OCR
Oxford Cambridge and RSA

Tuesday 21 June 2022 – Morning

A Level Geology

H414/03 Practical skills in geology

Time allowed: 1 hour 30 minutes

You must have:
- the Insert (inside this document)

You can use:
- a ruler (cm/mm)
- an HB pencil
- a protractor
- a scientific or graphical calculator

Please write clearly in black ink. **Do not write in the barcodes.**

Centre number | | | | | | Candidate number | | | | |

First name(s) _____

Last name _____

INSTRUCTIONS
- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided. If you need extra space use the lined pages at the end of this booklet. The question numbers must be clearly shown.
- Answer **all** the questions.
- Where appropriate, your answer should be supported with working. Marks might be given for using a correct method, even if your answer is wrong.

INFORMATION
- The total mark for this paper is **60**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended response will be assessed in questions marked with an asterisk (*).
- This document has **20** pages.

ADVICE
- Read each question carefully before you start your answer.

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Answer **all** the questions.

1 **(a)** The table shows information about four different siliciclastic rocks.

Sample	Grain size	Roundness	Sorting	Composition	Rock type
A	>2 mm	Angular	Poor	Large rock clasts, smaller sand-sized grains and a fine sandy matrix	Breccia
B	>2 mm	Rounded	Poor	Large rock clasts, smaller sand-sized grains and a fine sandy matrix	
C	0.0625–2 mm	Angular to sub-angular	Poor	Rock clasts, grey and white sand-sized grains, clay matrix	
D	<0.0625 mm	Cannot be seen with hand lens	Cannot be seen with hand lens	Cannot be seen with hand lens	

(i) Complete the table by identifying samples **B**, **C** and **D**. Sample **A** has been completed for you. **[2]**

(ii) Rock **C** contains grains of **two** unidentified minerals.

- The first is a grey mineral that shows no cleavage and cannot be scratched by a steel nail.
- The second is a white mineral and shows two good planes of cleavage.

Identify these **two** minerals.

Grey mineral .....

White mineral .....

[2]

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(iii) **Fig. 1.1** in the **Insert** shows a photograph of rock **C** taken in the field.

Sketch the sedimentary structure shown in the photograph. Include labels in your sketch.

[2]

(b) **Fig. 1.2** shows a thin-section diagram of Jurassic Oolite.

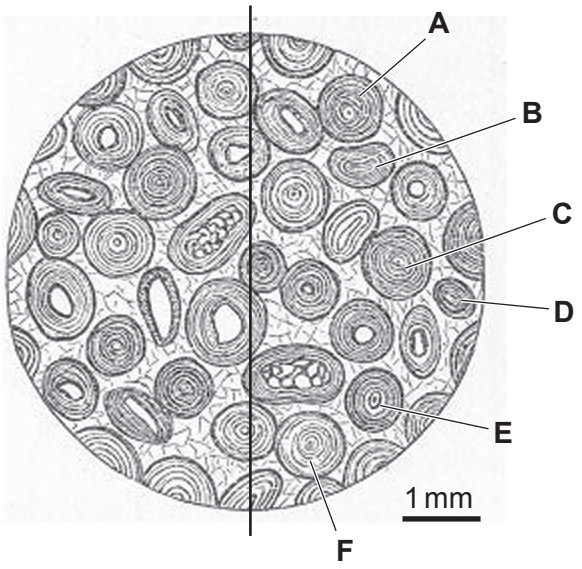

Fig. 1.2

(i) Annotate **Fig. 1.2** to show the key features of this oolite.

Write your annotations on the left-hand side of the thin-section diagram. **[2]**

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(ii) Measure the maximum diameter of the grains labelled **A** to **F** on **Fig. 1.2** and calculate the mode. Write your measurements in the table.

Grain	Maximum diameter
A	
B	
C	
D	
E	
F	
Mode	

[2]

(iii) Calculate the magnification of the thin-section diagram.

Magnification = ... **[2]**

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(c)* Describe the similarities and differences that could be observed in the field between bioclastic and reef limestones.

In your answer you should describe the depositional environment for each limestone and refer to a named sedimentary basin where they could both be found.

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Additional answer space if required.

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2 **Fig. 2.1** in the **Insert** shows a photograph of a hand specimen taken from an igneous outcrop.

(a) Using specific igneous terminology, describe the texture shown in the photograph in **Fig. 2.1**.

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..... **[3]**

(b) Explain the process or processes that formed the texture shown in **Fig. 2.1**.

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..... **[2]**

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(c)* Describe the processes involved in the evolution of magma to produce rocks of varying compositions.

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Additional answer space if required.

