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

8242083163

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.

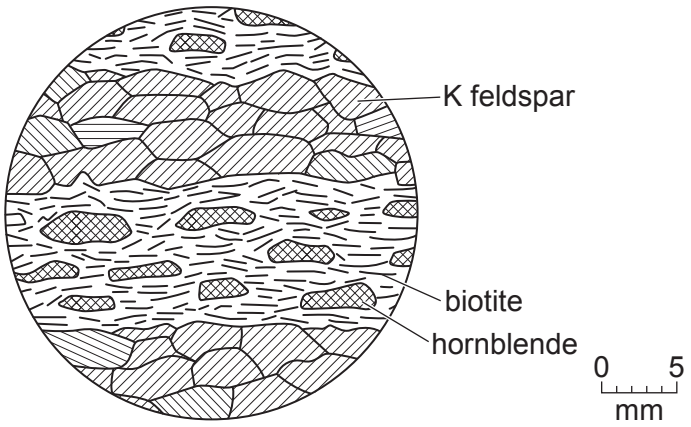

Fig. 1.1

(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.

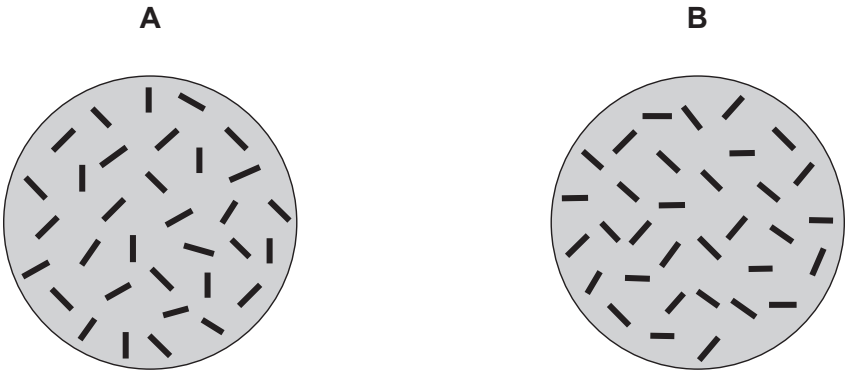

Fig. 1.2

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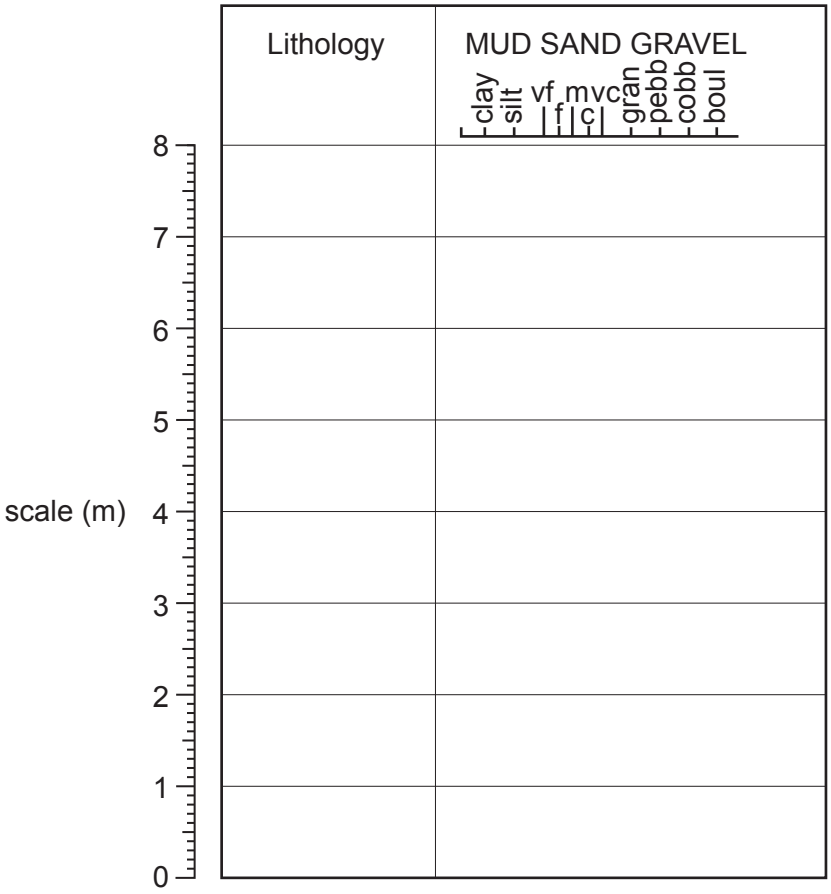
..... **[3]**

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°.

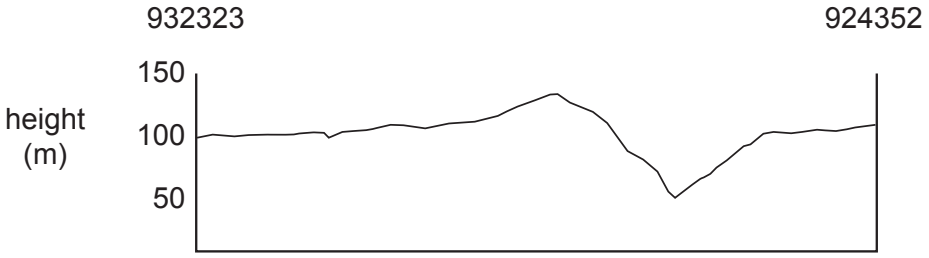
Calculate the true thickness of **Bed 4**.

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?

.....

..... **[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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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).

OCR
Oxford Cambridge and RSA

Monday 19 October 2020 – Morning

A Level Geology

H414/03 Practical skills in geology

Insert

Time allowed: 1 hour 30 minutes

8 2 4 2 1 5 8 8 9 5

INSTRUCTIONS
- Do **not** send this Insert for marking. Keep it in the centre or recycle it.

INFORMATION
- This Insert contains Fig. 2.1, Fig. 2.2 and the map excerpt.
- This document has **8** pages.

