OCR
Oxford Cambridge and RSA

Monday 19 October 2020 – 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

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H41403

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 **16** pages.

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

Answer **all** the questions.

1 **(a)** The thin-section diagram in Fig. 1.1 shows a metamorphic rock.

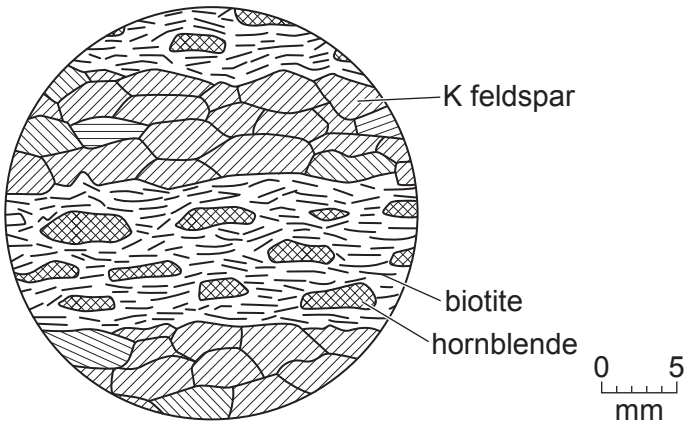

Fig. 1.1

(i) What term best describes the metamorphic fabric shown?

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

(ii) Identify the metamorphic rock shown in Fig. 1.1.

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

(b) Fig. 1.2 shows diagrams of the orientation of the platy minerals found in two rocks, **A** and **B**, which are undergoing stress.

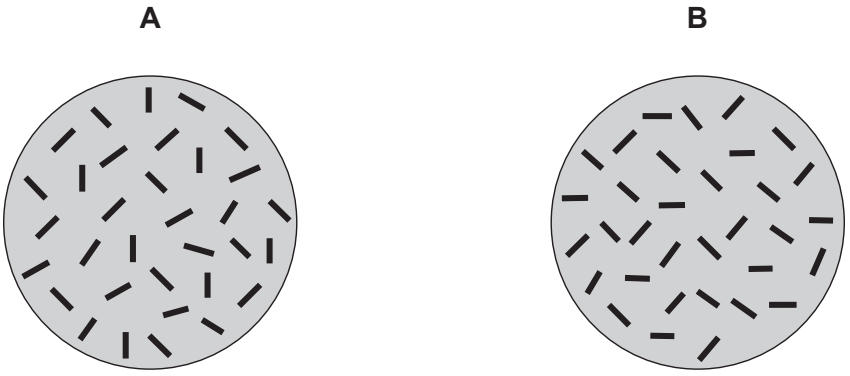

Fig. 1.2

(i) Using arrows, indicate **on Fig. 1.2** the principal stress directions (maximum and minimum, where appropriate) that result in the orientation of the platy minerals shown. **[1]**

(ii) Which of these rocks, **A** or **B**, is most likely to be a hornfels?

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

(c) Slaty cleavage occurs in fine grained rocks that have been formed by low-grade regional metamorphism. Use words from the following list to complete the sentences.

perpendicular muscovite garnet parallel quartz relict

Slaty cleavage only occurs in rocks consisting of platy minerals like ..... and mica. Slaty cleavage is usually ..... to axial planes of the folds but can be at any angle. Slaty cleavage cannot occur in rocks that have rounded grains composed of ..... . **[3]**

Turn over for the next question

2 Whilst on a geology field-trip to the Lake District, a student could identify a number of rocks which they considered to be igneous.

(a)* Evaluate the diagnostic features including texture, crystal size and mineralogy that may be used to identify igneous rocks in the field.

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Additional answer space if required.

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(b) Igneous rocks can be identified by examining their crystals. An igneous rock with crystals large enough to see without a microscope has a texture which is known as phaneritic.

(i) Using specific terminology, describe the crystals shown on the photograph in Fig. 2.1, **in the insert**.

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

(ii) Feldspars are the most common rock forming minerals in igneous rocks. They can be easily recognised by their colour: pink, grey or white.

Measure the maximum length for five pink feldspar crystals on the photograph in Fig. 2.1. Complete the table and calculate the mean crystal size.

Crystal	Pink feldspar crystals (mm)
1	
2	
3	
4	
5	
mean size	

[2]

(iii) Circle the rock type which most closely identifies the rock in Fig. 2.1.

pegmatite **basalt** **granite** **obsidian** **[1]**

(c) The photograph in Fig. 2.2, **in the insert**, shows an igneous intrusion studied by a student.

