local tectonic variations</u>**; • Faults • Rifting and subsidence • Earthquakes e.g. leading to tsunamis • MOR formation and global SL • submarine volcanic eruptions • Hot spot / mantle plume volcanic activity to form seamounts / guyots **<u>Case Studies;</u>** • Appropriate reference to Welsh basin • Jurassic basin rifting / cyclical deposition	

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GCE

Geology

H414/03: Practical skills in geology

A Level

Mark Scheme for June 2024

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

It is also responsible for developing new specifications to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support, which keep pace with the changing needs of today's society.

This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

MARKING INSTRUCTIONS

PREPARATION FOR MARKING
RM ASSESSOR

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *RM Assessor Assessor Online Training*; *OCR Essential Guide to Marking*.

2. Make sure that you have read and understood the mark scheme and the question paper for this unit. These are posted on the RM Cambridge Assessment Support Portal http://www.rm.com/support/ca

3. Log-in to RM Assessor and mark the **required number** of practice responses ("scripts") and the **number of required** standardisation responses.

   YOU MUST MARK 10 PRACTICE AND 10 STANDARDISATION RESPONSES BEFORE YOU CAN BE APPROVED TO MARK LIVE SCRIPTS.

MARKING

1. Mark strictly to the mark scheme.

2. Marks awarded must relate directly to the marking criteria.

3. The schedule of dates is very important. It is essential that you meet the RM Assessor 50% and 100% (traditional 40% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.

4. If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone or the RM Assessor messaging system, or by email.

5. **Crossed Out Responses**
   Where a candidate has crossed out a response and provided a clear alternative then the crossed out response is not marked. Where no alternative response has been provided, examiners may give candidates the benefit of the doubt and mark the crossed out response where legible.

   Rubric Error Responses – Optional Questions
   Where candidates have a choice of question across a whole paper or a whole section and have provided more answers than required, then all responses are marked and the highest mark allowable within the rubric is given. Enter a mark for each question answered into RM assessor, which will select the

highest mark from those awarded. *(The underlying assumption is that the candidate has penalised themselves by attempting more questions than necessary in the time allowed.)*

Multiple Choice Question Responses
When a multiple choice question has only a single, correct response and a candidate provides two responses (even if one of these responses is correct), then no mark should be awarded (as it is not possible to determine which was the first response selected by the candidate).
When a question requires candidates to select more than one option/multiple options, then local marking arrangements need to ensure consistency of approach.

Contradictory Responses
When a candidate provides contradictory responses, then no mark should be awarded, even if one of the answers is correct.

Short Answer Questions (requiring only a list by way of a response, usually worth only **one mark per response**)
Where candidates are required to provide a set number of short answer responses then only the set number of responses should be marked. The response space should be marked from left to right on each line and then line by line until the required number of responses have been considered. The remaining responses should not then be marked. Examiners will have to apply judgement as to whether a 'second response' on a line is a development of the 'first response', rather than a separate, discrete response. *(The underlying assumption is that the candidate is attempting to hedge their bets and therefore getting undue benefit rather than engaging with the question and giving the most relevant/correct responses.)*

Short Answer Questions (requiring a more developed response, worth **two or more marks**)
If the candidates are required to provide a description of, say, three items or factors and four items or factors are provided, then mark on a similar basis – that is downwards (as it is unlikely in this situation that a candidate will provide more than one response in each section of the response space.)

Longer Answer Questions (requiring a developed response)
Where candidates have provided two (or more) responses to a medium or high tariff question which only required a single (developed) response and not crossed out the first response, then only the first response should be marked. Examiners will need to apply professional judgement as to whether the second (or a subsequent) response is a 'new start' or simply a poorly expressed continuation of the first response.

6. Always check the pages (and additional objects if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there, then add a tick to confirm that the work has been seen.

7. Award No Response (NR) if:
    - there is nothing written in the answer space

Award Zero '0' if:

- anything is written in the answer space and is not worthy of credit (this includes text and symbols).

Team Leaders must confirm the correct use of the NR button with their markers before live marking commences and should check this when reviewing scripts.

8. The RM Assessor **comments box** is used by your team leader to explain the marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.**
If you have any questions or comments for your team leader, use the phone, the RM Assessor messaging system, or e-mail.