BLANK PAGE

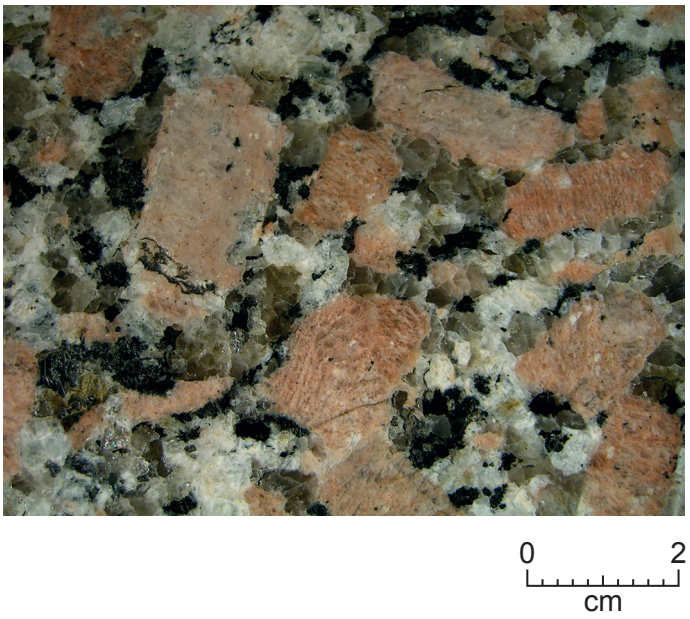


Fig. 2.1

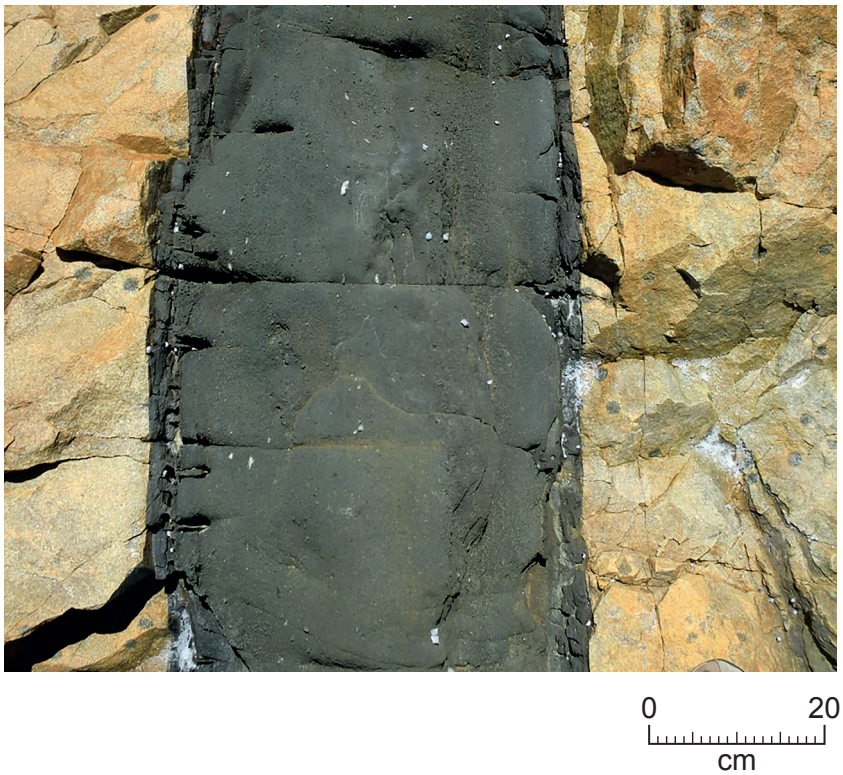
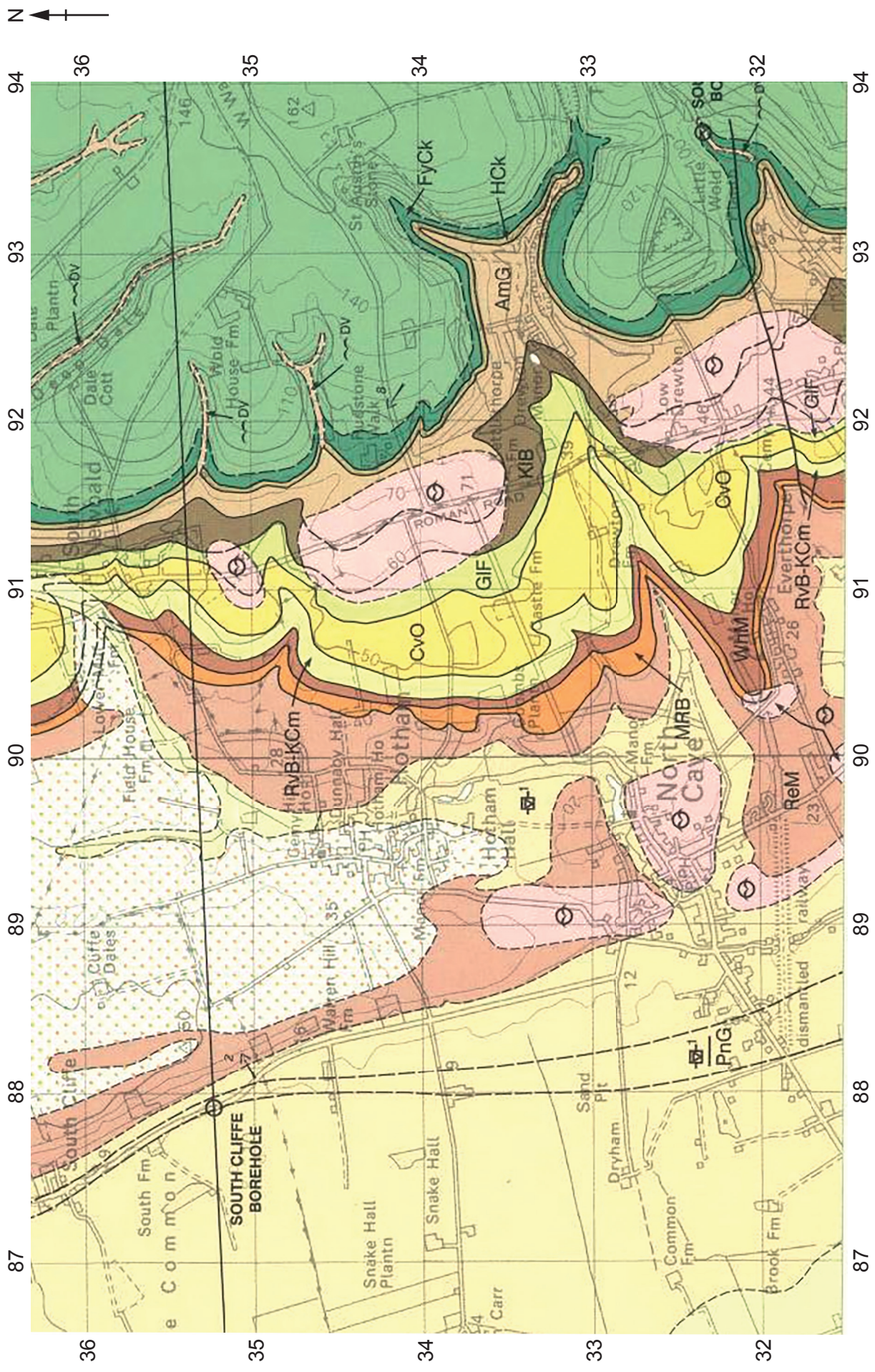
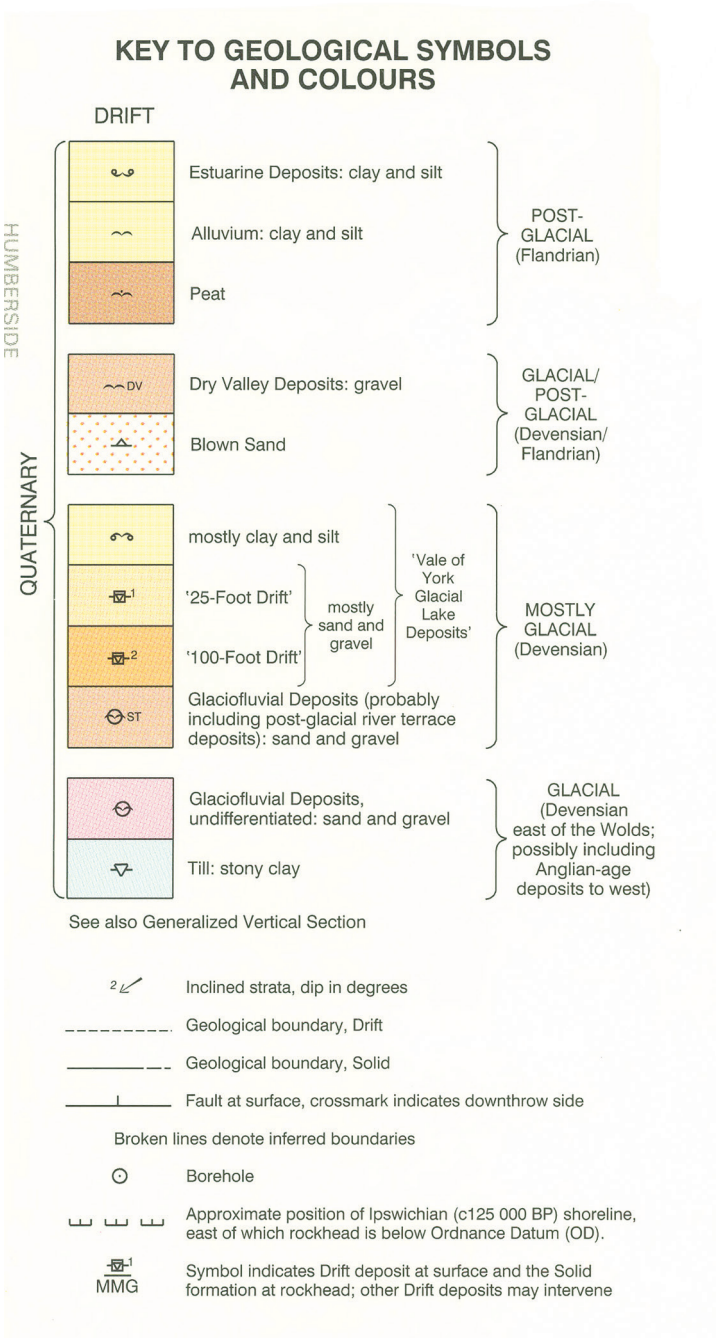
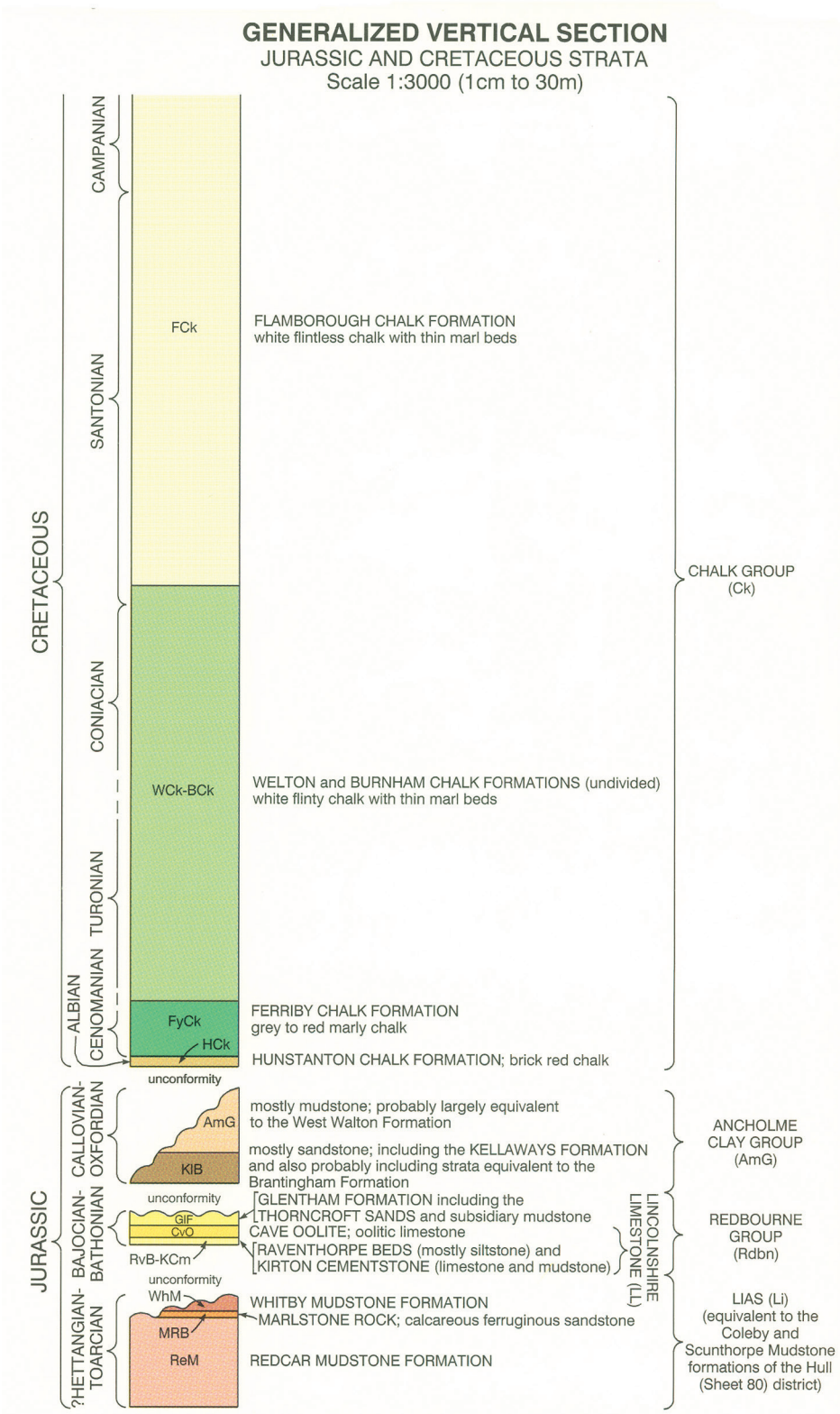


Fig. 2.2

BEVERLEY 1:50 000 (Solid and Drift)




KEY TO GEOLOGICAL SYMBOLS AND COLOURS
DRIFT
HUMBERSIDE
QUATERNARY
Estuarine Deposits: clay and silt
Alluvium: clay and silt
Peat
POST-GLACIAL (Flandrian)
DV
Dry Valley Deposits: gravel
Blown Sand
GLACIAL/ POST-GLACIAL (Devensian/ Flandrian)
mostly clay and silt
1
'25-Foot Drift'
2
'100-Foot Drift'
mostly sand and gravel
'Vale of York Glacial Lake Deposits'
ST
Glaciofluvial Deposits (probably including post-glacial river terrace deposits): sand and gravel
MOSTLY GLACIAL (Devensian)
Glaciofluvial Deposits, undifferentiated: sand and gravel
Till: stony clay
GLACIAL (Devensian east of the Wolds; possibly including Anglian-age deposits to west)
See also Generalized Vertical Section
2
Inclined strata, dip in degrees
Geological boundary, Drift
Geological boundary, Solid
Fault at surface, crossmark indicates downthrow side
Broken lines denote inferred boundaries
Borehole
Approximate position of Ipswichian (c125 000 BP) shoreline, east of which rockhead is below Ordnance Datum (OD).
1
MMG
Symbol indicates Drift deposit at surface and the Solid formation at rockhead; other Drift deposits may intervene


GENERALIZED VERTICAL SECTION
JURASSIC AND CRETACEOUS STRATA
Scale 1:3000 (1cm to 30m)
CRETACEOUS
JURASSIC
CAMPANIAN
SANTONIAN
CONIACIAN
TURONIAN
CENOMANIAN
ALBIAN
CALLOVIAN-OXFORDIAN
BAJOCIAN-BATHONIAN
?HETTANGIAN-TOARCIAN
FCk
FLAMBOROUGH CHALK FORMATION
white flintless chalk with thin marl beds
WCk-BCk
WELTON and BURNHAM CHALK FORMATIONS (undivided)
white flinty chalk with thin marl beds
FyCk
HCk
FERRIBY CHALK FORMATION
grey to red marly chalk
HUNSTANTON CHALK FORMATION; brick red chalk
CHALK GROUP
(Ck)
unconformity
AmG
KlB
mostly mudstone; probably largely equivalent to the West Walton Formation
mostly sandstone; including the KELLAWAYS FORMATION and also probably including strata equivalent to the Brantingham Formation
ANCHOLME CLAY GROUP
(AmG)
unconformity
GlF
CvO
RvB-KCm
GLENTHAM FORMATION including the THORNCROFT SANDS and subsidiary mudstone
CAVE OOLITE; oolitic limestone
RAVENTHORPE BEDS (mostly siltstone) and KIRTON CEMENTSTONE (limestone and mudstone)
LINCOLNSHIRE LIMESTONE (LL)
REDBOURNE GROUP
(Rdbn)
unconformity
WhM
MRB
ReM
WHITBY MUDSTONE FORMATION
MARLSTONE ROCK; calcareous ferruginous sandstone
REDCAR MUDSTONE FORMATION
LIAS (Li)
(equivalent to the Coleby and Scunthorpe Mudstone formations of the Hull (Sheet 80) district)

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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
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INFORMATION
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- 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.