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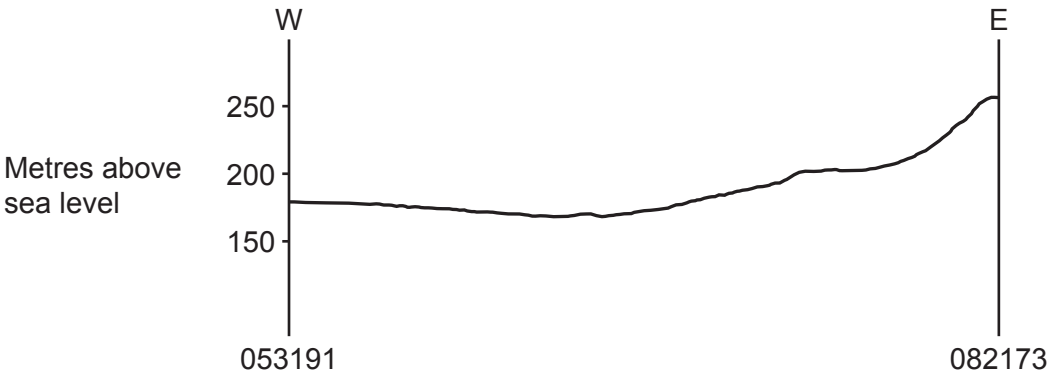
3 The 1:50 000 scale geological map excerpt (Whitehaven), **Fig. 3.1** in the **Insert**, should be used for this question.

(a) (i) On the topographic sketch profile below, draw and label a cross-section of the solid geology from grid reference 053191 in the West to 082173 in the East. These grid references have been marked in yellow on the map.



[3]

(ii) Using the map and a dip of 15°, calculate the true thickness of the Great Scar Limestone Group.

Thickness = ... m **[3]**

(iii) Using the correct geological terminology, fully describe the relative movement of the faults shown on your cross section. Give **one** piece of supporting evidence.

Movement .....

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Evidence .....

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[2]

(b) Comment on the distribution of metallic deposits that are found in the rocks shown in the south-east portion of the map.

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..... **[2]**

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(c) State a grid reference where you may find further metallic deposits of the same type.

..... **[1]**

(d) In this area, coal mining has taken place in the Carboniferous strata.

Outline possible mitigations that could be used to reduce the geohazard risks associated with historical coal mining when constructing new buildings on the surface.

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..... **[2]**

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4 A student wanted to investigate the quality of some copper ore minerals in the laboratory to see if they had a content which approached that of an economic ore deposit.

The student had three pieces of malachite (copper carbonate ore) as hand specimens **A**, **B** and **C**. The student decided to measure the loss of mass of crushed samples of ore when reacted with 1M HCl (hydrochloric acid). The loss of mass equates to the loss of CO_2 from the ore during the reaction.

Method:
- each sample was crushed
- 2 g of each crushed sample **A**, **B** and **C** were placed onto separate pieces of paper
- a 250 ml beaker was placed on an electronic balance
- 50 ml of 1M HCl was added to the beaker
- the balance was tared (set to zero)
- sample **A** was added to the beaker and left for 6 minutes
- the loss of mass was recorded in g
- the experiment was repeated using samples **B** and **C**.

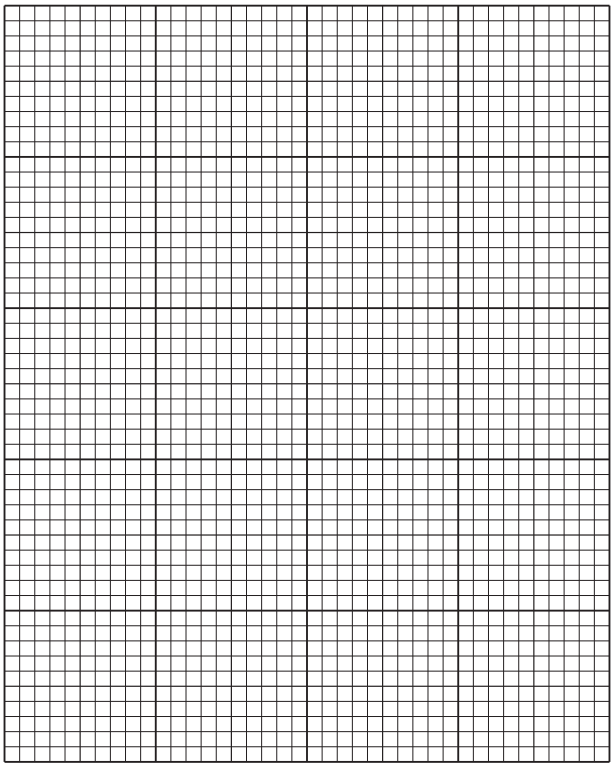
It is assumed that the reaction is complete after 6 minutes.

