OCR
Oxford Cambridge and RSA

# Monday 18 October 2021 – 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
- A4 plain paper

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)** **Fig. 1.1** shows a photograph of a geological fault.

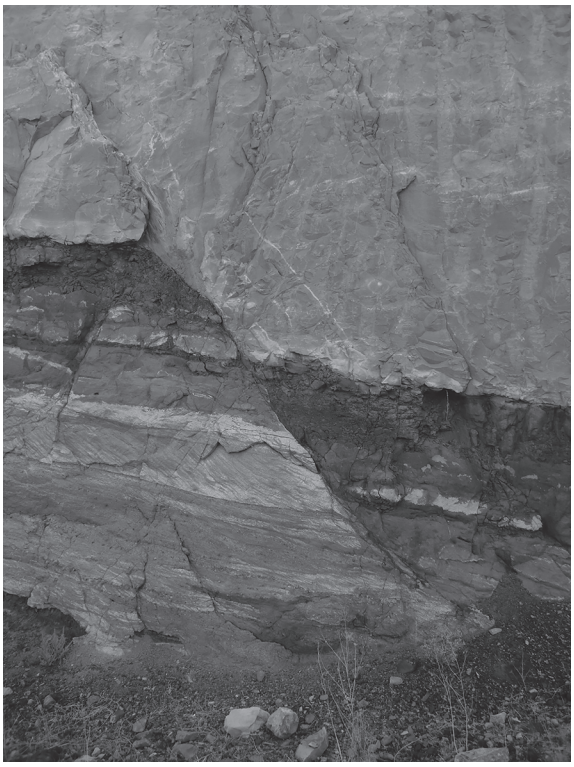


**Fig. 1.1**

**(i)** Measure the throw of the fault.

Give your answer in cm.

Throw = ..... cm **[1]**

**(ii)** Measure the angle of dip of the fault.

Dip = ..... **[1]**

**(iii)** Calculate the crustal extension shown in **Fig. 1.1**.

Crustal extension = ..... cm **[2]**

**(b) (i)** Fault traps allow the accumulation of oil and natural gas to occur in the North Sea Basin.

In the space provided, draw a fully labelled diagram to show the morphology of a fault trap.

**[4]**

**(ii)** Describe how oil and gas could be lost from a fault trap.

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

**(iii)** State **two** other types of oil trap found in the North Sea Basin.

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

**(c)** Faults are associated with stress and strain within crustal rocks.

A student conducted a simple laboratory experiment into the relationship between stress and strain by measuring the extension of a wire when an increasing number of masses were applied.

**Fig. 1.2** shows how the apparatus was set up at the start of the experiment.

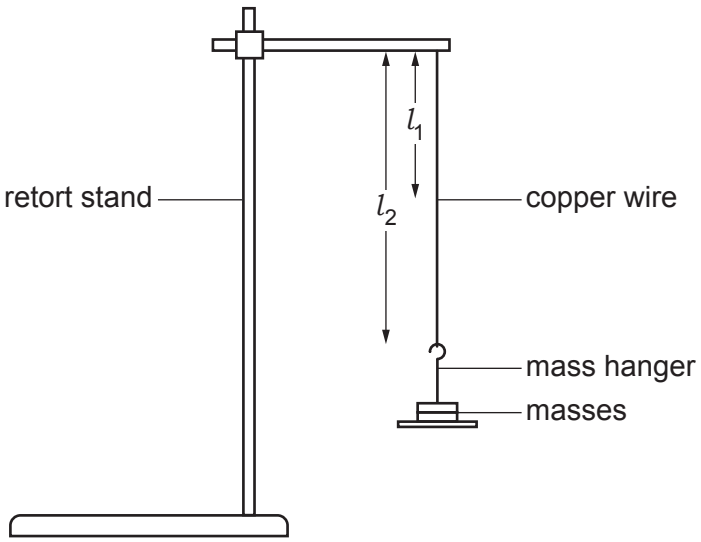
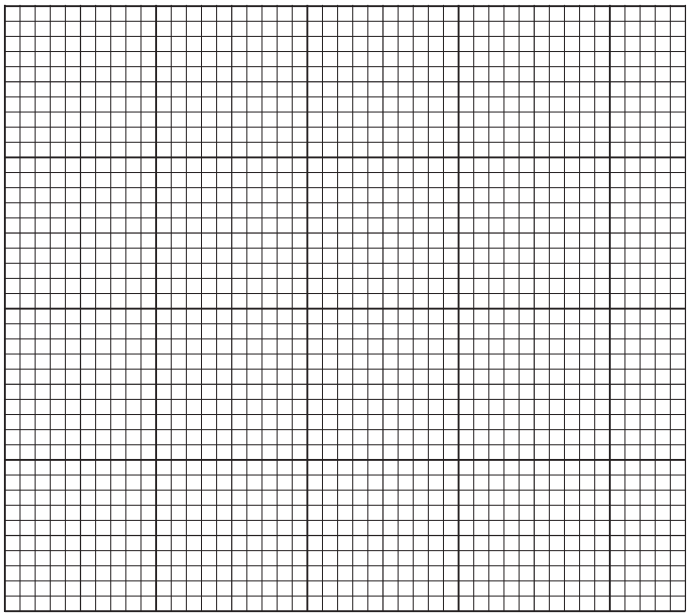