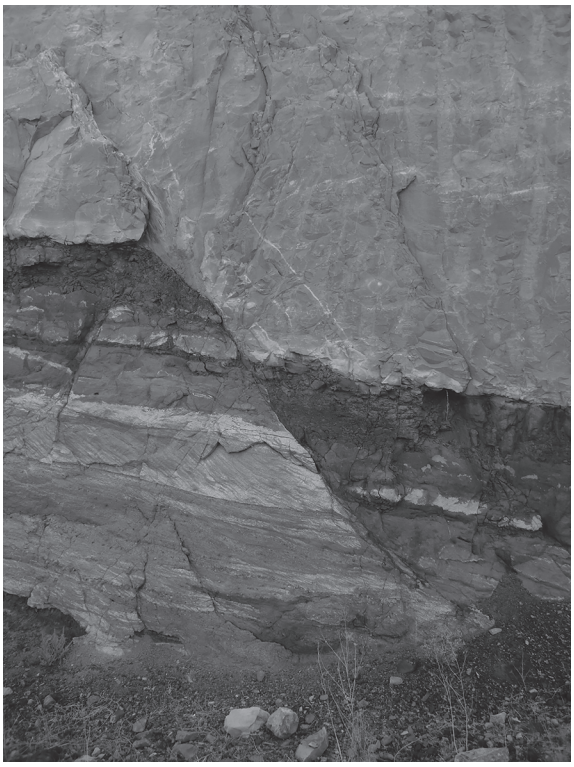


Fig. 1.1

(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.

.....

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

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

.....

..... **[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.

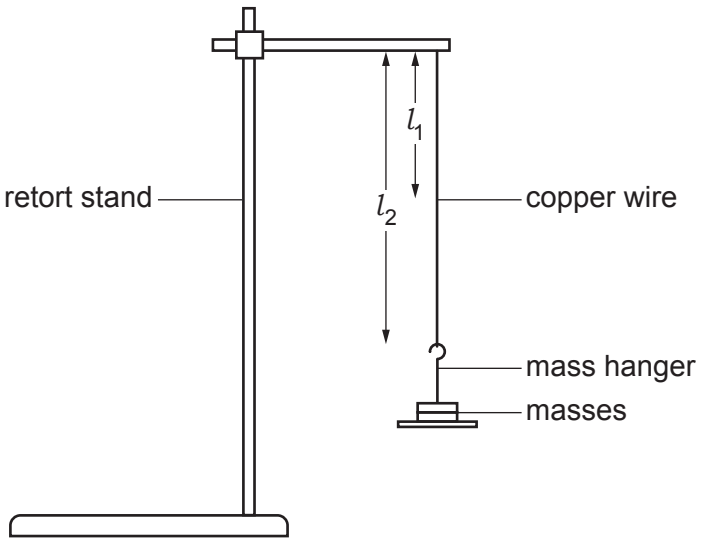
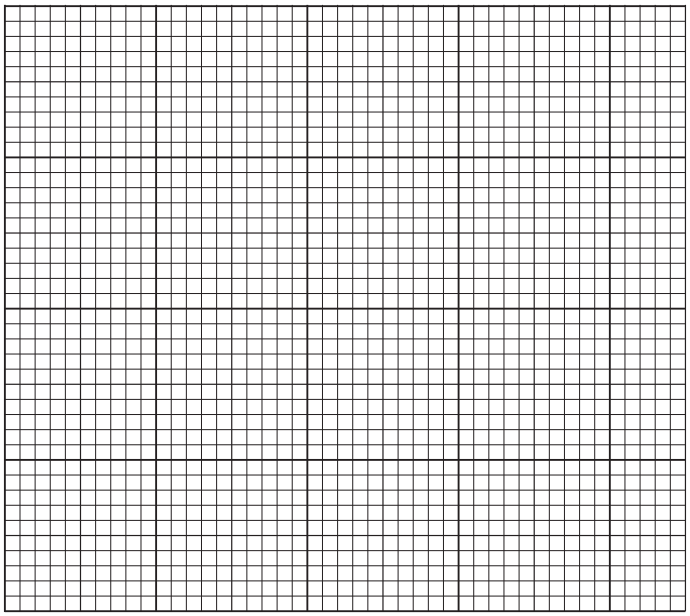


Fig. 1.2

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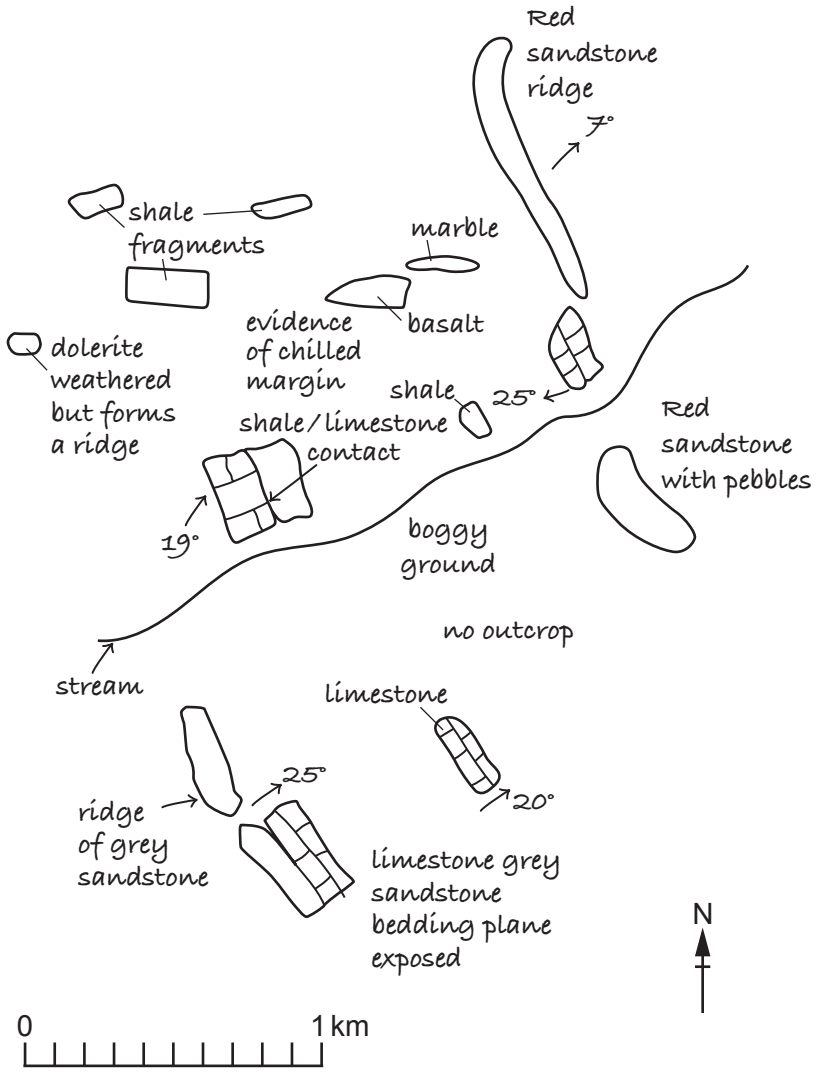
..... **[1]**

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.

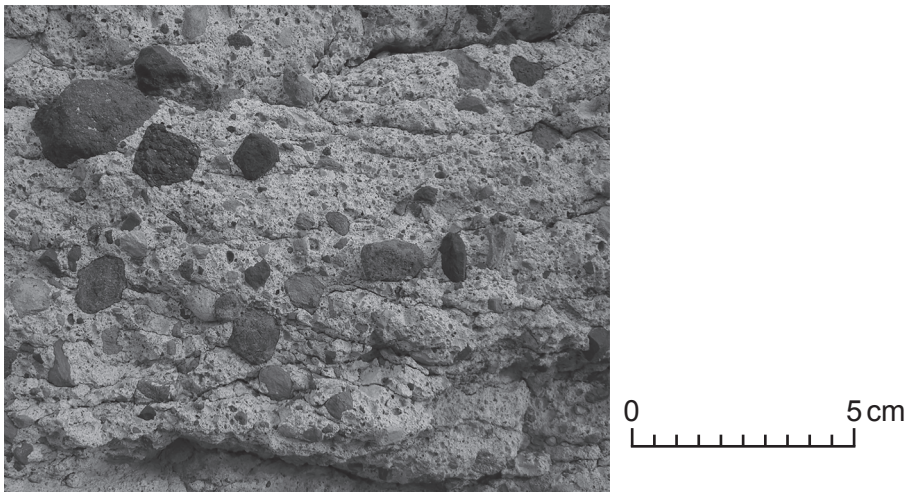


Fig. 2.2

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.

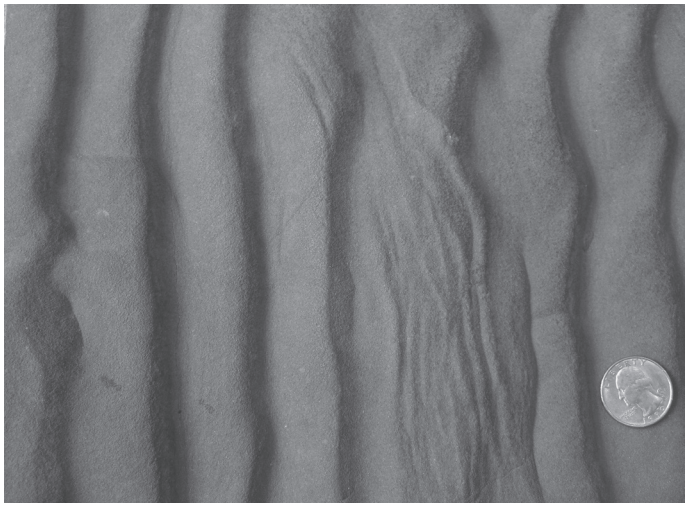

Fig. 3.1

(i) Identify the sedimentary structure shown.

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

(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.

