Surname	Centre Number	Candidate Number
First name(s)		2

GCE A LEVEL

A480U10-1

S24-A480U10-1-R1

TUESDAY, 4 JUNE 2024 – MORNING

GEOLOGY – A level component 1
Geological Investigations

2 hours 15 minutes

ADDITIONAL MATERIALS
- the Resource Sheet
- **specimens C**, **E**, **G** and **K**
- geological equipment for testing specimens
- the Mineral Data Sheet
- a calculator
- a ruler
- a protractor

INSTRUCTIONS TO CANDIDATES
Use black ink or black ball-point pen. Do not use gel pen or correction fluid.
You may use a pencil for graphs and diagrams only.
Write your name, centre number and candidate number in the spaces at the top of this page.
Answer **all** questions.
Write your answers in the spaces provided in this booklet. If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

	For Examiner's use only		
	Question	**Maximum Mark**	**Mark Awarded**
Section A	**1.**	**15**	
	2.	**15**	
Section B	**3.**	**7**	
	4.	**9**	
	5.	**12**	
	6.	**9**	
	7.	**7**	
	8.	**7**	
	9.	**14**	
	10.	**10**	
	Total	**105**	

INFORMATION FOR CANDIDATES
This paper is in 2 sections, **A** and **B**.
Section **A**: 30 marks. Answer **both** questions. You are advised to spend about 35 minutes on this section.
Section **B**: 75 marks. Answer **all** questions. You are advised to spend about 1 hour 40 minutes on this section.
The geology is **not** designed to represent any particular area.
The Mineral Data Sheet and **Map 1** are provided on separate resource sheets.
Strips of plain paper may be obtained from the supervisor on request.
Four specimens, **C**, **E**, **G** and **K**, are provided for use.
The number of marks is given in brackets at the end of each question or part-question.
The assessment of the quality of extended response (QER) will take place in questions **2** and **6**.

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Section A

Answer **all** questions.

1. **Figure 1a** is a sketch of a photomicrograph of rock **R**.

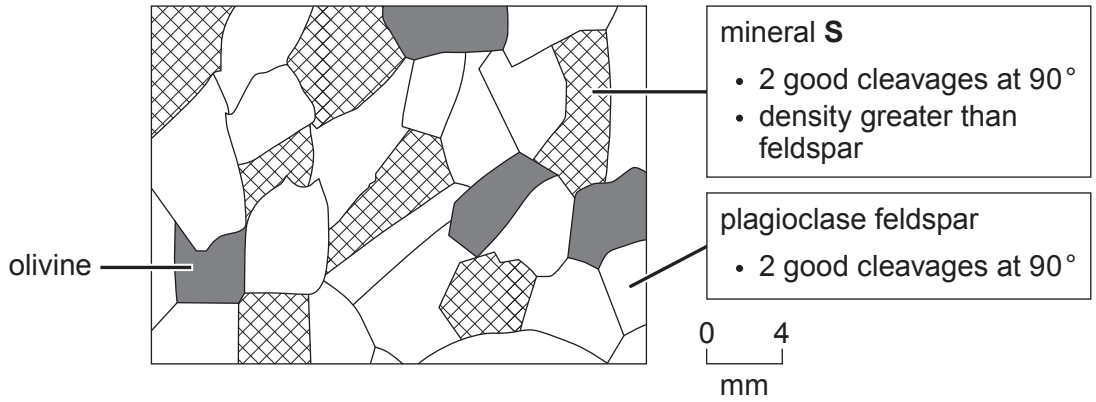

Figure 1a

(a) Refer to **Figure 1a**.

(i) Identify mineral **S**. You may wish to use the Mineral Data Sheet. [1]

Mineral **S** .....

(ii) State the name of rock **R**. [1]

Rock **R** .....