**Fig. 1.2**

The results from the experiment are shown in the table.

| **Mass (kg)** | **Extension (cm) (difference between $l_1$ and $l_2$)** |
|---|---|
| 0.5 | 2.5 |
| 1.0 | 5.0 |
| 1.5 | 7.5 |
| 2.0 | 10.0 |
| 2.5 | 15.0 |
| 3.0 | 20.0 |

**(i)** Plot the results in the table as a graph on the graph paper.



**[2]**

**(ii)** **On your graph**, label the following:

- elastic deformation
- elastic limit. **[2]**

**(iii)** **On your graph**, sketch the line you would expect if the temperature of the wire was increased. Label the line **T**. **[1]**

**(iv)** It was noted that during the experiment there was a ±0.05 cm degree of uncertainty with the results obtained.

Explain what this means.

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

**(v)** Using the information from this experiment and your own knowledge, define the term **stress**.

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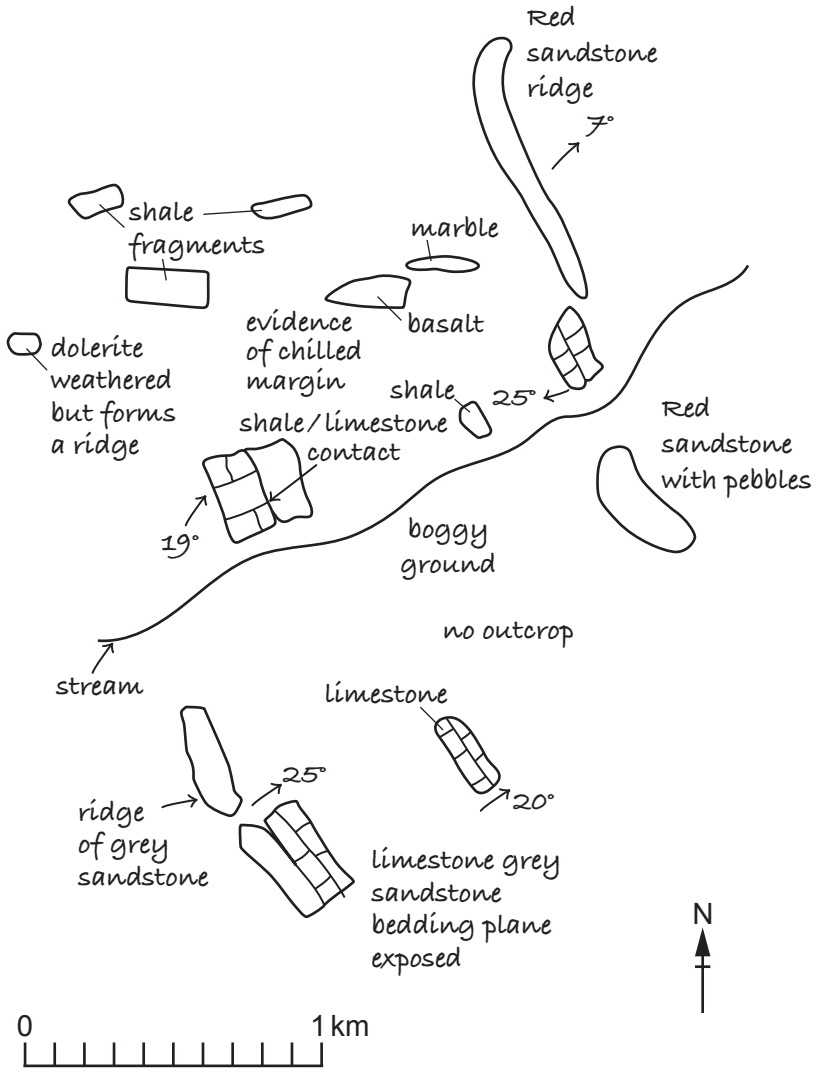
..... **[1]**