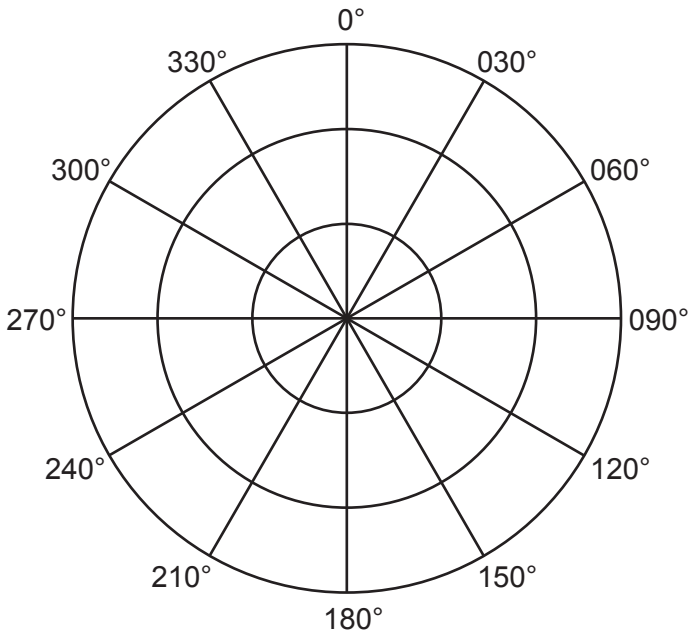
049	125	135	028	176	185	278	245	280	180
355	015	168	146	155	200	167	050	110	245

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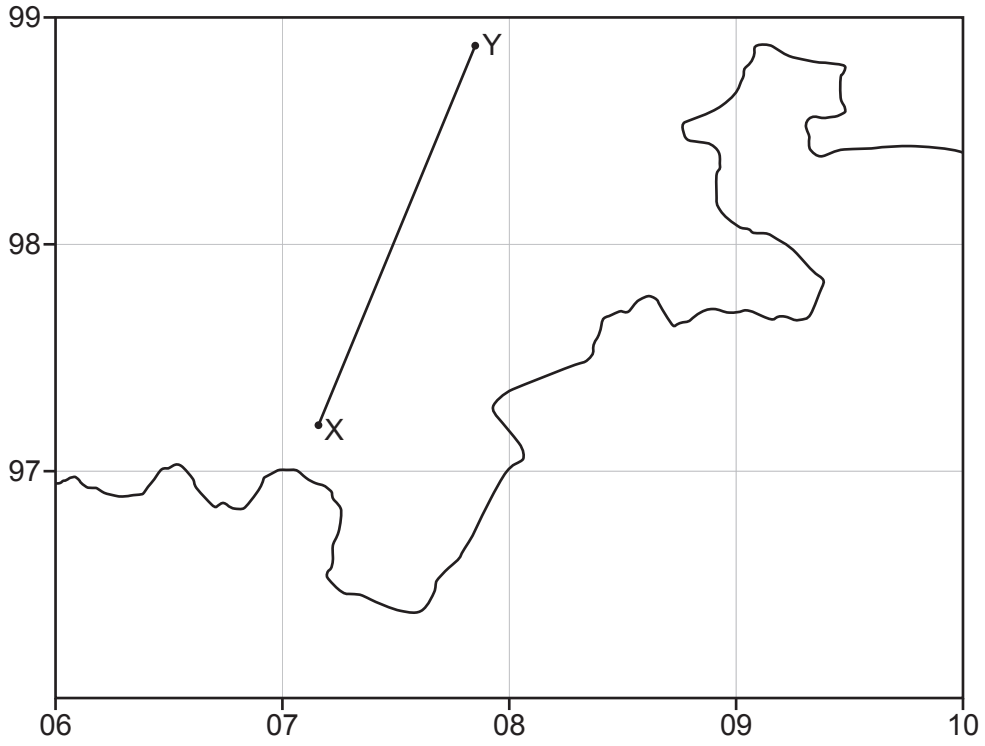
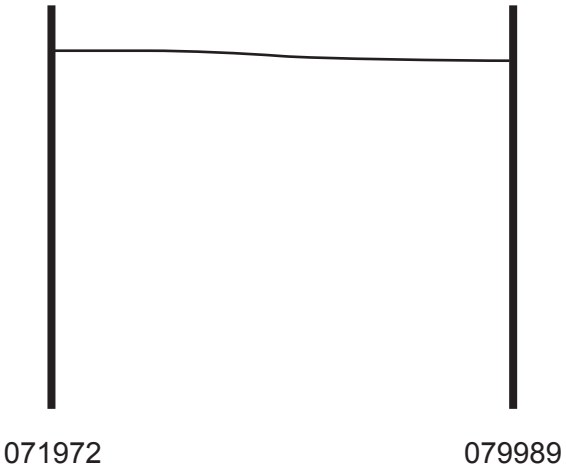
4 The 1:50 000 geological **map excerpt** (Pembroke and Linney Head), **in the Insert**, should be used for this question.

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

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).

OCR
Oxford Cambridge and RSA

Monday 18 October 2021 – Morning

A Level Geology

H414/03 Practical skills in geology

Insert

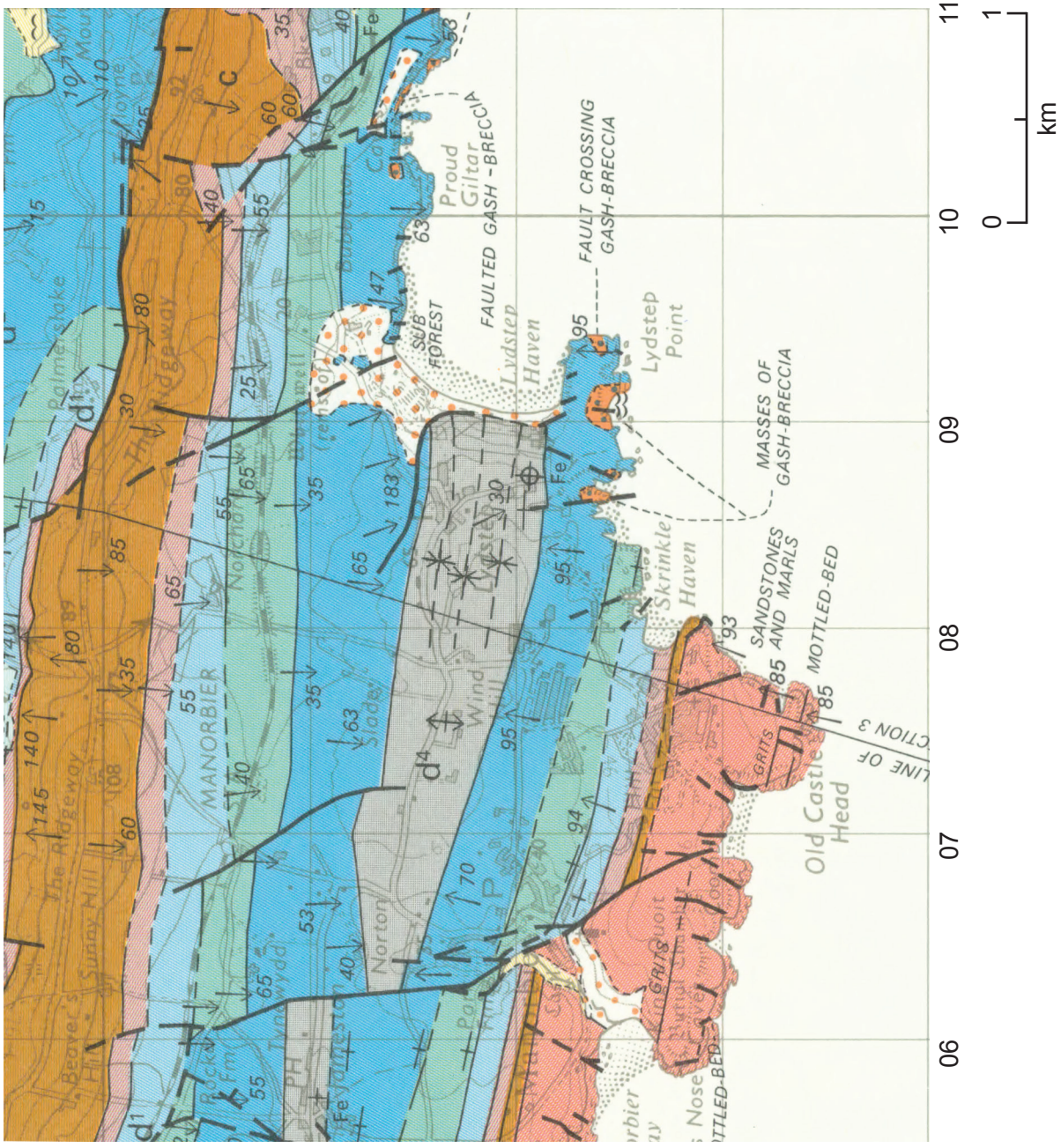
Time allowed: 1 hour 30 minutes

8956551833

INSTRUCTIONS
- Do **not** send this Insert for marking. Keep it in the centre or recycle it.

INFORMATION
- This Insert contains the **map excerpt** and **Fig. 5.1**.
- This document has **4** pages.

Pembroke and Linney Head, 1:50 000 for use with Question 4.



KEY

Explanation of geological symbols continued

- Horizontal strata
- Inclined strata, dip in degrees (20)
- Anticline
- Syncline
- Geological boundary, Solid
- Fault at surface

Stratigraphic column

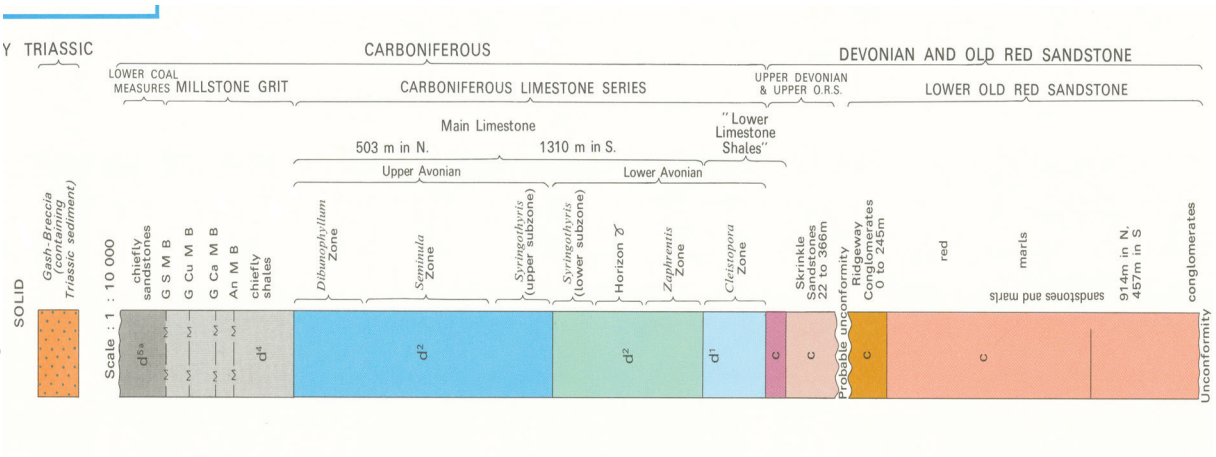
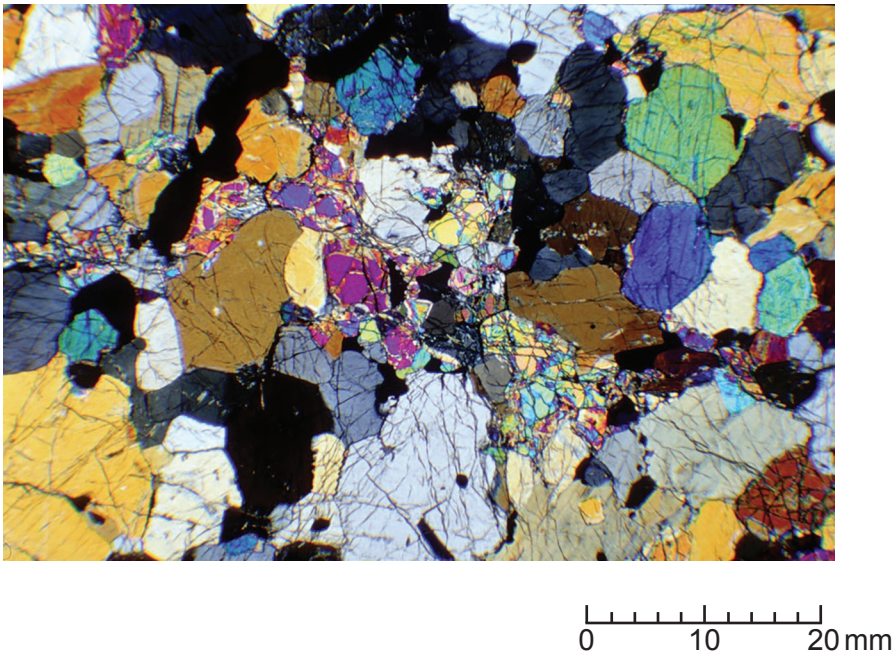


Fig. 5.1 photograph to be used with Question 5.