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(iii) **Table 1** shows a range of silicate structures. Indicate, with **one** tick (✓) in **each** of the blank columns, the silicate structure represented by mineral **S** and plagioclase feldspar. [2]

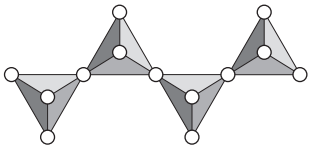
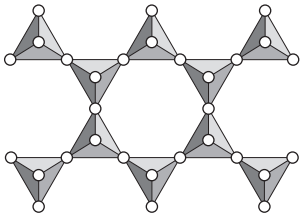
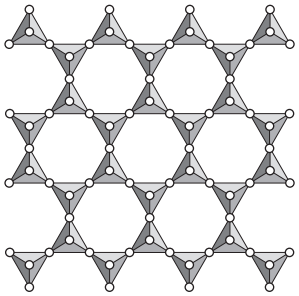
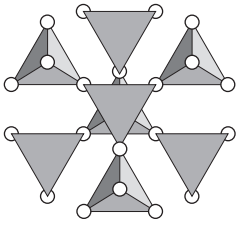
Silicate Structure	Mineral S	Plagioclase feldspar
Single Chain 		
Double Chain 		
Sheet 		
Framework 		

Table 1

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(b) **Figure 1b** is a phase diagram showing the experimental crystallisation of olivine over a range of compositions (from Mg-rich forsterite to Fe-rich fayalite).

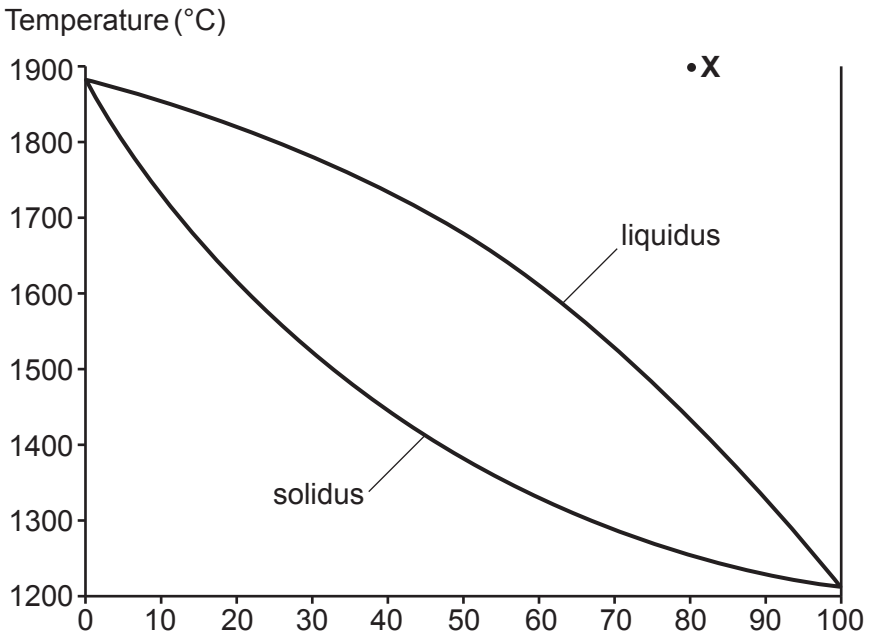

Figure 1b

Refer to **Figure 1b**.

(i) Name the variety of olivine to crystallise at the highest temperature. [1]

.....

(ii) Melt **X** has the composition of 80% fayalite.

Complete **Table 2** below to show the crystallisation characteristics of melt **X** as it cools. Assume that the melt remains in equilibrium with the crystals that form. [5]

	Temperature of melt (°C)	**Composition of melt (% fayalite)**	**Composition of crystals (% fayalite)**
Initial crystallisation	•	80	•
Crystallisation at 1300 °C	1300	•	67
Final crystallisation	•		•

Table 2

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(c) **Figure 1c** is a photomicrograph showing the texture of an igneous rock including a zoned phenocryst of olivine.