Pure malachite loses 19.9% of its mass by the evolution of CO_2 during the experiment.

The table shows the student's results.

	Sample		
	A	**B**	**C**
Mass of sample (g)	2.00	2.00	2.00
Loss of mass (g)	0.22	0.02	0.37
Pure malachite in a 2 g sample (%)	55.28	5.00	92.96

(a) Plot the results on a graph, loss of mass (g) against calculated percentage of pure malachite. Draw a line of best fit.



[3]

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(b) Circle on the graph the position of the purest sample. **[1]**

(c) Using your graph, determine the purity of a copper sample with a loss of mass of 0.15 g.

..... **[1]**

(d) Give **one** reason why this method may not yield accurate results.

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..... **[1]**

(e) The table shows the top five highest grade open pit copper deposits in the world.

Location	Copper grade reserves %
Las Cruces, Spain	5.03
KOV, Democratic Republic of the Congo	4.20
Kinsevere, Democratic Republic of the Congo 2	3.55
Sepon, Laos	2.79
Antas, Brazil	2.58

Using this data and the data from the student's investigation, explain which sample, **A**, **B** or **C**, is most likely to form an economic ore deposit in a large copper pit.

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..... **[2]**

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5 **(a)** A mineral exploration company are analysing data to find a viable copper ore deposit. **Fig. 5.1** shows stream sediment analysis data within the area of interest.

The data shown indicates concentration of copper in parts per million (ppm).

