

GCE

Geology

H414/03: Practical skills in geology

A Level

Mark Scheme for June 2022

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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.

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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	<p>B Conglomerate C Greywacke D Mudstone</p>	2	<p>All three correct = 2 marks ✓✓</p> <p>Two correct = 1 mark ✓ None or One correct = 0 mark</p> <p>ALLOW For Rock D Shale or Clay</p>	3.1b
1	(a)	ii	<p>Grey mineral = Quartz ✓</p> <p>White mineral = Feldspar OR Plagioclase (Feldspar) OR Orthoclase (Feldspar) / Potash Feldspar / K Feldspar ✓</p>	2		3.1b
1	(a)	iii	<p>Sketch showing large grains at the base fining upwards ✓</p> <p>Two labelled features on the sketch from the following: ✓</p> <p>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</p>	2	<p>1 mark for sketch showing graded bedding</p> <p>1 mark for two accurate labelled features indicated with a line / arrow / bracket to indicate the feature</p> <p>ACCEPT ORA</p>	2.1b

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

1	(c)*	<p>Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.</p> <p>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):</p> <ul style="list-style-type: none"> ○ award the higher mark where the Communication Statement has been met. ○ award the lower mark where aspects of the Communication Statement have been missed. <p>• The Science Content determines the level. • The Communication Statement determines the mark within a level.</p>			
		<p>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. <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i></p> <p>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. <i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i></p> <p>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.</p>	6	<p>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</p> <p>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</p>	3.1c 2.1a

		<p><i>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</i></p> <p>0 marks <i>No response worthy of credit.</i></p>		<p>may have matrix (micrite) or cement (sparite)</p> <p>Named sedimentary basins could include: Welsh Basin – Silurian reef systems of the Wenlock and Aymestry limestones Jurassic Basins – Jurassic bioclastic Corallian limestone</p>	
2	(a)	<p>Porphyritic / coarser crystals surrounded by finer ✓</p> <p>Phenocrysts / Large / coarse pink / Orthoclase / K-feldspar / Potash ✓</p> <p>Medium grey / glassy / colourless quartz ✓</p> <p>Coarse white Plagioclase / Orthoclase / K feldspar / potash feldspar / feldspar (phenocrysts) ✓</p> <p>Finer / darker Biotite (mica) (groundmass) ✓</p> <p>Coarse / medium crystals are subhedral / euhedral ✓</p> <p>Groundmass is anhedral ✓</p>	3	<p>ALLOW 1 mark for general comment about coarse crystals / phenocrysts surrounded by finer crystals / groundmass</p> <p>ALLOW quartz referred to as Groundmass</p>	2.1b

2	(b)	<p>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 ✓</p> <p>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 ✓</p>	2	<p>1 mark MAX for reference to crystals forming Plutonically</p> <p>1 mark MAX for reference to crystals forming later/ Hypabyssally</p> <p>MUST have reference to magma cooling in 2 different places for 2 marks</p> <p>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</p>	3.1b
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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):

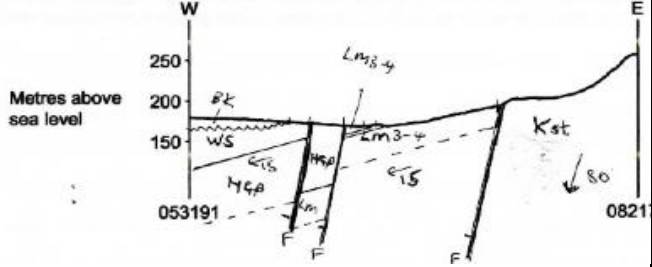
- award the higher mark where the Communication Statement has been met.
- award the lower mark where aspects of the Communication Statement have been missed.

• **The science content determines the level.**

• **The Communication Statement determines the mark within a level.**

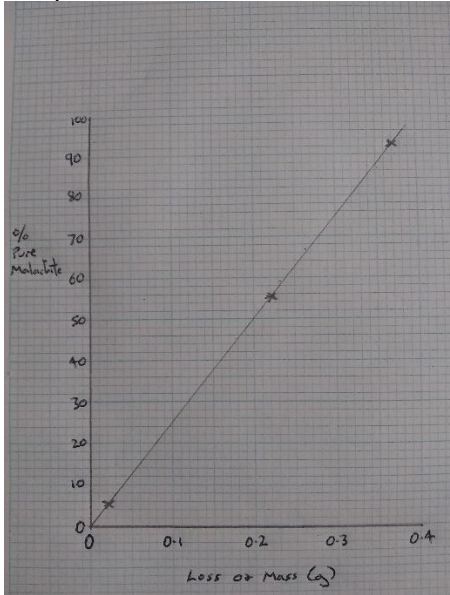
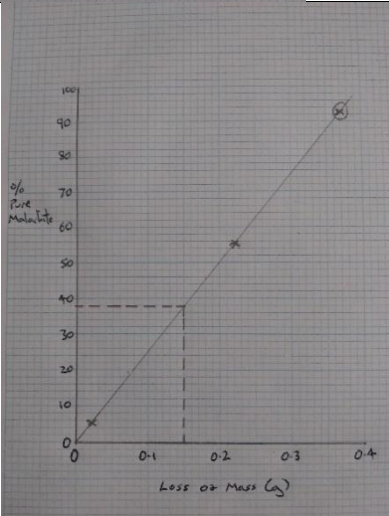
2	(c)*	<p>Level 3 (5-6 marks) A detailed description of how magmatic evolution may change the composition of the magma. Should include reference to minerals formed, rock types and include magmatic processes <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i></p> <p>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 <i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i></p> <p>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</p>	6	<p>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;</p> <ul style="list-style-type: none"> • 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
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		<p><i>There is an attempt at logical structure with a line of reasoning. The information is in the most part relevant.</i></p> <p>0 marks <i>No response worthy of credit.</i></p>		<ul style="list-style-type: none"> • 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 <p>AO2.1a Apply knowledge and understanding of geological ideas</p> <ul style="list-style-type: none"> • Knowledge that early formed crystals will deprive the magma of certain elements <p>ACCEPT ideas about the possible tectonic setting of a silicic magma at convergent plate margin settings.</p>	
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<p>3</p>	<p>(a)</p>	<p>(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 displacement 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 ✓</p>	<p>3</p>	<p>ALLOW the boundary between Kst and LM3- 4 to be shown as a faulted contact (diagram below) OR to be shown as conformable</p>  <p>ALLOW the colours of the rocks shown on the map for the labelling mark ACCEPT faults drawn vertically</p>	<p>2.1b 3.1c</p>
<p>3</p>	<p>a</p>	<p>(ii) FIRST CHECK ANSWER ON ANSWER LINE If answer = 270.(0262385) m) award 3 marks True thickness of bedding plane = $(h \cos \theta) + (L \sin \theta)$ ✓ Apparent thickness (L) = 950m OR Height difference(h) = 25m OR Angle of dip = 15° ✓</p>	<p>3</p>	<p>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</p>	<p>2.1b</p>