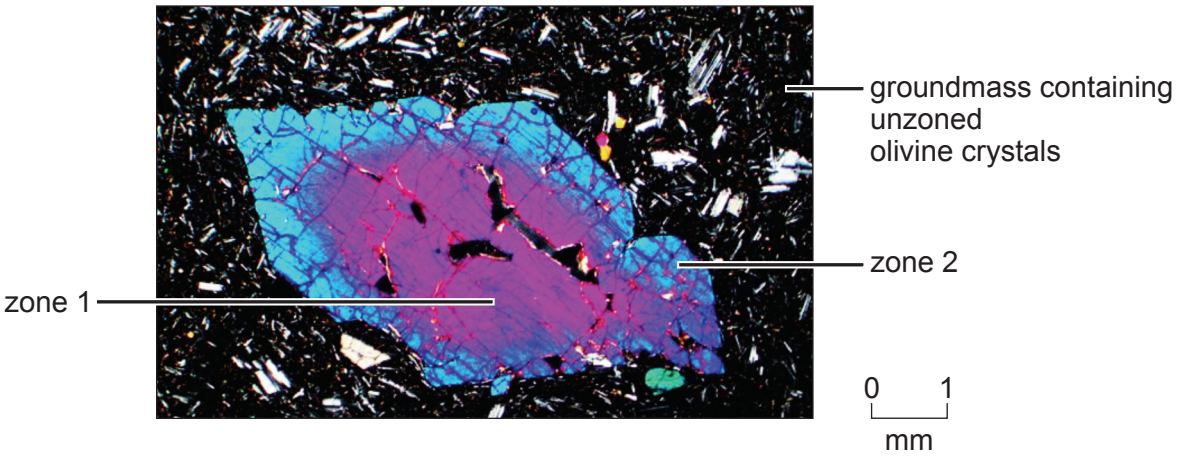

Figure 1c

Refer to **Figure 1b** and to the zoned olivine phenocryst in **Figure 1c**.

(i) Describe and account for the probable difference in composition between zone 1 and zone 2 of the zoned olivine phenocryst. [3]

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(ii) Explain why the olivine crystals in the groundmass are not zoned. [2]

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2. **Figure 2a** shows a model of a divergent plate margin in which symmetrical spreading is taking place. The plates are moving at the same speed.