9. Assistant Examiners will send a brief report on the performance of candidates to their Team Leader (Supervisor) via email by the end of the marking period. The report should contain notes on particular strengths displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.

10. For answers marked by levels of response:

Read through the whole answer from start to finish, using the Level descriptors to help you decide whether it is a strong or weak answer. The indicative scientific content in the Guidance column indicates the expected parameters for candidates' answers, but be prepared to recognise and credit unexpected approaches where they show relevance. Using a 'best-fit' approach based on the skills and science content evidenced within the answer, first decide which set of level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer.

Once the level is located, award the higher or lower mark:

The higher mark should be awarded where the level descriptor has been evidenced and all aspects of the communication statement (in italics) have been met.
The lower mark should be awarded where the level descriptor has been evidenced but aspects of the communication statement (in italics) are missing.

In summary:

The skills and science content determines the level.

The communication statement determines the mark within a level.

Level of response questions on this paper are **1(c)** and **2(b)(iii).**

11. **Annotations**

Annotation	Meaning
	Correct response
	Incorrect response
	Omission mark
	Benefit of doubt given
	Contradiction
	Rounding error
	Error in number of significant figures
	Error carried forward
	Level 1
	Level 2
	Level 3
	Benefit of doubt not given
	Noted but no credit given
	Ignore
	Blank page

12. **Subject Specific Marking Instructions**

Abbreviations, annotations and conventions used in the detailed Mark Scheme (to include abbreviations and subject-specific conventions).

Annotation	Meaning
/	alternative and acceptable answers for the same marking point
✓	Separates marking points
DO NOT ALLOW	Answers which are not worthy of credit
IGNORE	Statements which are irrelevant
ALLOW	Answers that can be accepted
( )	Words which are not essential to gain credit
__	Underlined words must be present in answer to score a mark
ECF	Error carried forward
AW	Alternative wording
ORA	Or reverse argument

INTRODUCTION

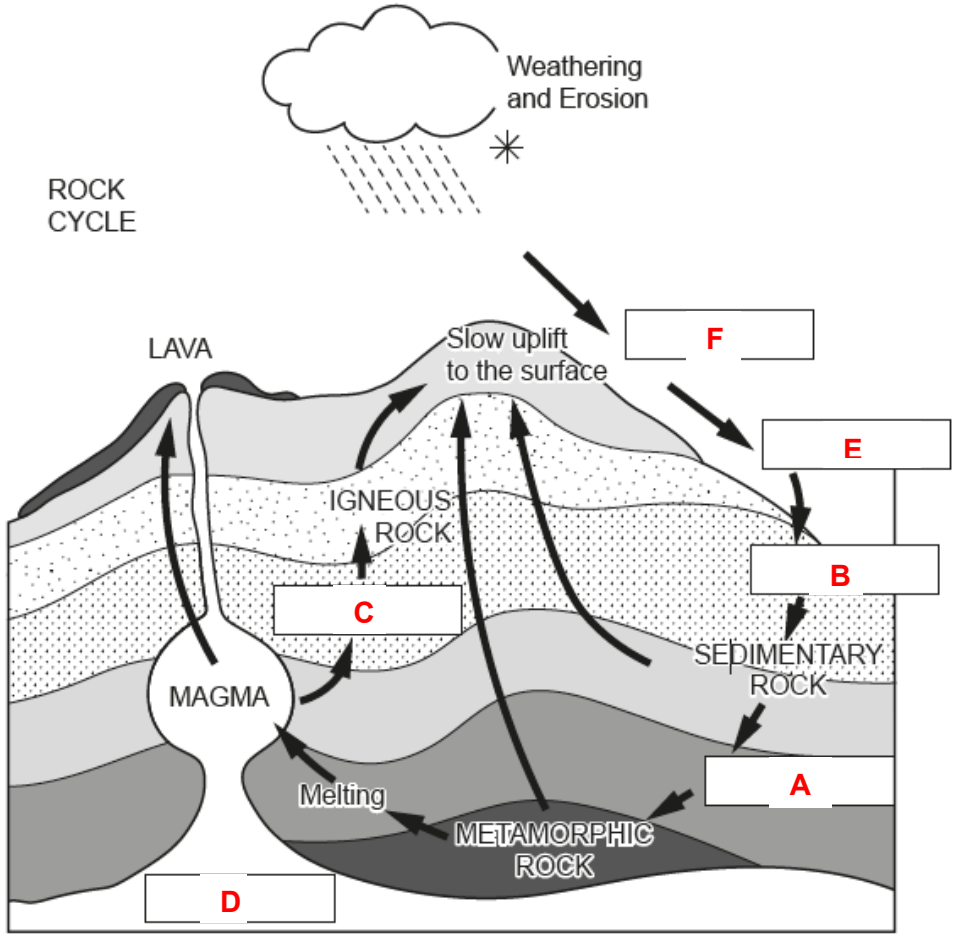
Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