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]

(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.

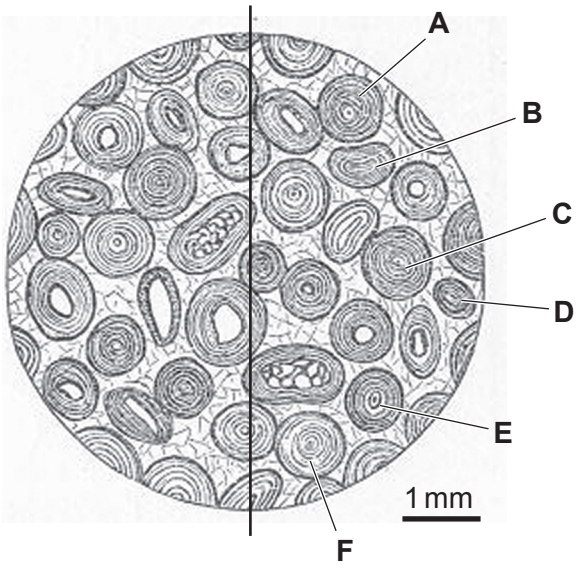

Fig. 1.2

(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]**

(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]**

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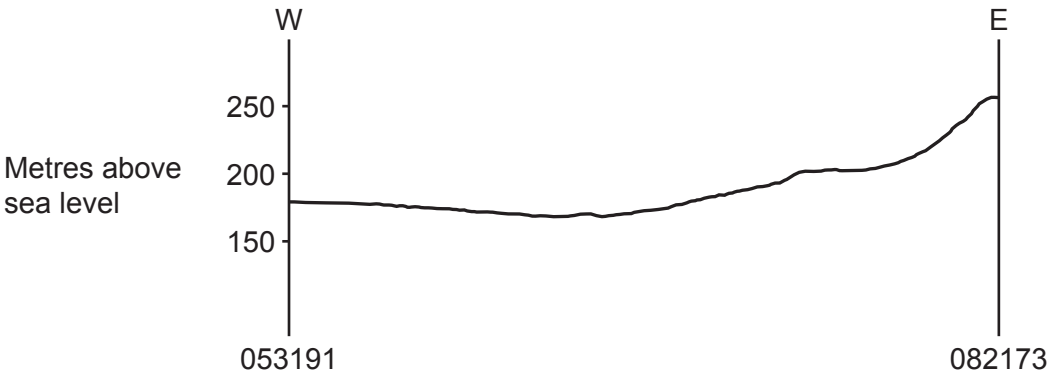
3 The 1:50 000 scale geological map excerpt (Whitehaven), **Fig. 3.1** in the **Insert**, should be used for this question.

(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 .....

.....

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]**

(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]**

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**.

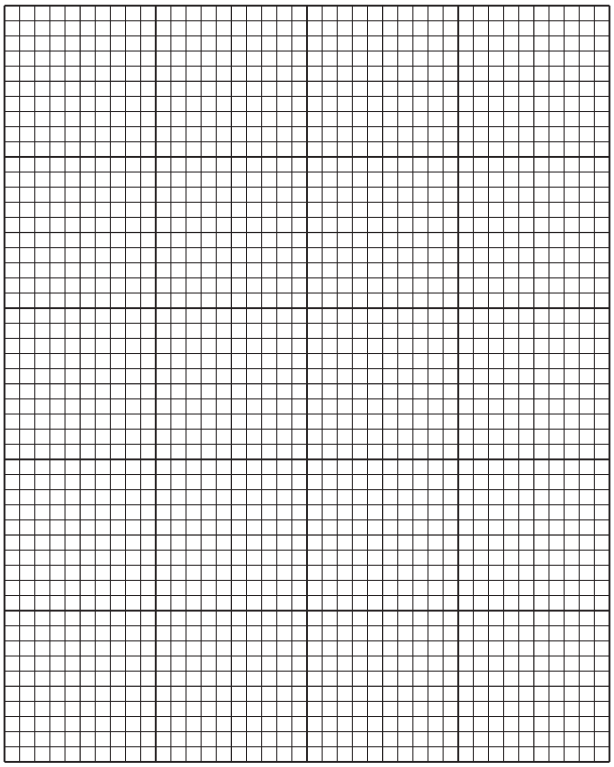
It is assumed that the reaction is complete after 6 minutes.

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]

(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]**

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).

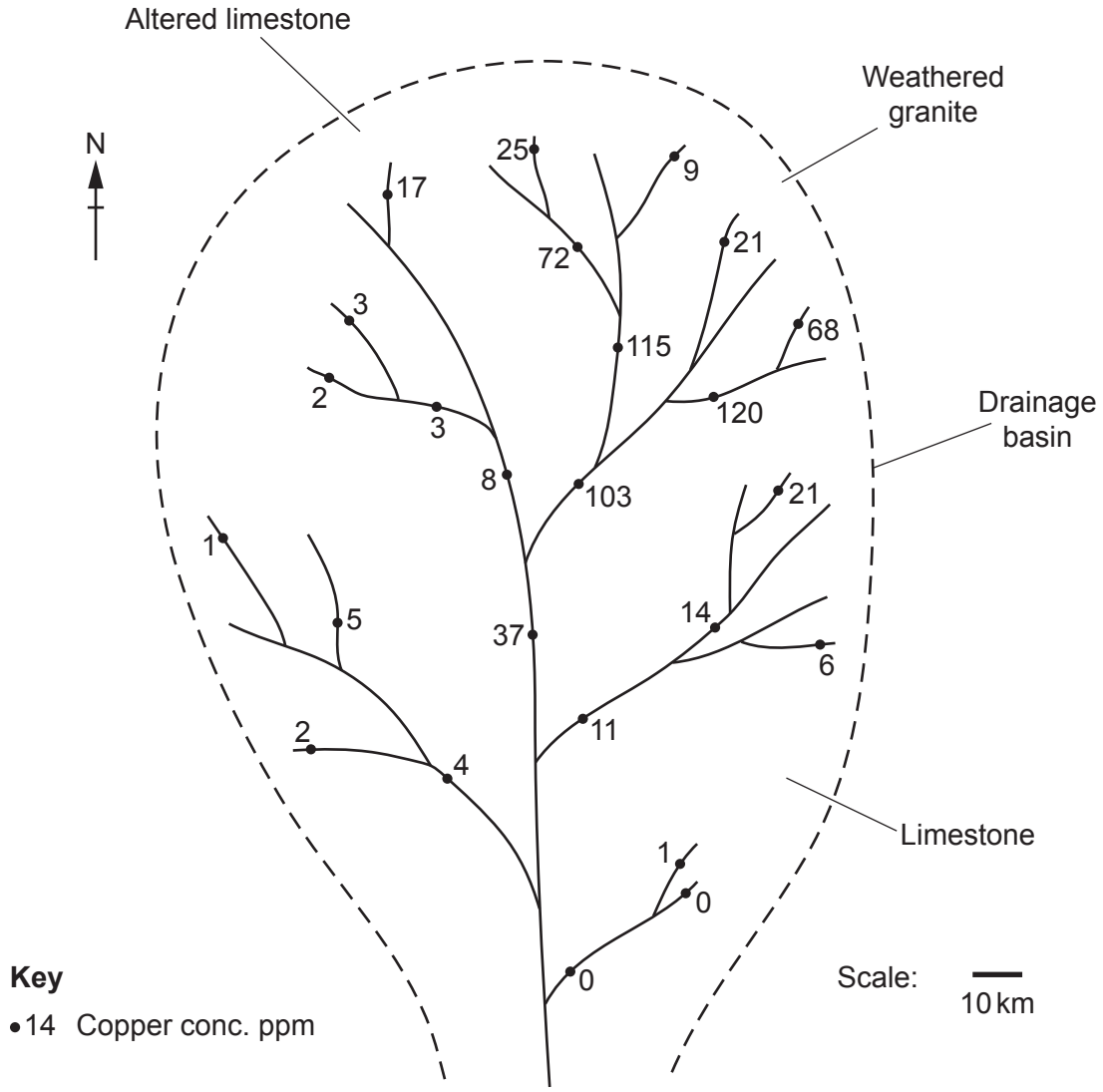

Fig. 5.1

(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]**

(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]**

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

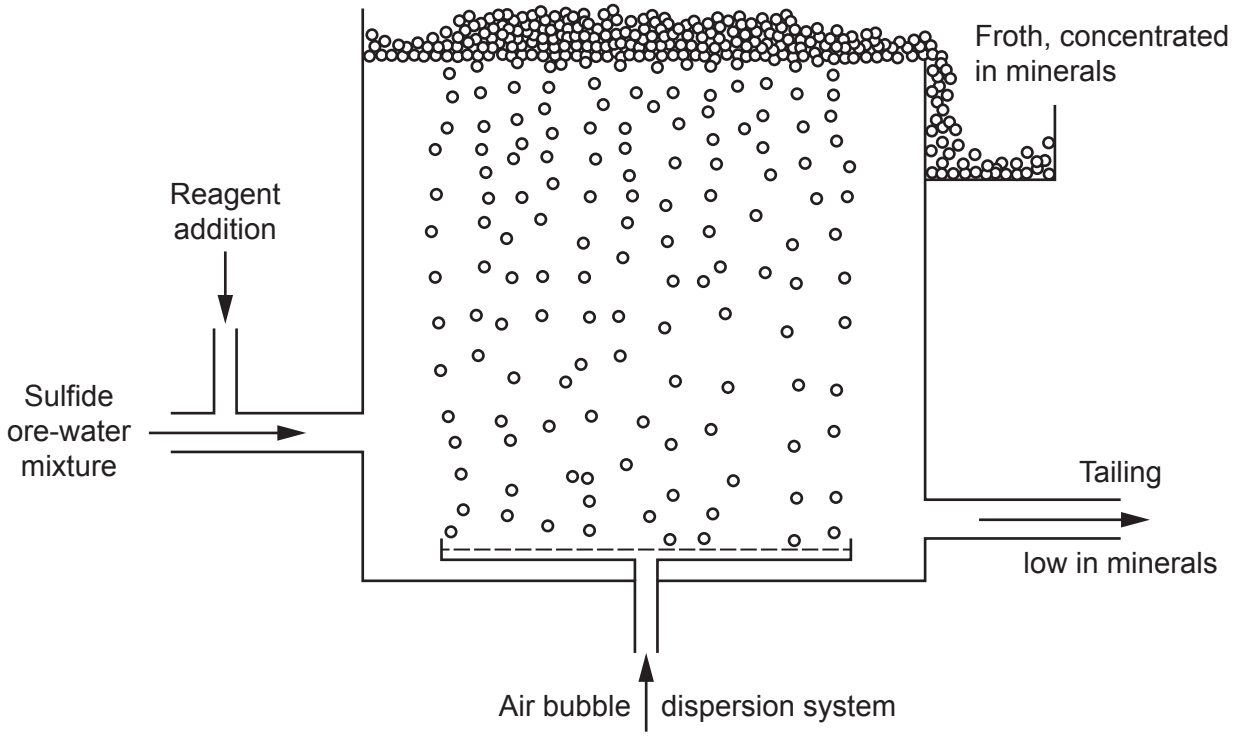

Fig. 5.2

Explain how this process concentrates the metal ore.

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

END OF QUESTION PAPER

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).

OCR
Oxford Cambridge and RSA

Tuesday 21 June 2022 – Morning

A Level Geology

H414/03 Practical skills in geology

Insert

Time allowed: 1 hour 30 minutes

9094153820

INSTRUCTIONS
- Do **not** send this Insert for marking. Keep it in the centre or recycle it.