**2** The sketch map below, **Fig. 2.1**, is taken from an A Level Geology student's field notebook.




**KEY**

| Rock type | Rock symbol |
|---|---|
| Red sandstone | |
| Grey sandstone | |
| Shale | |
| Limestone | |
| Dolerite | |
| Marble | |

**Fig. 2.1**

**(a)** Complete the geological sketch map of the area to show:

– the range of different rock types, using rock symbols on the sketch map and in the key
– at least two other features of geological interest.

**[Answer on Fig. 2.1]** **[4]**

**(b)** **Fig. 2.2** below shows one of the rocks labelled on the sketch map.

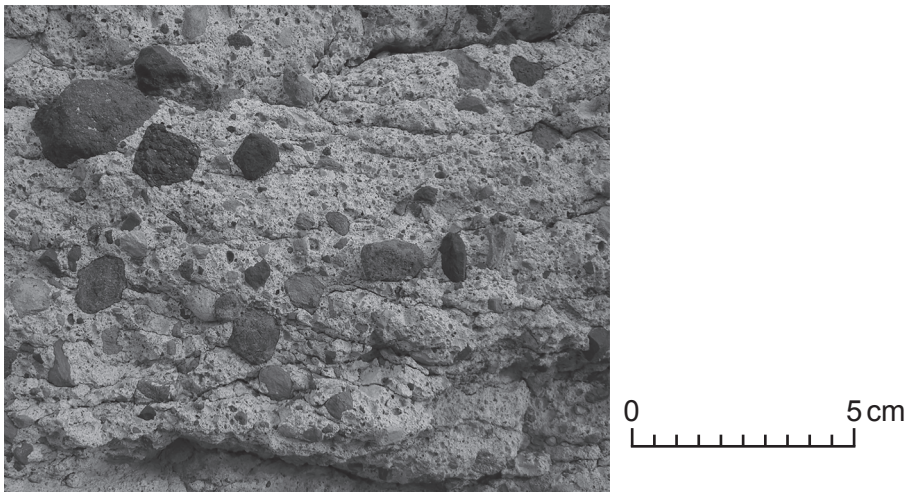



**Fig. 2.2**

Using ideas about the rock cycle, identify **three** geological processes which formed this rock.

1. .....

2. .....

3. .....

**[1]**

**(c)*** Identifying sedimentary sequences is an important part of geology fieldwork.

While undertaking geological fieldwork, a repeating sequence was found in a cliff outcrop. From top to bottom, this sequence consisted of coal underlain by seat earth containing plant roots, cross-bedded sandstone, marine shale containing bivalve fossils and then limestone.

Outline what other information could be gathered in the field in order to produce a graphic log of this sequence **and** how a student might then analyse, interpret and evaluate this information to determine the sedimentary environment of deposition of the sequence.

In your response, be clear to link the sedimentary rock characteristics to their position in the sedimentary environment.

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..... **[6]**

Additional answer space if required.

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**3** This question is about the sediments and processes that form Bouma sequences found in turbidite deposits, such as those found in the Welsh Basin.

**(a)** **Fig. 3.1** below shows a sedimentary structure found in a turbidite Bouma sequence, with a coin for scale.

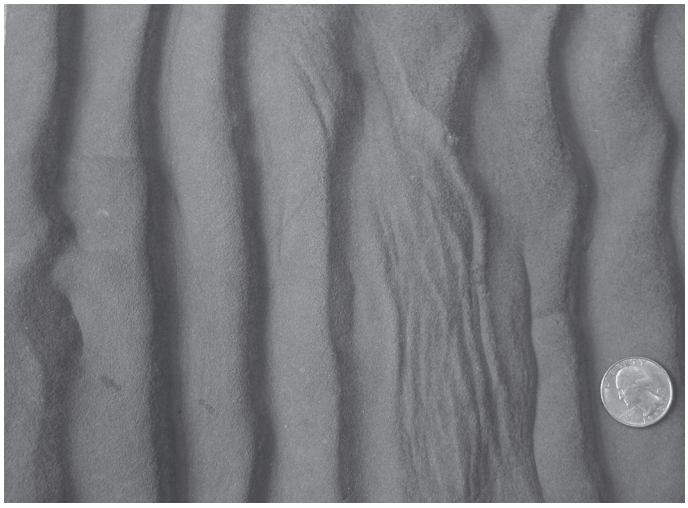

**Fig. 3.1**

**(i)** Identify the sedimentary structure shown.

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**(ii)** Flute casts are common sedimentary structures in turbidite Bouma sequences.