You should ensure that you have copies of these materials.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

Question			Answer	Marks	AO Element	Guidance
1	(a)		 Any 2 labels correct ✓ 3 or 4 correct ✓✓ 5 or 6 correct ✓✓✓	3	AO1.1a AO1.1c	

<table>
<tr>
<td>1</td>
<td>(b)</td>
<td>(i)</td>
<td>
<table>
<tr><th></th><th>Rock A</th><th>Rock B</th><th>Rock C</th></tr>
<tr><td>Crystal size (fine / medium / coarse)</td><td>Coarse</td><td>Coarse crystals in fine groundmass</td><td>Not visible</td></tr>
<tr><td>Texture</td><td>Equicrystalline / Equigranular</td><td>Porphyritic</td><td>Glassy</td></tr>
<tr><td>Colour</td><td>Black and white / grey and white / dark greenish grey and white</td><td>Pink / Red / Brown</td><td>Black</td></tr>
<tr><td>Rock type</td><td>Gabbro</td><td>Rhyolite / Porphyritic Rhyolite</td><td>Obsidian</td></tr>
</table>
1 mark for each correct row in the table; ✓✓✓
</td>
<td>4</td>
<td>AO2.1b
AO3.1a
AO3.1e</td>
<td>Crystal size AO2.1b
Texture AO3.1a
Colour AO3.1a
Rock type AO3.1e

ALLOW 1 Mark for any correct column If NO rows are accurate

ALLOW orange for Rock B

ALLOW diorite for rock A
ALLOW porphyry for rock B</td>
</tr>
<tr>
<td>1</td>
<td>(b)</td>
<td>(ii)</td>
<td><u>Any 3 valid points:</u>

M1 Accurate scale bar ✓
M2 Accurate crystal size drawn according to their scale 1- 3cm in diameter ✓

M3 Accurate crystal shape drawn ✓

M4 Groundmass / fine <u>crystals</u> labelled ✓
M5 Phenocrysts / coarse <u>crystals</u> labelled ✓

M6 Euhedral shape labelled ✓
M7 Porphyritic texture labelled ✓</td>
<td>3</td>
<td>AO2.1b</td>
<td>Any part of hand specimen may be drawn.</td>
</tr>
</table>

1	**(b)**	**(iii)**	**<u>Both have (similarities):</u>** M1 One stage of cooling / Glassy – single stage of cooling AND Equigranular – single stage of cooling ✓ **<u>Differences:</u>** M2 Gabbro is intrusive / plutonic in origin AND Obsidian is Extrusive / Volcanic ✓ M3 Gabbro is slow-cooling AND Obsidian is fast cooling ✓ M4 Gabbro is mafic AND Obsidian is silicic / Gabbro has 44-52% Silica content AND Obsidian >66% ✓ M5 Gabbro forms at Divergent Plate Margins AND Obsidian at Convergent ✓	3	AO3.1a AO3.1e	Comparison must be made to gain credit (not a simple list for each) 1 mark **MAX** for similarity **MAX** 2 marks for differences only **ALLOW ECF** from 1 b (i) if misidentified for 1 mark **MAX**

1	(c)	*	**Level 3 (5–6 marks)** Accurately places geological features from the diagram in chronological order with **detailed** explanations of how they link to the **rock cycle AND relative dating** laws to support their answer e.g. superposition / cross-cutting relationships / included fragments / original horizontality. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** Places some geological features in chronological order AND attempts to link their formation to the rock cycle OR relative dating *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** Attempts to place some geological features in chronological order OR attempt to identify parts of the rock cycle OR some ideas about relative dating in which some of the rock units are formed. *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* **0 marks** *No response or no response worthy of credit.*	6	AO1.1a AO1.1c AO2.1a AO3.1a AO3.1b	**Content may include:** **Rock Cycle;** Deposition of sedimentary layers / burial / compaction / cementation / diagenesis to form sedimentary rocks followed by tilting / folding / deformation Intrusion of granite discordantly / stoping / assimilation to metamorphose country rocks and form a metamorphic aureole and contact metamorphism / recrystallisation of county rocks Period of uplift and erosion to expose granite and country rock forming an angular unconformity. Deposition of upper series unconformably to include eroded granite material