INFORMATION
- This Insert contains **Fig. 1.1**, **Fig. 2.1** and **Fig. 3.1**.
- This document has **8** pages.

Fig. 1.1

Fig. 2.1

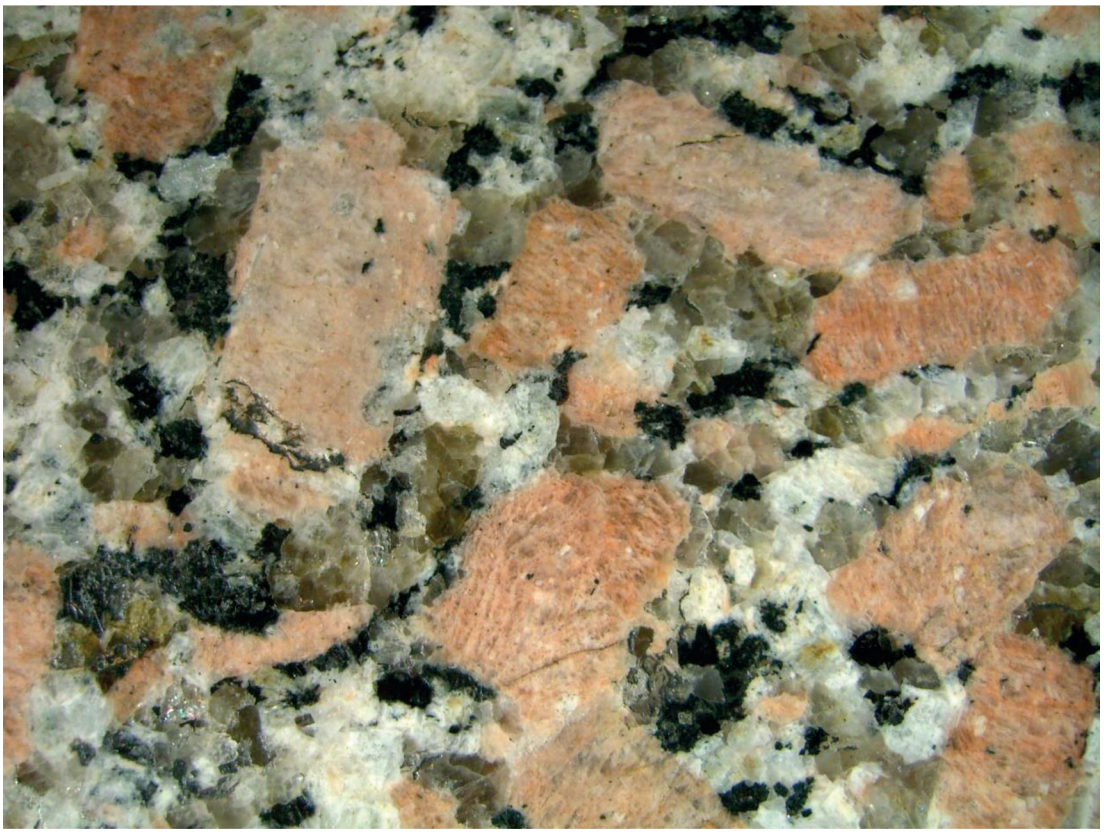
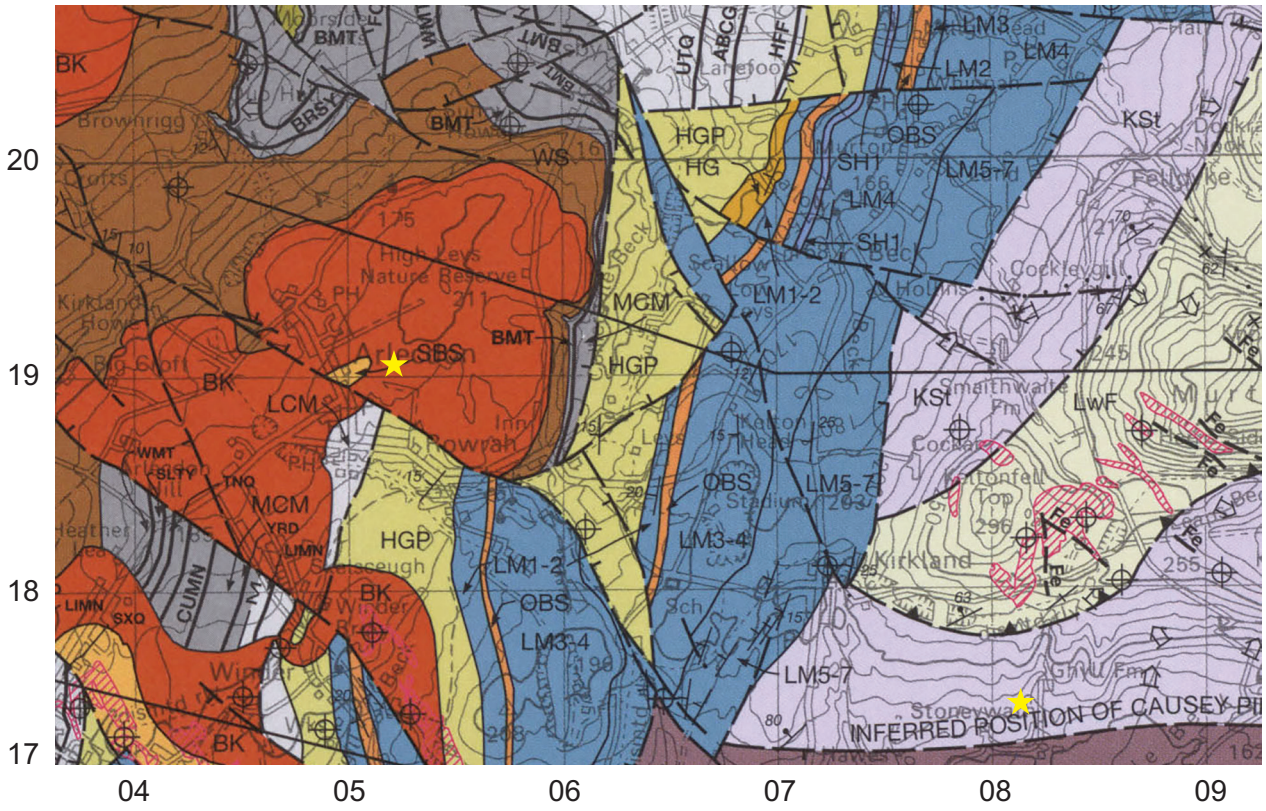
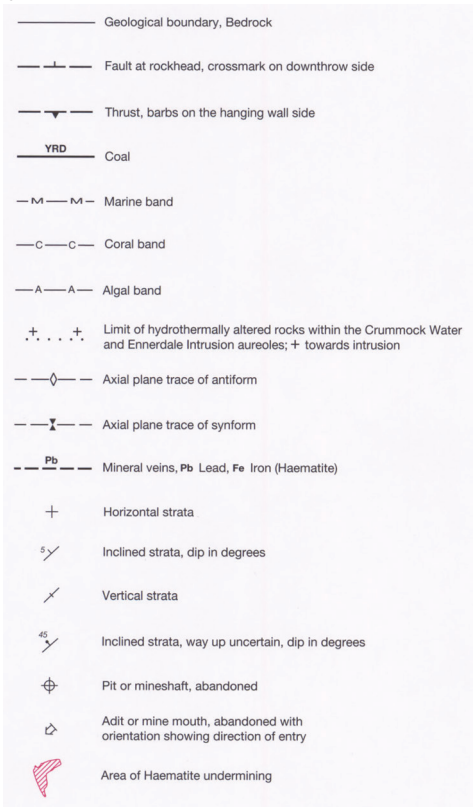


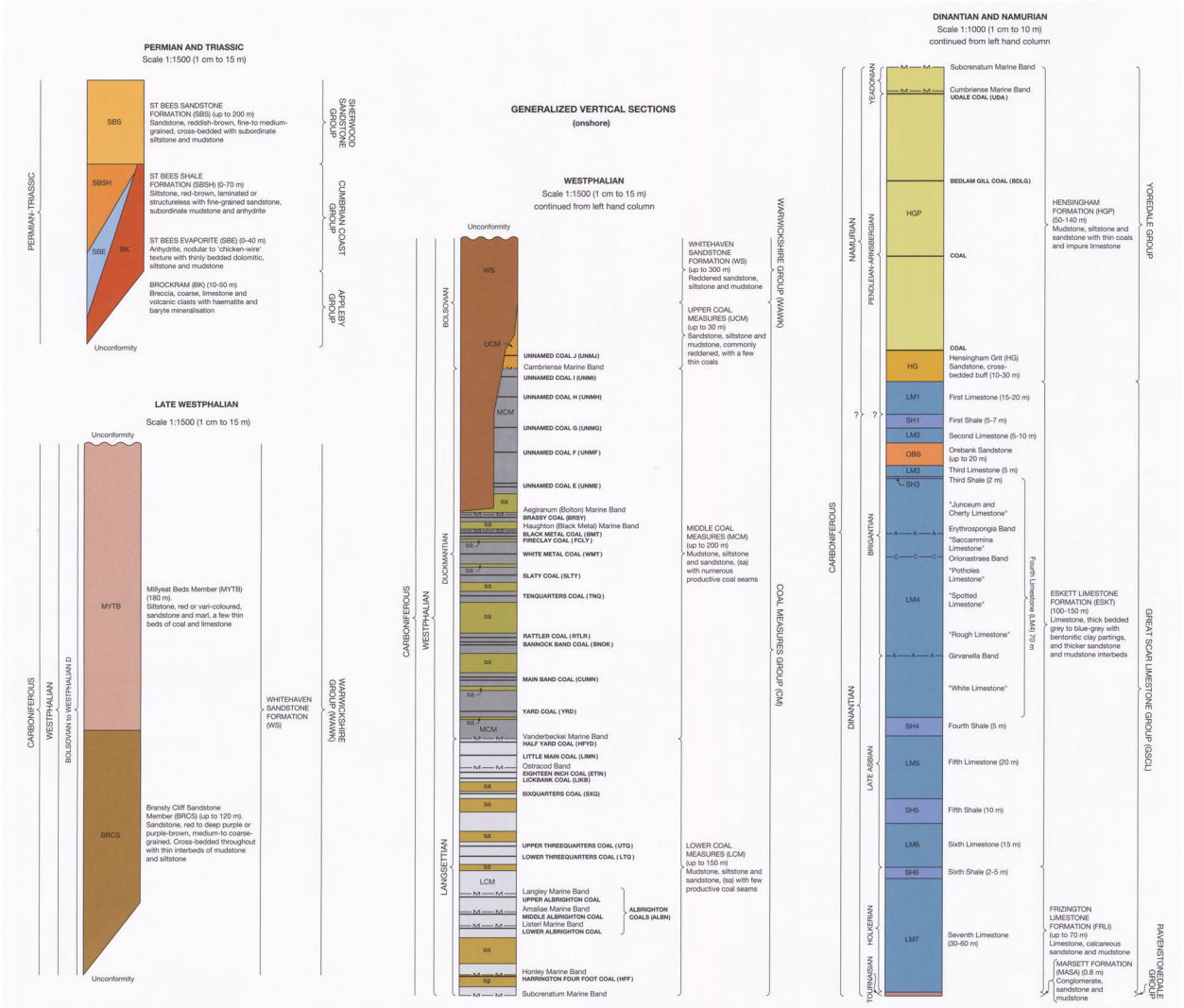
Fig. 3.1 1:50 000 scale geological map excerpt (Whitehaven)