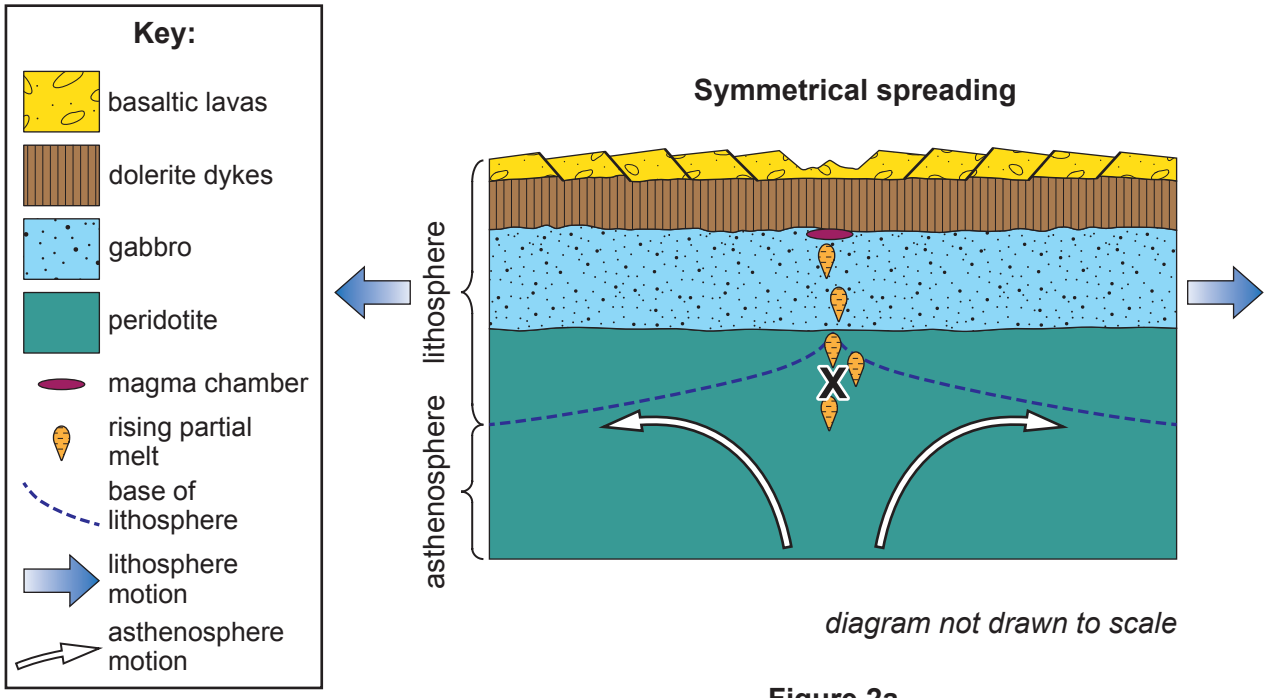

Figure 2a

(a) Refer to **Figure 2a**.

(i) Mark on the right-hand edge of **Figure 2a** the position of the boundary between the crust and the mantle using an arrow labelled **M** (**M➔**). [1]

(ii) State the type of faults present in the basaltic lavas. Give the evidence for your answer. [2]

Fault type .....

Evidence .....

.....

(iii) Explain why magma is generated at location **X**. [2]

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(b) **Figure 2b** shows an alternative model of a divergent plate margin in which asymmetrical spreading is taking place. The plates are moving at different speeds.

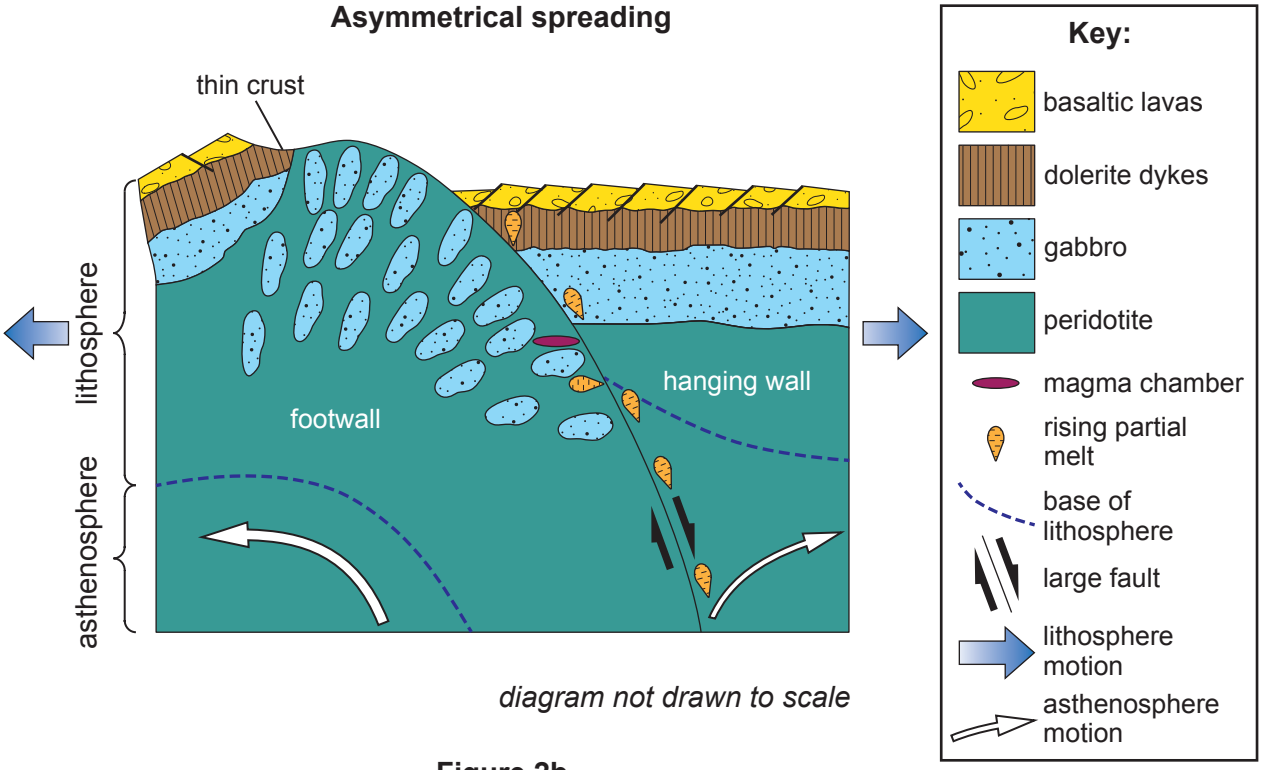

Figure 2b

Compare and contrast the:

- lithology of the rocks that outcrop on the sea floor
- faulting present

in **Figure 2a** and **Figure 2b**. [4]

Lithology

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Faulting

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(c) Using **Figure 2a**, **Figure 2b** and your knowledge, explain how **magnetic** data and **ocean drilling** could be used to determine the rate of sea floor spreading on either side of an ocean ridge. You may wish to use an annotated diagram(s) in your answer.

[6 QER]

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Section B

Answer **all** questions.

3. **Specimen E** was collected within **Rock Unit E** on **Map 1**.

(a) (i) Complete **Table 3** by:

- stating the result of the test or observation described
- describing **one** other diagnostic test/observation which confirms the identity of the mineral forming **Specimen E**, and stating the result.

You may wish to refer to the Mineral Data Sheet. [3]

Description of test/observation	Result of test/observation
Observe the colour of the light reflected by the surface	white
Observe the reaction with dilute HCl	no reaction
Observe the lustre (the appearance of the surface in reflected light)	•
•	•

Table 3

(ii) Name the mineral forming **Specimen E**. [1]

Specimen E .....

(b) Beds of halite were also found within **Rock Unit E**. Describe the environmental and climatic conditions required for the formation of beds of halite. [3]

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4. **Specimen C** was collected from **Rock Unit C** on **Map 1**.

(a) Describe the texture of **Specimen C**. [3]

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.....

.....

.....

(b) State the type of igneous body formed by **Rock Unit C**. Give **one** piece of evidence from each of **Specimen C** and **Map 1**. [3]

Type of igneous body .....

Evidence from **Specimen C** .....

.....

Evidence from **Map 1** .....

.....

(c) A student stated:

"The weathering of **Rock Unit C** could lead to the formation of economic deposits of china clay."

Evaluate this statement. [3]

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5. **Specimen K** was found at **Locality 1** on **Map 1**.

(a) Draw an internal view of **Specimen K** using the scale provided. [4]

0 1
cm

(b) State the fossil group represented by **Specimen K**. Explain your answer with reference to the symmetry of this valve. [2]

Fossil group .....

Explanation .....

.....

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(c) **Figure 5** shows internal and external views of another modern shell **L**, found at **Locality 1**.

Figure 5

Complete **Table 4** to interpret the mode of life of the organisms represented by **Specimen K** and shell **L**. Explain your answers. [6]

	Mode of Life	Explanations
K	•	• •
L	•	• •

Table 4

12

6. **Figure 6a** shows part of **Rock Unit D** on **Map 1**. **Figure 6b** shows a bedding plane surface found within **Rock Unit D**.

Figure 6a

Figure 6b

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Plan a field investigation to collect information to determine:

- the environment of deposition of **Rock Unit D**
- the information that the trace fossils in **Figure 6b** indicates about the animals that lived in that environment.

Your answer should include details of the observations and measurements you would make and justifications for why you have chosen these observations and measurements. You may wish to use an annotated diagram(s) in your answer. [9 QER]

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7. **Specimen G** is a type of coal found within **Rock Unit G** on **Map 1**.

(a) State, giving **two** reasons, the rank of coal (peat, lignite, bituminous, anthracite) represented by **Specimen G**. [3]

Rank .....

Reason 1 .....

.....

Reason 2 .....

.....

(b) A student concluded that **Specimen G**:

- was deposited in a well-oxygenated tropical sea
- has undergone burial to a maximum depth of 100 m.