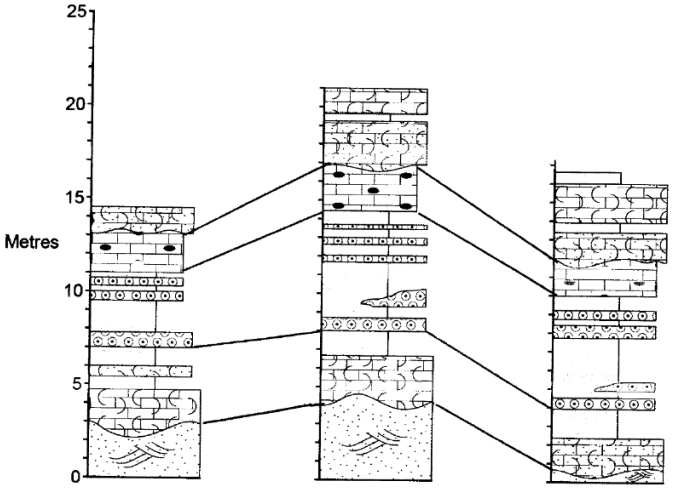
						<u>Relative Dating;</u> Principle of Superposition; O, M, K, J, G, E/N, L, I, H and F, (granite, metamorphic rocks) D, C, B and A Principle of Original Horizontality; lower series rock O must be oldest unless inverted Law of Cross Cutting Relationships; Granite intrudes and cuts across country rock / Metamorphic Aureole Law of included Fragments; Xenoliths / inclusions of country rock in the granite / fragments of Granite in bed D <u>Other valid points which may be present;</u> Comments re environments of deposition of Sedimentary rocks

Question			Answer	Mark	AO Element	Guidance
2	(a)	(i)	**First check the answer on the answer line.** **If answer = 29(%) award 2 marks** $$percentage\ change = \frac{new\ quantity - original\ quantity}{original\ quantity} \times 100$$ M1 (54-42) / 42 x 100 = 28.57 ✓ M2 29% to 2 SF ✓	2	AO2.1b	1 mark for correct working **ALLOW** 28.6 for M1 **DO NOT ALLOW** 28
2	(a)	(ii)	**First check the answer on the answer line.** **If answer = 0.5 ($^oC\ cm^{-1}$) award 2 marks** Calculate the difference in temperature between B and C (5^{o}C) and divide by 10 cm. M1 (25-20=5)/10 ✓ M2 0.5 ($^oC\ cm^{-1}$) ✓	2	AO2.1b	1 mark for correct working **ALLOW** the rate of temperature change given as a positive or negative answer
2	(a)	(iii)	M1 Heat transfer would be quicker ✓ M2 Water filling pore spaces would act as a conduit / water is better at transferring heat / water is a more efficient conductor of heat ✓	2	AO3.1c	1 mark for identifying the difference 1 mark for explanation of difference