Key



Summary Section



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OCR
Oxford Cambridge and RSA

Tuesday 20 June 2023 – Afternoon

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

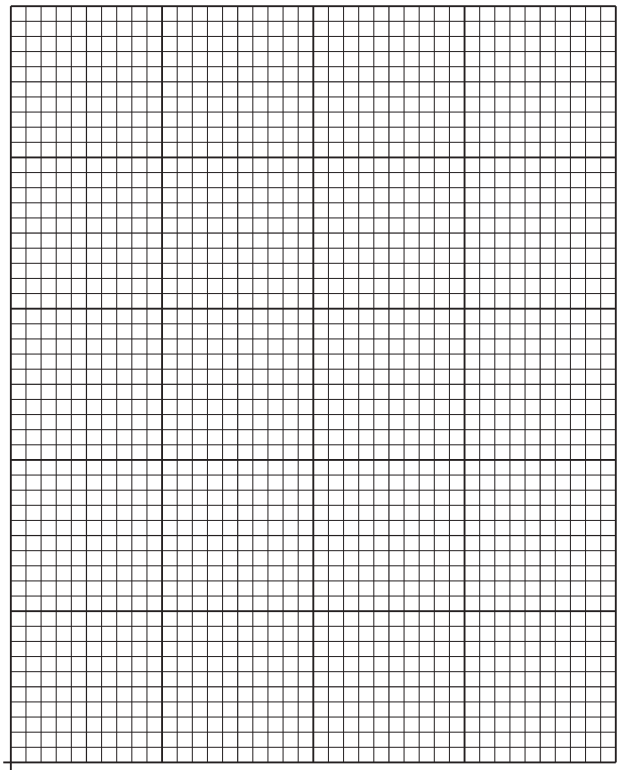
ADVICE
- Read each question carefully before you start your answer.

1 A student has collected a sediment sample for analysis in the laboratory using a sieve stack. This is a stack of sieves arranged with the biggest mesh at the top (4 mm or –2Φ) and the smallest at the bottom (0.0625 mm or 4Φ).

The student's results are shown in the table.

Phi Φ	% of Sample
–2	0
–1	3
0	23
1	64
2	8
3	2
4	0

(a) Plot the results from the table as a cumulative frequency curve on the grid.



[3]

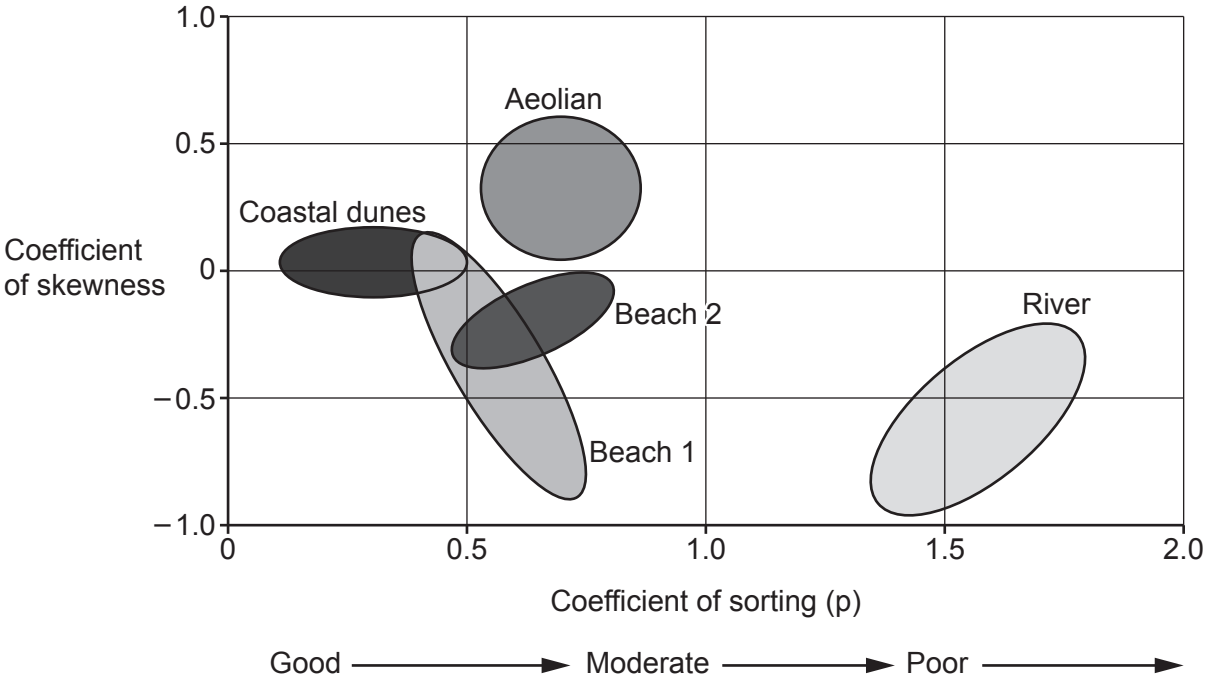
(b) The coefficient of skewness can be calculated using the equation:

$$\text{Coefficient of skewness} = \frac{(\Phi_{84} + \Phi_{16}) - 2\Phi_{50}}{2}$$

Calculate the coefficient of skewness for this sample.

Coefficient of skewness = ... **[2]**

(c) The bivariate plot shows the likely origin of sediment based on the coefficient of skewness against the coefficient of sorting (p).



The coefficient of sorting for the sediment was calculated as 0.65.

Use the value you have calculated for the coefficient of skewness in **part (b)** to suggest a likely origin for this sediment sample.

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

(d) Other than skewness and sorting, suggest **three** characteristics of sediment found in this environment of deposition.

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

(e) Evaluate the method used by the student to interpret the environment of deposition for this sediment sample.

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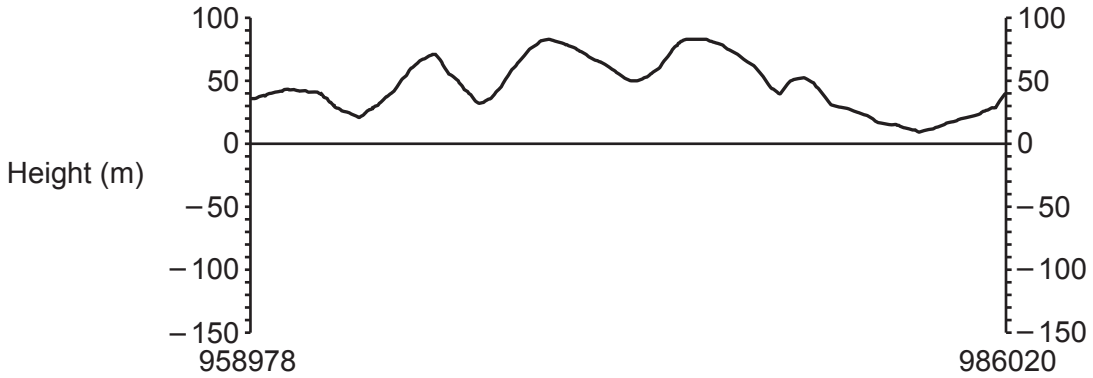
..... **[2]**

2 The 1:50 000 geological map excerpt (Pembroke and Linney Head), **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 958978 in the South West to 986020 in the North East.



[5]

(ii) On your cross section, sketch the axial plane of the fold shown in the North East of the area. **[1]**

(iii) Identify and fully describe **two** geological structures shown in your cross section.

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

(b) (i) **Fig. 2**, **in the Insert**, is a photograph of a locality close to the area shown on the geological map.

Draw a sketch of this geological outcrop and label **two** geological features.

[2]

(ii) The angle and direction of dip is often measured at geological localities.

Describe how to find and measure the strike of a bedding plane using a compass clinometer.

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

(c)* Evaluate the potential geological problems that could be encountered by a company aiming to quarry the Carboniferous Limestone d^1 and d^2 shown on the geological map.

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Additional answer space if required.

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3 **(a)** Describe the difference between porosity and permeability in a hydrocarbon reservoir rock.

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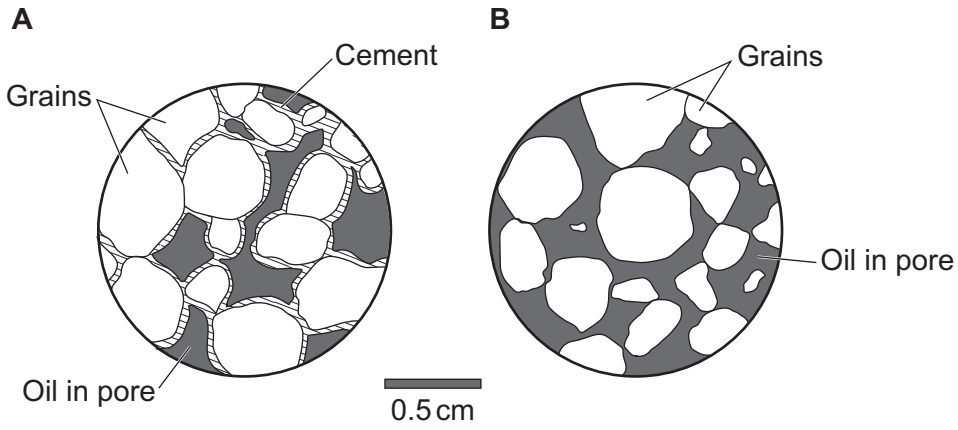
..... **[2]**

(b) **(i)** Diagrams **A** and **B** show two sandstone samples, collected from two boreholes in a hydrocarbon field.



Explain which sample would yield a greater value of hydrocarbons.

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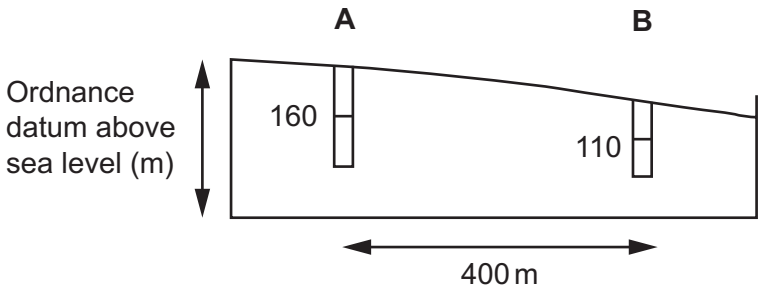
..... **[4]**

(ii) The diagram shows the location of the two boreholes, **A** and **B**.



The two boreholes can be used to calculate the permeability of the sandstones using Darcy's Law.

The hydraulic conductivity (k) of the sandstones was found to be 1×10^{-3} cm sec^{-1} and the area of the hydrocarbon field was 1500 m^2.

Calculate the permeability (Q) of the sandstones.

Use the formula: $Q = -kA\left(\frac{h_2 - h_1}{L}\right)$

Permeability (Q) = ... Units = ... **[3]**

4 **Fig. 4**, **in the Insert**, is a photograph of a specimen taken from a hydrothermal vein.

Mineral specimens are often identified with the help of diagnostic properties such as colour, density and arrangement of cleavages.

(a) **(i)** Describe the shape and arrangement of cleavage in the mineral shown in **Fig. 4**.

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

(ii) Describe **one** additional test, apart from those listed above, that could be carried out on the mineral shown in **Fig. 4** that would help to identify it.

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(iii) Describe how a student would measure the **density** of the unknown mineral in **Fig. 4**.

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

(b) Some minerals are found to have relatively high densities.

Describe how this property can lead to accumulations of ore that are economic to extract.