Evaluate the student's conclusion, giving reasons for your answer. [4]

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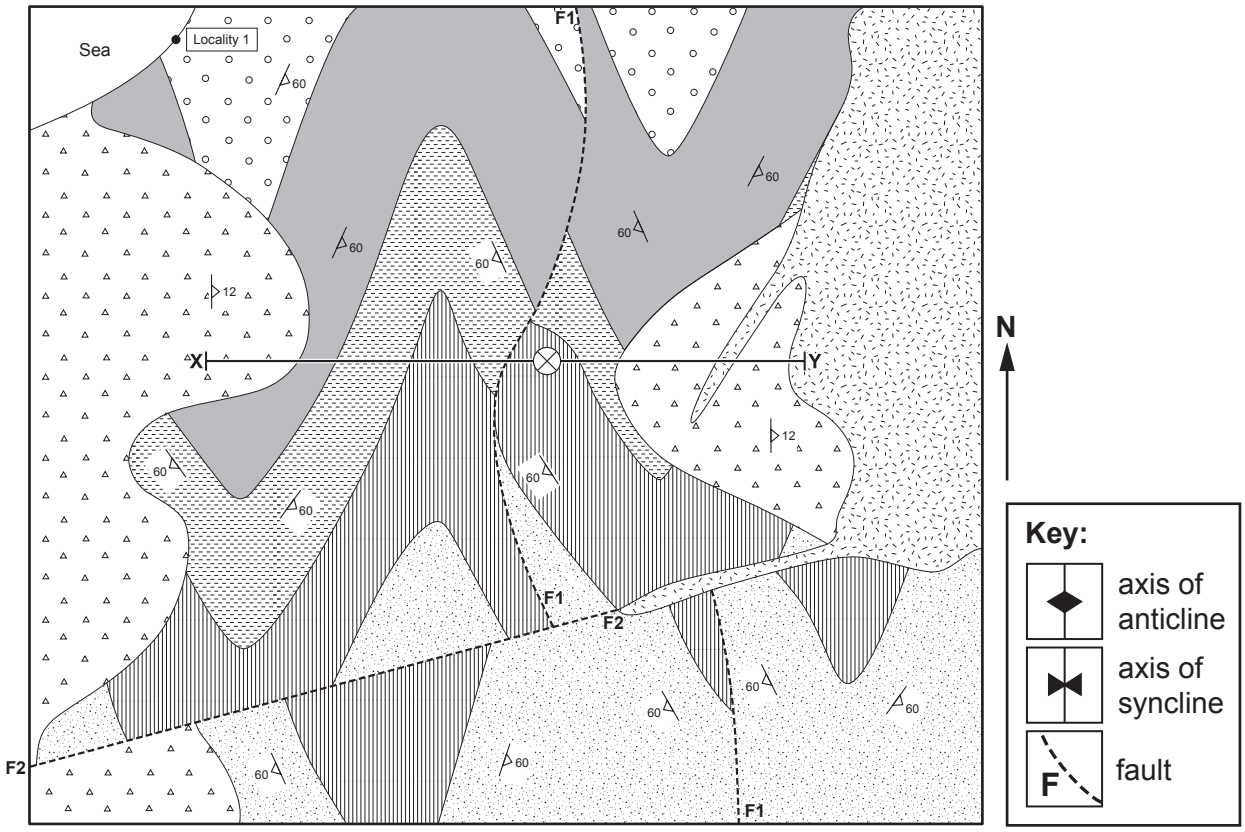
8. (a) **Map 2** is a reduction of **Map 1**. The key for the rock units is the same as for **Map 1**.

On **Map 2** clearly mark and label the position of:

- **two** fold axial plane traces to the **west** of **F1** (using the symbols in the key)
- **one** fold axial plane trace to the **south** of **F2** (using the symbols in the key)
- an unconformity to the **east** of **F1** (using an arrow labelled **U** (**U➔**). [4]



Map 2

(b) **Map 1** shows two faults, **F1** and **F2**.