			$(25 \times \cos 15) + (950 \times \sin 15) \checkmark$ $24.15 + 245.88 = 270.03 \checkmark$		ACCEPT ; for tolerance; $(23-27 \times \cos 15) + (945-955 \times \sin 15)$ 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 \checkmark Younger beds are downthrown / downthrown towards west / SW / NW \checkmark	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 \checkmark Linear \checkmark Parallel with each other \checkmark Perpendicular to the thrust fault / fault bounding LwF / Kst \checkmark Trend is NW-SE or N-S \checkmark Restricted to rock LwF \checkmark	2		3.1a
3	c		092191 OR 090186 \checkmark	1	ALLOW any 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	<p>Reinforced raft foundations ✓ AND To strengthen the foundations so that subsidence does not occur / to ensure structure moves as a unit ✓</p> <p>OR PVC/ sand layers to isolate foundations from surface movement ✓ AND To strengthen the foundations so that subsidence does not occur ✓</p> <p>OR Backfilling of mine ✓ AND To provide support to the mine/ stops subsidence / void / stope ✓</p> <p>OR Drain water / regrade / vegetate / add retaining walls AND To stables waste / spoil heaps</p> <p>OR Pump out methane AND To stop build of explosive gas</p>	2	<p>One mark for strategy One mark for development of the idea</p> <p>ALLOW Two ideas without development for 1 mark</p>	<p>1.1c 2.1b</p>
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4	a	<p>Correctly drawn and labelled axes ✓</p> <p>All three points correctly plotted ✓</p> <p>Line of best fit drawn ✓</p>	3	<p>ACCEPT points plotted with a tolerance of +/- half a square</p> 	2.1b
4	b	<p>Correct plot circled (Sample C) ✓</p>	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

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

	a	iii	<p>FIRST CHECK ANSWER IN TABLE If answer = 588.24ppm award 2 marks</p> <p>Concentration factor = <u>Concentration of metal in Ore</u> Average crustal abundance OR 4 / 0.0068 ✓ = 588.24ppm ✓</p>	2	Max one mark if answer not given to 2 d.p.	2.1b
5	b		<p>Two Issues stated and explained:</p> <p>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 ✓</p> <p>Lateral / vertical rock type changes AND Issues with variable hardness / stability / cost / ease of working ✓</p> <p>Porosity and permeability issues ✓ AND Porous / permeable rocks may cause flooding into the mine ✓</p> <p>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 ✓</p>	4	<p>2 Marks max should be awarded for each issue; 1 mark for stating the issue, 1 mark for explanation</p> <p>Max 2 marks for issues stated with no development</p>	3.1a 1.1c

		<p>Type of mineralisation / veins being concentrated ore / porphyry deposits being dispersed ore / zonation of mineralisation / grade of the ore ✓</p> <p>AND Economically unviable to mine due to presence of gangue minerals / difficult to mine / purity of deposit affecting grade ✓</p> <p>Associated toxic elements present ✓</p> <p>AND Economic costs of land decontamination & pollution control ✓</p> <p>Water management / drainage / pumping of mine workings ✓</p> <p>AND Reserves unable to be mined / Economic cost of pumping water out of the mines ✓</p> <p>Cost of extraction / cost of subsequent reclamations / planning restrictions / cost of planning / strip ratio / depth of overburden / depth of deposit ✓</p> <p>AND costs incurred affect profit ✓</p> <p>Change to cut off grade ✓</p> <p>AND Affects how much of the ore can be mined / lower grade deposits can become viable / global ore prices / ORA ✓</p> <p>Size of deposit ✓</p> <p>AND Small / dispersed deposits may not be (economically) viable / not valuable enough for the costs involved in extraction</p>		<p>ACCEPT ORA</p>	
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5	c	<p>Powdered ore mixed with water ✓</p> <p>Mineral is made water repellent/ hydrophobic (using a specific chemical) ✓</p> <p>Air is pumped through liquid/ slurry ✓</p> <p>Hydrophobic particles attach to bubbles ✓</p> <p>Bubbles rise to the top to form a froth rich in the required mineral ✓</p> <p>Bubbles and mineral scooped / skimmed / collected from surface for processing ✓</p>	max 2		2.1b
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