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

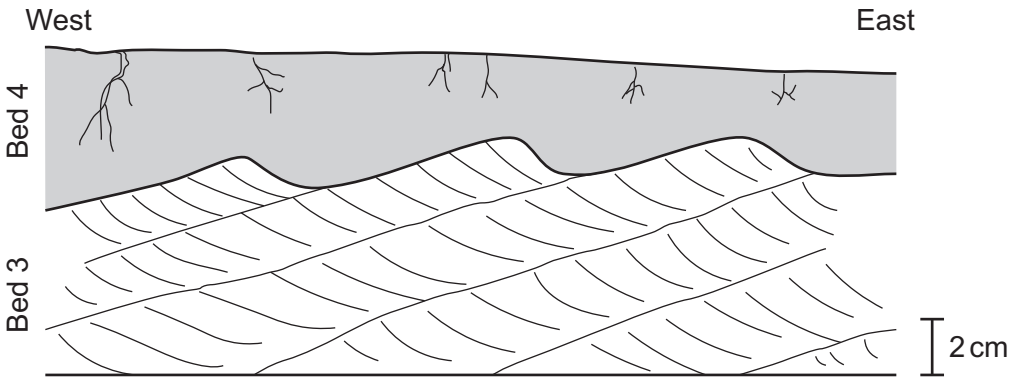
5 Information recorded by students from a cliff section during a field excursion is shown in the table below.

Bed 1 is 3.8 m from the base of the cliff, whilst the base of **bed 5** is 7.8 m from the base of the cliff.

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

(a) Complete the table to identify the energy level and sea level for each bed as either low, medium or high. The first bed has been completed. **[3]**

(b) One of the students produced a field sketch showing the top surface of Bed 3.



Outline how the palaeocurrent direction can be determined.

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

(c) Using the lithological evidence of Bed 5, interpret the palaeoenvironment and climate that must have been present at this time.

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

(d)* Depositional cycles such as those recorded in the table can be caused by basin-wide sea-level changes or local tectonic variations.

Describe and compare the processes involved in both sea-level changes and local tectonic variations.

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

Additional answer space if required.

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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).

Oxford Cambridge and RSA

Tuesday 20 June 2023 – Afternoon

A Level Geology

H414/03 Practical skills in geology

Insert

Time allowed: 1 hour 30 minutes

9895545463

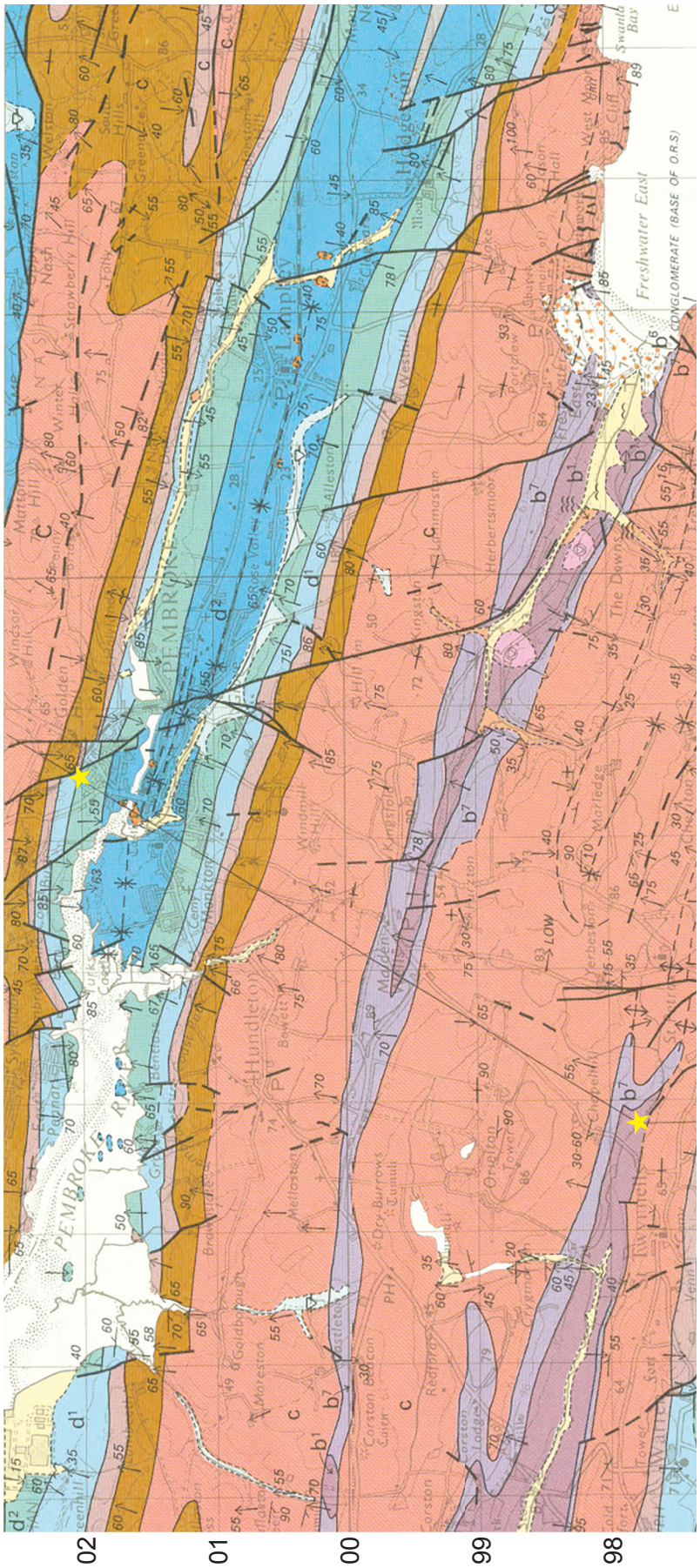
INSTRUCTIONS

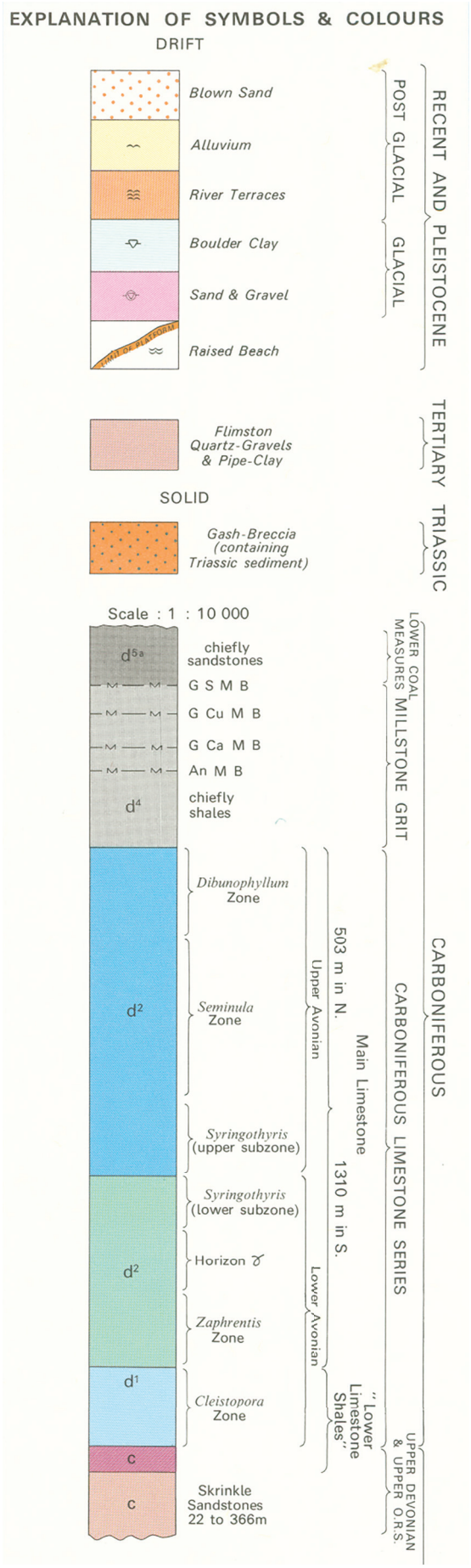
- Do **not** send this Insert for marking. Keep it in the centre or recycle it.

INFORMATION

- This Insert contains the map excerpt, **Fig. 2** and **Fig. 4**.
- This document has **4** pages.

Pembroke and Linney Head 1:50000 (Solid and Drift)




EXPLANATION OF SYMBOLS & COLOURS
DRIFT
Blown Sand
Alluvium
River Terraces
Boulder Clay
Sand & Gravel
LIMIT OF PLATFORM
Raised Beach
RECENT AND PLEISTOCENE
POST GLACIAL
GLACIAL
Flimston Quartz-Gravels & Pipe-Clay
TERTIARY
SOLID
Gash-Breccia (containing Triassic sediment)
TRIASSIC
Scale : 1 : 10 000
d5a
chiefly sandstones
G S M B
G Cu M B
G Ca M B
An M B
d4
chiefly shales
LOWER COAL MEASURES
MILLSTONE GRIT
CARBONIFEROUS
d2
Dibunophyllum Zone
Seminula Zone
Syringothyris (upper subzone)
Syringothyris (lower subzone)
d2
Horizon γ
Zaphrentis Zone
d1
Cleistopora Zone
c
c
Skrinkle Sandstones 22 to 366m
Upper Avonian
Lower Avonian
503 m in N.
1310 m in S.
Main Limestone
"Lower Limestone Shales"
CARBONIFEROUS LIMESTONE SERIES
UPPER & UPPER O.R.S.
DEVONIAN

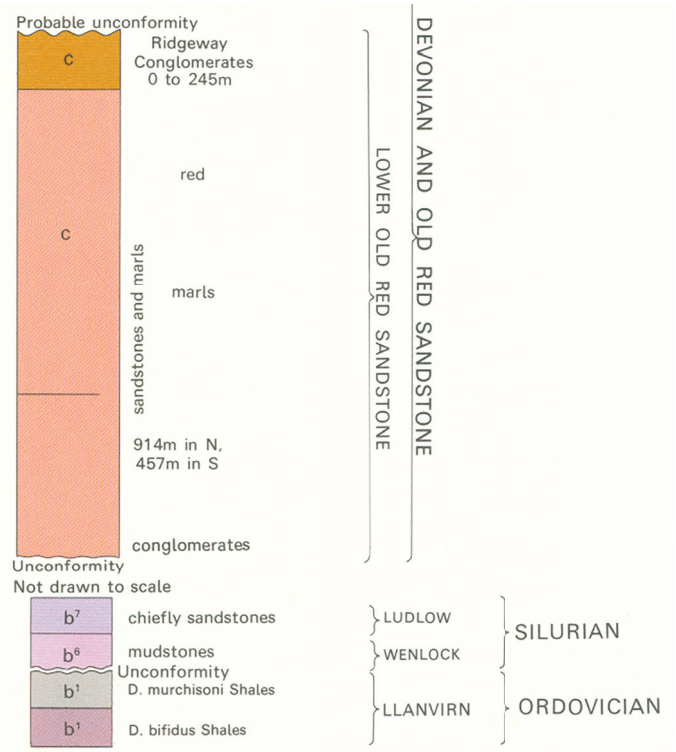

Probable unconformity
c
Ridgeway Conglomerates 0 to 245m
c
red
sandstones and marls
marls
914m in N, 457m in S
conglomerates
Unconformity
Not drawn to scale
LOWER OLD RED SANDSTONE
DEVONIAN AND OLD RED SANDSTONE
b7
chiefly sandstones
b6
mudstones
Unconformity
b1
D. murchisoni Shales
b1
D. bifidus Shales
LUDLOW
WENLOCK
LLANVIRN
SILURIAN
ORDOVICIAN

Fig. 2

Fig. 4