Complete **Table 5** to describe the features of faults **F1** and **F2** on **Map 1**. [3]

Feature of Fault	Fault F1	Fault F2
Angle of dip of the fault plane	75°	•
Direction of dip of the fault plane	East	
Type of fault (dip-slip, thrust, strike-slip)	•	•

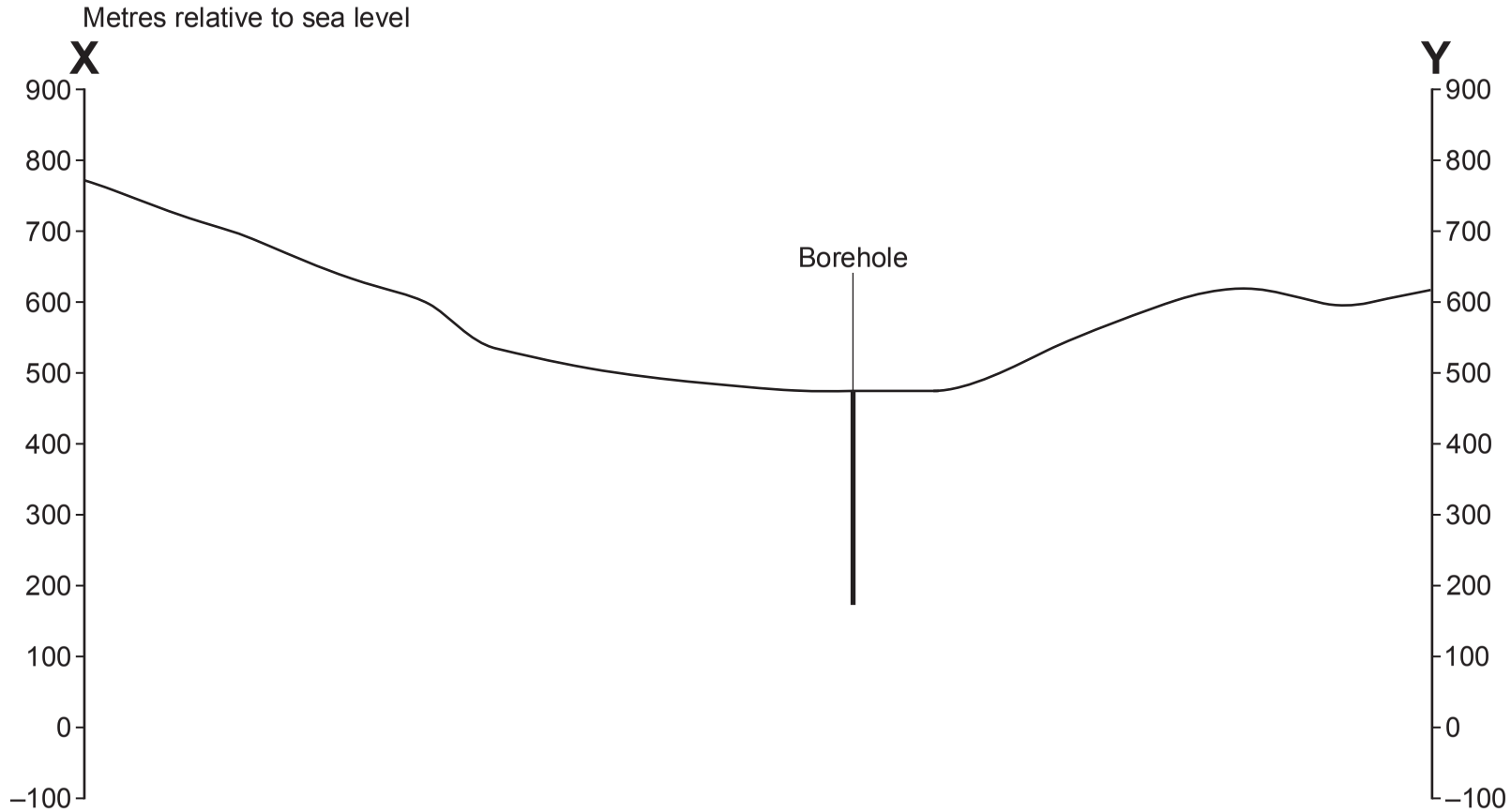
Table 5

7

9. The topographic profile below was taken along the line **X–Y** on **Map 1**.

Construct the geological cross-section along this line using **Map 1**.