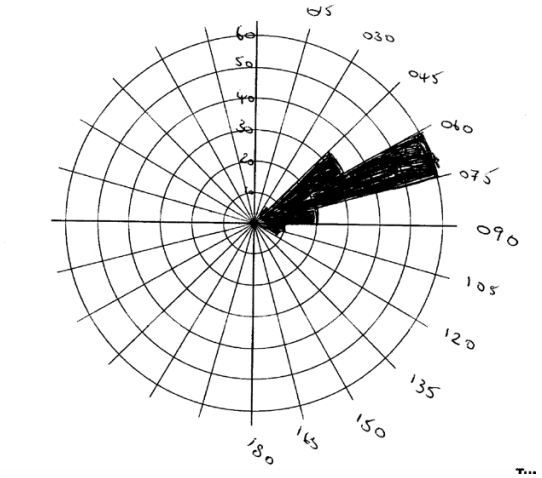
2	**(a)**	**(iv)**	M1 Unknown temperature of immersion heater / efficiency of immersion heater ✓ M2 Variation in temperature of surroundings during the experiment ✓ M3 Accuracy of thermometers ✓ M4 Issue with thermometers or can remaining upright in the sand / difficulties ensuring all the thermometer bulbs are at the same depth within the sand ✓ M5 Water inside the can may drop in temperature before experiment has started ✓ M6 Total time of experiment not long enough for heat transfer ✓ M7 Difficulties accurately measuring the distance between the thermometers ✓ M8 Variations in the size of sand grains / composition of grains ✓	3	AO3.1a	Any 3 valid ideas
2	**(b)**	**(i)**	M1 Foliation / schistosity / aligned platy minerals / micas / biotite / muscovite aligned ✓ M2 Porphyroblastic / garnet porphyroblasts ✓	2	AO2.1b	
	(b)	**(ii)**	Schist	1	AO1.1a	

2	**(b)**	**(iii) ***	**Level 3 (5–6 marks)** Clear links between metamorphic facies / **conditions of metamorphism** e.g. appropriate temperatures and pressures with the formation of mica foliation and recrystallisation to form garnet porphyroblasts. Specific values / ranges of temperature and pressure may be given. Explains that these conditions lead to the formation of new minerals e.g. **Index minerals and/ or changing stability of minerals** and maybe outlines why this cannot occur due to contact metamorphism. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** Some links are made between pressure and temperature conditions and foliated texture and / or porphyroblastic texture. Some awareness of growth of new minerals. Mentions medium grade / medium temperature / medium pressure to form regional metamorphism rock / facies *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** Simple ideas that increased temperatures and / or pressure are required to form Regional Metamorphic rocks and / or simple ideas about new minerals / textures forming. May state high temperature / pressure instead of medium. *There is an attempt at a logical structure with a line of reasoning. The information is only partially relevant.*	6	AO1.1c AO2.1a AO3.1c	**Content may include:** **Mineralogy;** Barrovian Index minerals are Garnet and Biotite mica indicating medium grade. Absence of Kyanite / Sillimanite at high grade or Chlorite changed into Biotite as grade increases **Texture;** Requires medium directed pressure to align minerals / foliation / perpendicular to pressure / form Schistosity / medium sized crystals ALLOW values around 300-500 MPa Medium temperature allows growth of Garnet porphyroblasts / large porphyroblasts indicate long duration of metamorphism ALLOW values around 300-500° C

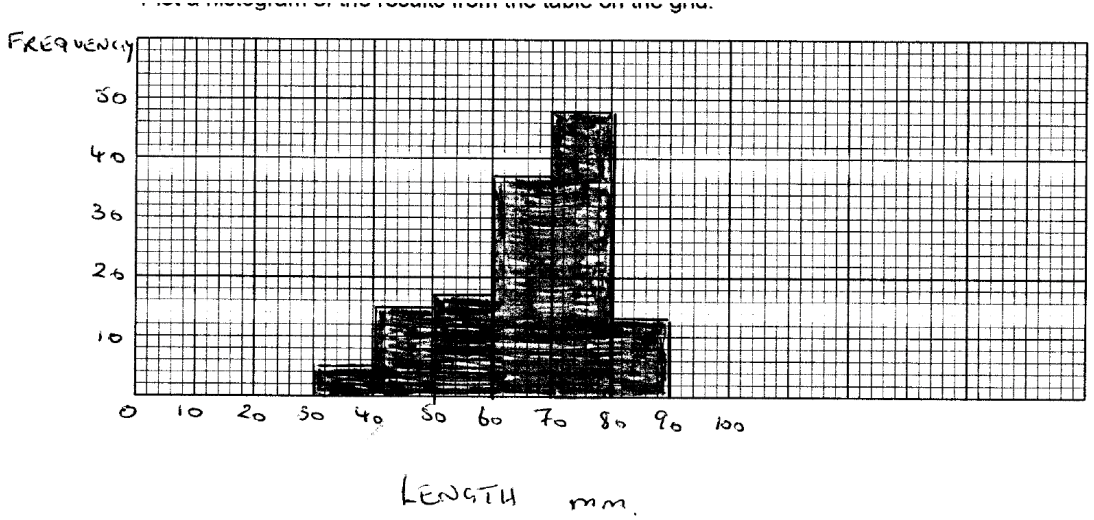
			0 marks No response or no response worthy of credit.			**Conditions of metamorphism;** Medium temperature / Medium grade to form garnet / parent rock should be rich in clay minerals / clay minerals become unstable and change to biotite and/or garnet Greenschist Facies Regional Metamorphism not Contact due to mineral re-alignment. Medium pressure to form schistosity **Tectonic Setting;** Convergent plate margins / collision zones / orogenic belts / fold mountain belts / deep underground **Check answer for 2bii;** **ALLOW** responses which refer to a higher metamorphic grade if candidates answered Gneiss OR a lower grade if they answered Slate