Explain how these sedimentary structures formed and how they can indicate the direction the current flowed in.

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

**(b)** The data shown in the table are readings taken from a student's field notebook. The readings measure the orientation (degrees from North) of a number of the sedimentary structures where the flow **direction** could be determined from a turbidite bouma sequence.

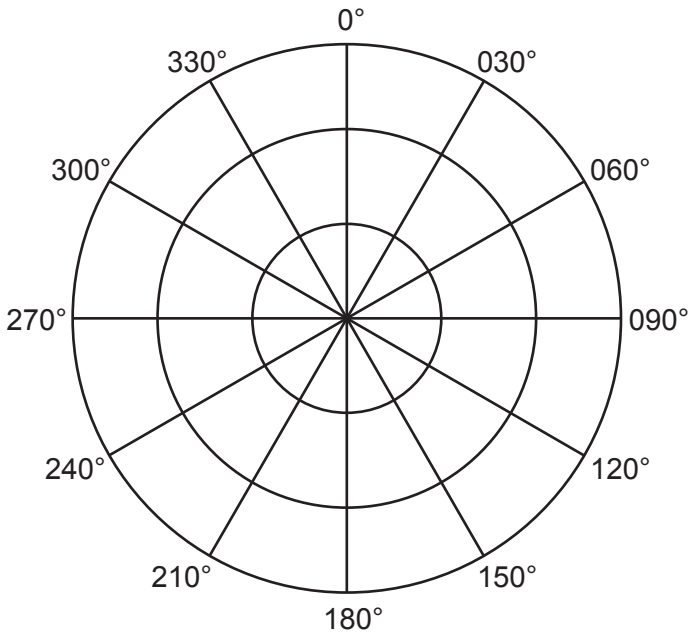
| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 049 | 125 | 135 | 028 | 176 | 185 | 278 | 245 | 280 | 180 |
| 355 | 015 | 168 | 146 | 155 | 200 | 167 | 050 | 110 | 245 |

**(i)** Use the student's readings to complete the tally chart below.

| Orientation (Degrees) | Number of observations | Orientation (Degrees) | Number of observations |
|---|---|---|---|
| 001–030 | | 181–210 | |
| 031–060 | | 211–240 | |
| 061–090 | | 241–270 | |
| 091–120 | | 271–300 | |
| 121–150 | | 301–330 | |
| 151–180 | | 331–360 | |

**[2]**

**(ii)** Plot the data from the tally chart on the rose diagram below.




**[2]**

**(iii)** State the flow direction(s) shown in the rose diagram you have drawn.

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

**(iv)** State the mode for the data ranges.

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

**(c)*** Describe an experiment a student could simply and safely perform in a school laboratory to simulate the environment of deposition that might produce the characteristic sediments and sedimentary structures found in a turbidite deposit.

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Additional answer space if required.