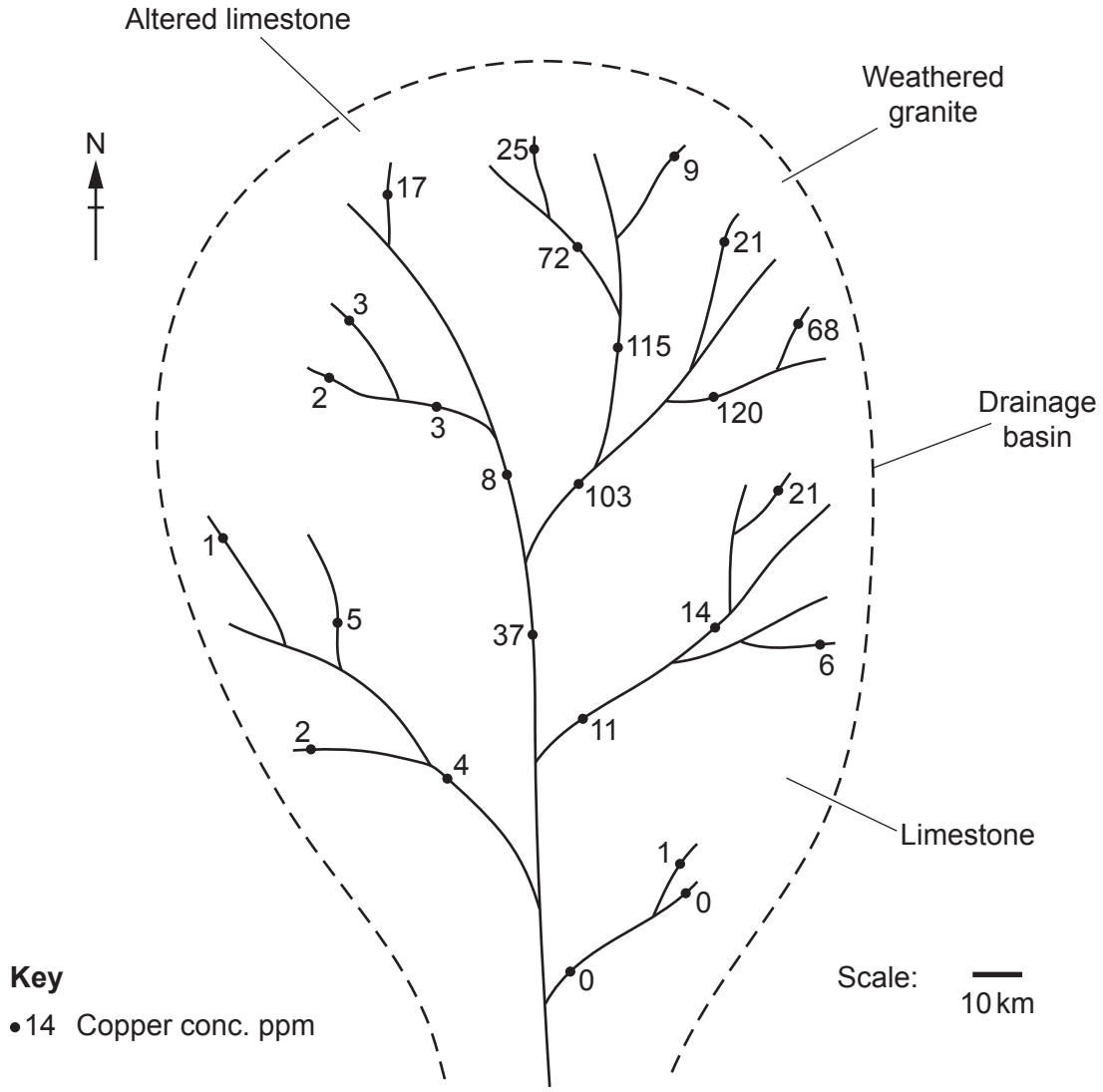

Fig. 5.1

(i) **Circle** an area **on Fig. 5.1** that shows an anomalous level of copper in the stream sediments. **[1]**

(ii) **Shade** an area **on Fig. 5.1** where the copper ore deposit is most likely to be found. **[1]**

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(iii) The ore deposit was found to contain 4% copper.

Calculate the concentration factor of this ore deposit, assuming the average crustal abundance of copper is 0.0068%.

Give your answer to **2** decimal places.

Concentration factor = ... **[2]**

(b) State and explain **two** possible issues that would affect the economic viability of extracting a proven reserve of a metal ore.

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..... **[4]**

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(c) **Fig. 5.2** shows the froth flotation method of separating metal ore.

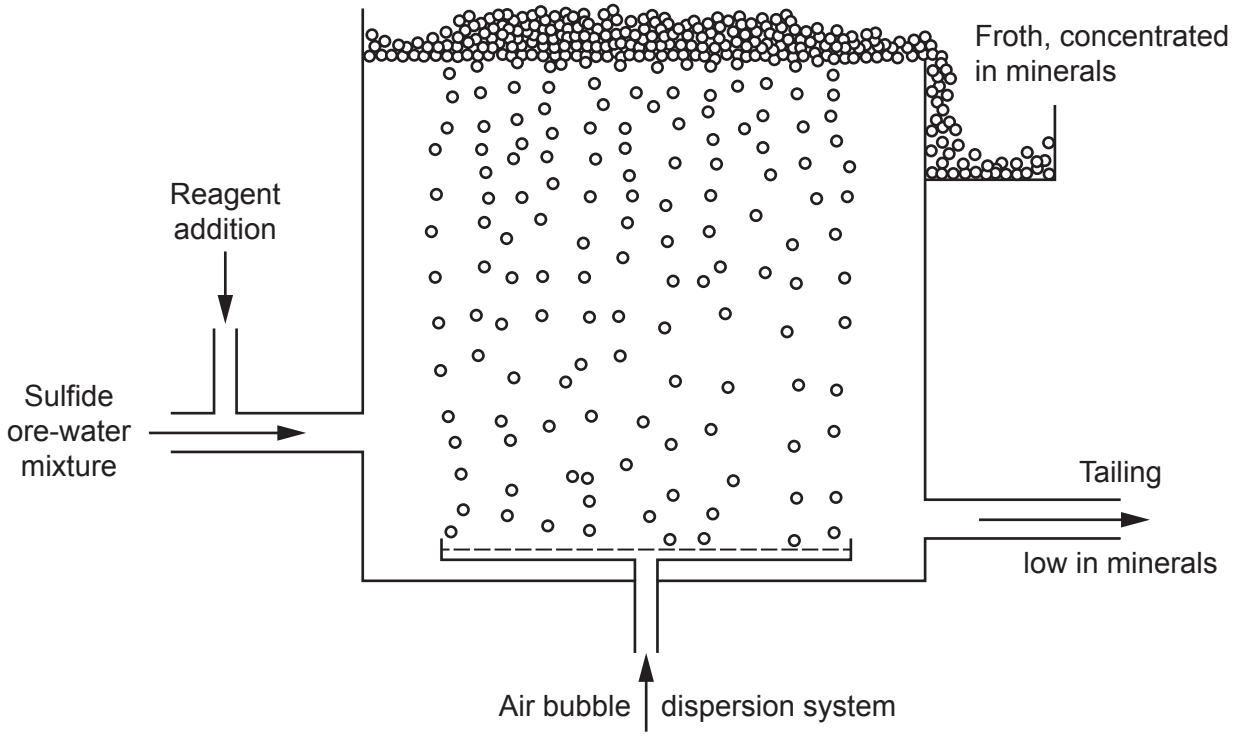

Fig. 5.2

Explain how this process concentrates the metal ore.

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..... **[2]**

END OF QUESTION PAPER

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ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).

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