Question			Answer	Mark	AO Element	Guidance
3	(a)	(i)	<u>Any 3;</u> M1 Base of lower Shelly Limestone / Top of the cross stratified Sandstone (lower erosive surface) ✓ M2 Base of the lowest Oolitic Limestone ✓ M3 Base of the Limestone containing Nodules✓ M4 Base of upper Shelly Limestone / Top of the Limestone containing Nodules (upper erosive surface) ✓  M1 1 or 2 correct lines ✓ M2 3 correct lines ✓✓	2	AO2.1b	Lines must correlate AND connect to all 3 sections; **ALLOW**; lines not drawn with a ruler

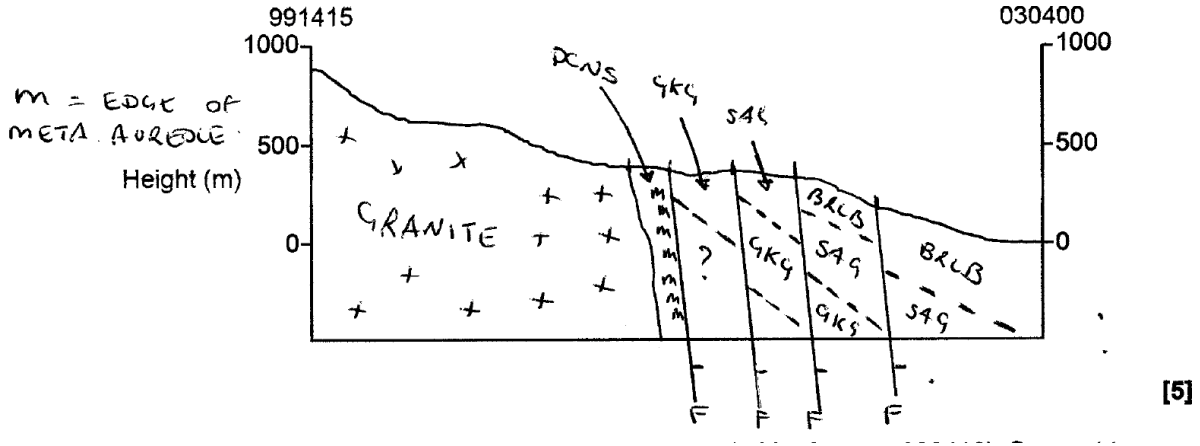
3	**(a)**	**(ii)**	<u>Any Two:</u> M1 Varying Rates of sedimentation producing variation in thickness of beds ✓ M2 Diachronous beds / zone fossils could die out during deposition of a diachronous rock ✓ M3 Erosion so some cycles / rocks / units are missing ✓ M4 Lateral variation in beds / wedging out of beds meaning beds appear in some logs and not others / different sedimentary environments may occur in different parts of the basin resulting in different rocks OR fossils ✓ M5 Planktonic or nektonic zone fossils could be found in a variety of different facies / rock types / ✓ M6 Derived Fossils / idea of fossil eroded from an older rock and deposited in a younger ✓	2	AO1.1c AO3.1c	**ALLOW;** rock / unit / bed / layer

3	**(b)**	**(i)**	 M1 Appropriate Frequency scale AND orientations labelled ✓ M2 Accurate plot ✓	2	AO2.1b	Degrees labelled with 4 or more orientations OR 4 compass points The scale can be placed on any of the spokes of the circle. Candidates can achieve full marks whether they plot both sides or half of the rose diagram. **ALLOW** 1 plotting error for M2 **ALLOW** orientations as 2 figure numbers for M1 **DO NOT ALLOW** M2 if there is no scale on one of the spokes of the circle