(i) Identify the igneous feature shown in Fig. 2.2.

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

(ii) In the space below, draw a fully labelled diagram to show the main features of the intrusion.

[3]

3 A student performed an experiment in a laboratory to determine the density of four unknown minerals **A** to **D**.

The student used the following practical method:

1. Take specimen **A**, place on a balance and obtain the mass in grams.
2. Fill a displacement can (eureka can) to the top with water and allow excess water to drip out of the spout.
3. Place a measuring cylinder under the spout of the displacement can.
4. Gently lower specimen **A** into the can, ensuring there is no splashing and collect the water that overflows through the spout.
5. Record the amount of displaced water in cm^3.
6. Repeat for specimens **B**, **C** and **D**.

The results for the experiment were recorded in Table 3.1.

	Mass of dry mineral (g)	**Volume of displaced water (cm^3)**
A	20.702	3.20
B	9.491	4.30
C	85.343	19.97
D	32.725	6.10

Table 3.1

(a) (i) Calculate the density of specimen **C**.

Give your answer in kg/m^3 and to **3** significant figures.

density = ... kg/m^3 **[3]**

(ii) With the exception of experimental error, give **one** reason why this method may not yield accurate results.

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

(iii) Describe and explain **one** safety precaution that must be considered during this practical.

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

(b) The student performed additional tests on the four specimens, recorded in Table 3.2 below.

Mineral	Colour	Hardness	Streak	Lustre
A	grey to black	2.5	grey	metallic
B	white to cream	3	white	glassy
C	white to colourless	3	white	glassy
D	black to brown	6	black	metallic

Table 3.2

Table 3.3 is a mineral identification table used by the student.

Mineral	Colour	Hardness	Streak	Lustre
Barite	white	3	white	variable
Calcite	white	3	white	glassy
Magnetite	black	6	black	metallic
Cassiterite	brown	6–7	brown	brilliant
Halite	white	2.5	white	glassy
Galena	grey	2.5	grey	metallic
Gypsum	white	2	white	variable

Table 3.3

(i) Use the information in Table 3.2 and Table 3.3 to identify minerals **A**, **C** and **D**.

Mineral **A**: .....

Mineral **C**: .....

Mineral **D**: ..... **[1]**

(ii) Mineral **B** has tentatively been identified as halite.

What simple, additional test could be undertaken to confirm that mineral **B** is halite?

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

(c) Describe a test that would allow you to determine the hardness of an unknown mineral.

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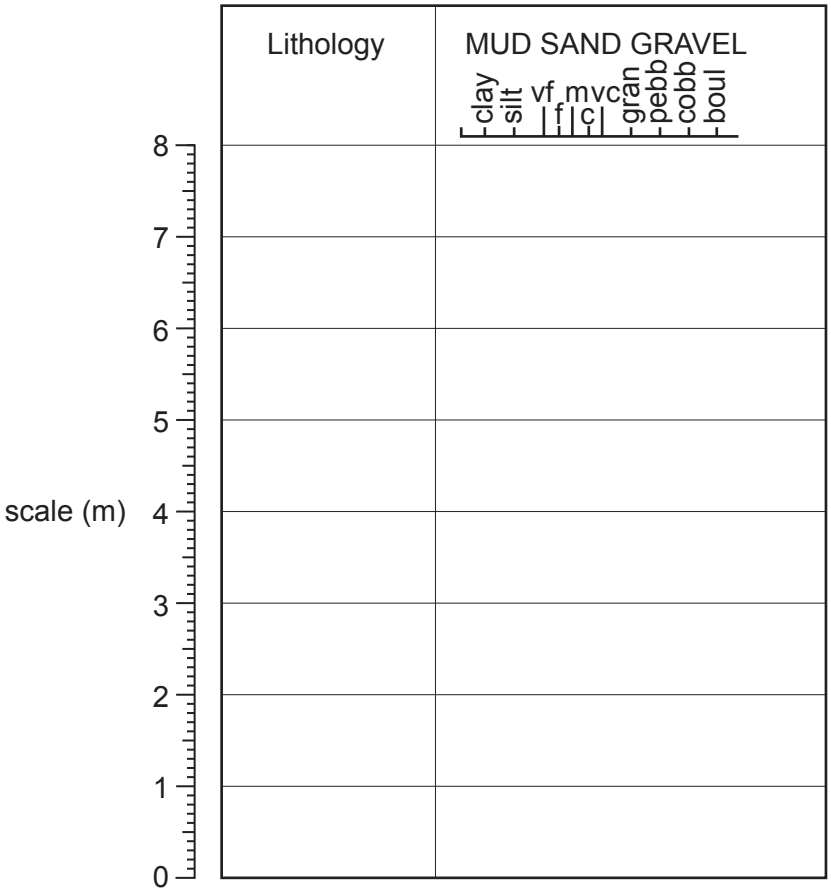
..... **[3]**

4 **(a)** An extract from a student's field notebook shows recordings made at an exposed cliff face. Six beds were identified by the student. Bed 6 is the oldest and bed 1 is the youngest.