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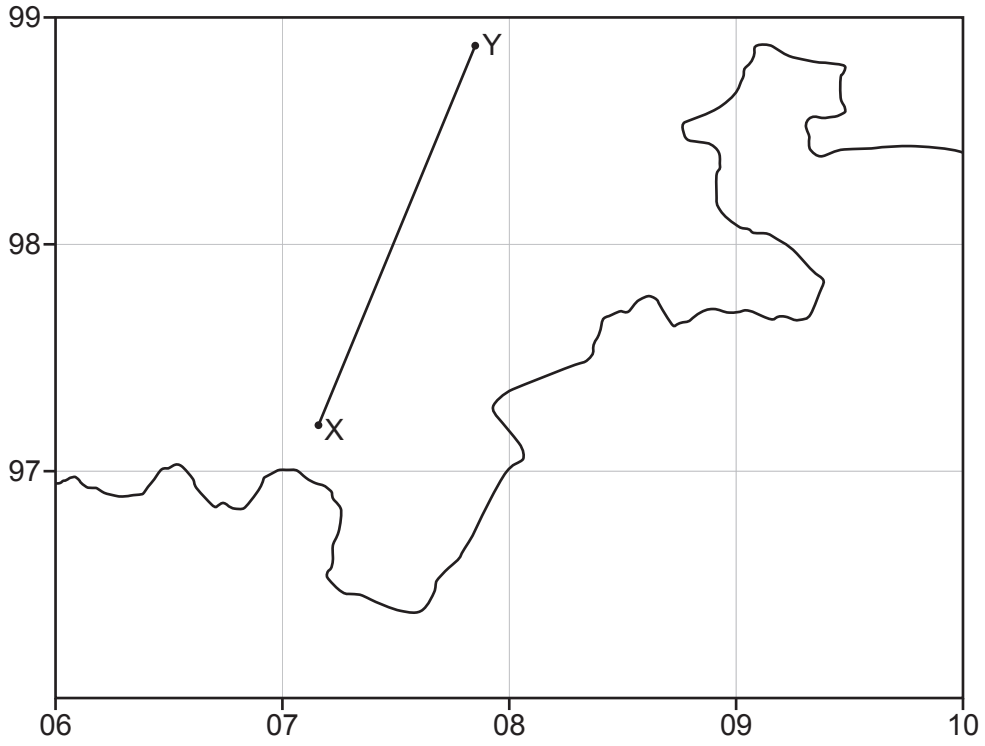
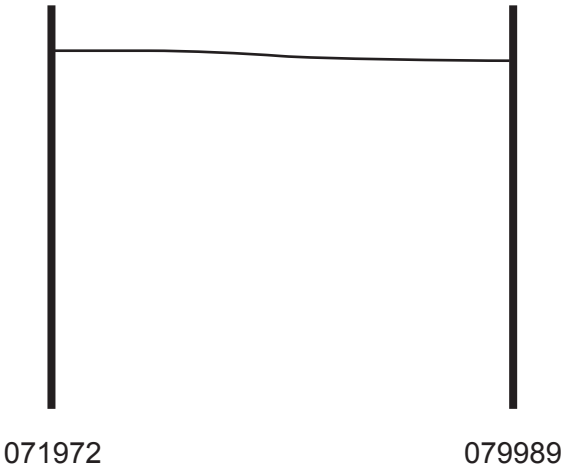
**4** The 1:50 000 geological **map excerpt** (Pembroke and Linney Head), **in the Insert**, should be used for this question.

**(a)** Using the geological map excerpt, draw and label the following onto the sketch outline below:
- the geological boundaries between the lower Old Red Sandstone and younger sediments
- a fault dissecting the shale and limestone
- a fault in the sandstone and marl.




**[3]**

**(b)** On the topographic sketch profile below, draw and clearly label a cross-section from grid reference 071972 to 079989, shown as line X – Y on the sketch outline in part **(a)**. Use symbols to show each rock type on your cross-section.




**[3]**

**(c)** Iron-rich mineral veins have been found in the limestone at grid reference 087977.

Describe a geophysical technique that could be used to establish if these mineral veins were widespread in the limestone.

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

**(d)** A company has commenced a site investigation to potentially build a large restaurant near Lydstep Point. The site investigation has identified a risk of subsidence.

Explain why subsidence could be a problem at this location and suggest an engineering solution to mitigate this effect.

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

**5** Igneous rocks can be classified based upon chemical analysis.

The table shows the chemical composition, by percentage, of oxides from four different igneous rocks, **A**, **B**, **C** and **D**.

| **Oxide %** | **A** | **B** | **C** | **D** |
|---|---|---|---|---|
| $SiO_2$ | 46.0 | 73.0 | 60.0 | 43.5 |
| $Al_2O_3$ | 15.0 | 13.0 | 17.0 | 4.0 |
| Fe oxides | 12.0 | 2.0 | 6.0 | 12.5 |
| MgO | 9.0 | 0.5 | 3.5 | 34.0 |
| CaO | 9.0 | 1.5 | 7.0 | 3.5 |
| $Na_2O$ | 3.5 | 4.0 | 3.5 | 0.5 |
| $K_2O$ | 1.5 | 4.0 | 1.5 | 0.3 |
| Others | 4.0 | 2.0 | 1.5 | 1.7 |

**(a)** Which igneous group do rocks **A**, **B**, **C** and **D** belong to?

**A** .....

**B** .....

**C** .....

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

**(b)** **Fig. 5.1**, **in the Insert**, shows a photograph of a thin section of a gabbro under cross-polarised light.

**(i)** Describe the texture seen in **Fig. 5.1** and explain how the order of crystallisation of the minerals results in this texture.

You should use specific named minerals found in gabbro to fully explain your answer.

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

**(ii)** Explain how this texture affects the strength of the rock in geotechnics.

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**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).