- The true thickness of **Rock Unit G** is 150 metres.
- Draw the rock units. Use similar ornament, or letters, to those on **Map 1**.
- Draw and label any **fold axes**, with the correct symbol.
- Draw any **faults**.
- **Project** the rock units and structures **above** the ground surface to illustrate any cross-cutting relationships and the reactivation of the fault. [14]



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10. **Figure 10** shows an included fragment found within **Rock Unit A** on **Map 1**.

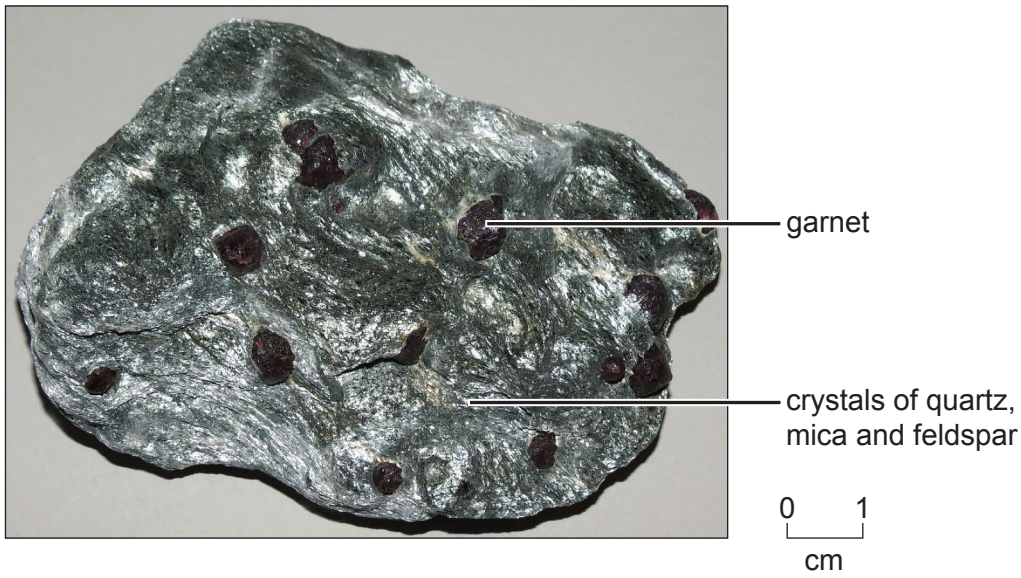

Figure 10

(a) State, giving **two** reasons, the name of the rock shown in **Figure 10**. [3]

Name .....

Reason 1 .....

.....

Reason 2 .....

.....

(b) The rock in **Figure 10** was radiometrically dated using the Potassium-Argon method as being 422 (±2%) Ma.

(i) Calculate the maximum age of the rock. Give your answer to the correct number of significant figures. Show your working. [2]

Maximum age ..... Ma

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(ii) State **two** assumptions or limitations of using the Potassium-Argon method to date rocks. [2]

1. .....

.....

2. .....

.....

(c) Refer to **Map 1** and **Figure 6b**. **Rock Unit C** is Palaeogene in age.

(i) State in which unit of geological time **Rock Unit A** could have been deposited. Tick (✓) only **one** box. [1]

Precambrian	Cambrian	Cretaceous	Neogene
☐	☐	☐	☐

(ii) Explain **two** reasons to support your answer to (c)(i). [2]

Explanation 1

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Explanation 2

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END OF PAPER

Acknowledgements

Figure 1c	https://www.alexstrekeisen.it/immagini/vulc/zoning2020(4).jpg
Figures 2a and 2b	https://teacheratseablog.wordpress.com/2017/04/17/a-level-geology/
Figure 5	Photograph M. Walsh
Figure 6a	https://www.sciencephoto.com/media/169095/view/dipping-rock-strata
Figure 6b	https://www.nhm.ac.uk/discover/

Question number	Additional page, if required. Write the question number(s) in the left-hand margin.

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