Bed	Apparent thickness (cm)	Rock description	Features visible
1	140	fine grained mudstones and shale dark grey to greenish grey in colour	marine fossil bivalves present
2	20	brittle fragments of coal, black in colour	fossil plant remains
3	60	clay with fine sand grey in colour	fossil roots visible
4	320	coarse sandstone well cemented	cross-bedded
5	100	thinly bedded fine sand	marine bivalves no sedimentary structures
6	160	very fine grained mudstones and shale dark grey to brownish grey in colour	marine fossil bivalves present

(i) Use the data to plot a graphic log. Use suitable symbols to indicate the lithology and provide a key.



[4]

(ii) Use evidence from the graphic log and the extract from the student's field notebook to determine the environment of deposition for this sequence of sedimentary rocks.

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

(b) (i) **Bed 4** has an asymmetrically rippled upper surface which can be seen further along the cliff.

Describe how you could determine the direction of the water flow that created the ripples and how you could use a compass clinometer to give you a numeric value.

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

(ii) The apparent thickness of **Bed 4** was measured as 320 cm. The bed is dipping at an angle of 15°.

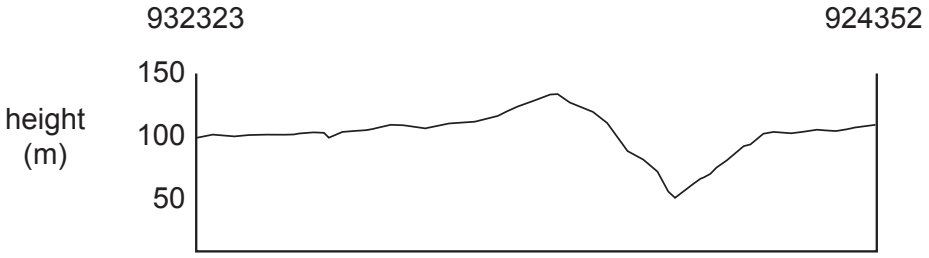
Calculate the true thickness of **Bed 4**.

true thickness = ... cm **[3]**

5 The 1:50 000 geological map of Beverley, **in the insert**, should be used for this question.

(a) (i) On the topographic sketch below, draw and clearly label a cross section from grid reference 932323 to 924352.

Use symbols to show the same rock types on your cross section.



[3]

(ii) Which method of relative dating can be used to date the rock layers in the cross section?

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

(iii) Assuming that the rock layers have not been inverted, identify using a six figure grid reference, the location of the oldest rock layer on your cross section.

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

(b) The area in the west of the map is largely covered by surface sand and gravel deposits. There are several open-cast quarries in this area extracting the sand and gravel for use in the construction industry.

The Humber Area Local Resources Plan has identified reserves of 7.1 million tonnes of sand and gravel in the region.

A 17 hectare site off Common Lane in North Cave (GR 875325) has been proposed as a site for a new open cast quarry.

(i) Calculate the lifespan of a potential quarry at Common Lane in North Cave if the:

- estimated reserves = 3 400 000 tonnes and
- estimated annual production = 600 000 tonnes

estimated lifespan = ...years **[1]**

(ii) Calculate the mass of sand and gravel that could be extracted per hectare.

Assume the sand and gravel deposits are of uniform thickness across the Common Lane site.

sand and gravel per hectare = ... tonnes **[1]**

(iii)* Open cast or surface mining is often considered to be an efficient and cost-effective method of mineral extraction.

Analyse the geological issues that may be encountered during the excavation of sand and gravel from this site and consider whether local authorities should support the proposed open cast quarry at the Common Lane site in North Cave (GR 875325).

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Additional answer space if required.

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(c) The South Cliffe Borehole (grid reference 879352) has identified the existence of a very thick seam of coal at 900 m below the surface.

Suggest geological reasons why, despite the coal seam being thick, coal mining has never taken place here.

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

END OF QUESTION PAPER

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).