3	**(b)**	**(ii)**	<u>Current direction;</u> M1 ENE / WSW / current flowed from ENE to WSW ora ✓ <u>Explanation;</u> M2 Palaeocurrents had sufficient energy to align the Belemnites / concept of some energy present to cause alignment ✓ M3 Fossils align with long axes / guard long axes parallel to the current direction / align to line of least resistance parallel to current ✓	2	AO3.1b	**ALLOW ECF;** 1 mark for current direction **DO NOT ALLOW;** NE / SW unless ECF for M1 **DO NOT ALLOW;** high energy for M2 as Belemnites are relatively intact

3	**(b)**	**(iii)**	M1 Axes correctly labelled ✓ M2 Accurate plot of 6 bars ✓ ✓  	3	AO2.1b	X Axis can be labelled 0-10,11-20, etc. between lines as class widths OR as numbers below lines as shown in diagram Max marks require full histogram drawn **ALLOW** 1 plotting error **DO NOT ALLOW** M1 if scale is non-linear **DO NOT ALLOW** M2 if bars are not touching **ALLOW** if Y axis labelled Frequency density (0-5) & points plotted correctly (0.5, 1.5 etc)

3	**(b)**	**(iv)**	Skewed distribution / Negative skew / shape of graph described e.g. peak of the graph is to the right of centre	1	AO3.1a	**ALLOW ECF**
3	**(b)**	**(v)**	<u>Palaeoenvironment 1 mark max;</u> M1 Marine environment of deposition (due to presence of Belemnites) / low energy marine due to fine grained rock ✓ OR M2 Shallow marine / shelf environment (50-200m deep) / deeper continental shelf / slope environment ✓ <u>Any three from:</u> M3 A current was present which may have removed smaller belemnites / dominance of longer Belemnites (shown by frequency distribution graph / histogram) ✓ M4 Current flowed ENE or WSW / uni-directional current / rose diagram shows ENE-WSW direction ✓ M5 Clear alignment of fossils could indicate a current / turbidite deposit / formed as part of a turbidity current / part of a Bouma sequence ✓ M6 Death assemblage –due to having sunk after death ✓ M7 Belemnites were Nektonic/ lived in the water column ✓	4	AO1.1a AO1.1c AO3.1d	

Question			Answer	Mark	AO Element	Guidance
4	(a)		Any 5 correct: M1 Labelling of 3 or more rock units with names from stratigraphic column or other appropriate key ✓ M2 Boundary of igneous intrusion to show irregular / steep contact ✓ M3 Metamorphic aureole present parallel to granite contact AND labelled ✓ M4 4 faults correctly plotted dipping east AND labelled / 4 faults plotted vertically with downthrow side indicated to the left AND labelled ✓ M5 Downthrow of sedimentary rocks to the east correctly drawn across one fault ✓ M6 Correct Dip of beds plotted 30-40 degrees in the Devonian GKG and SAG OR 25 degrees in the Permian BRLB ✓  [5]	5	AO2.1b AO3.1b	**ALLOW** use of abbreviations from the map e.g. BRLB OR names from the key e.g. Brodick Beds OR rock types named in the key e.g. Breccia & dune cross bedded sandstones **DO NOT ALLOW** labelling of GKG as LMW OR CRLM as these labels have arrows indicting beds in another part of the map OR LSC for SAG OR KD for Granite **ALLOW** plotting of granite boundary as vertical as no structural information is on the map **ALLOW** vertical plotting of faults Dip angles +/- 5°

4	**(b)**		<u>Any two:</u> M1 Faults allow water ingress and can flood the area of extraction / faults can displace coal making extraction more difficult / uneconomic / faults could re activate due to mining activity ✓ M2 (30^{o}) dip of rocks results in rock instability / could cause landslides / is too steep for machinery to extract coal ✓ M3 Rock formation is not all coal making it less economic to extract ✓ M4 Presence of mudstones/ less competent rocks which could cause sides to collapse / presence of sandstone which could be permeable could lead to water ingress ✓ M5 Subsidence AND due to cavities in the limestone (below the coal measures)	2	AO2.1a	**DO NOT ALLOW** limestone permeability for M4 as Limestone dips below the coal measures

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