Surname	Centre Number	Candidate Number
First name(s)		2

GCE A LEVEL

A480U20-1

S25-A480U20-1

MONDAY, 9 JUNE 2025 – AFTERNOON

GEOLOGY – A level component 2

Geological Principles and Processes

1 hour 45 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**13**	
2.	**13**	
3.	**18**	
4.	**20**	
5.	**10**	
6.	**16**	
Total	**90**	

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ADDITIONAL MATERIALS

In addition to this examination paper you will need:

- a calculator
- a ruler.

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.

INFORMATION FOR CANDIDATES

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 **5**.

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Answer **all** questions in the spaces provided.

1. **Figure 1a** is a photograph of stony meteorite **P**.
Table 1 shows the percentages of the main elements in the Earth's crust, meteorite **P** and another meteorite (meteorite **Q**).

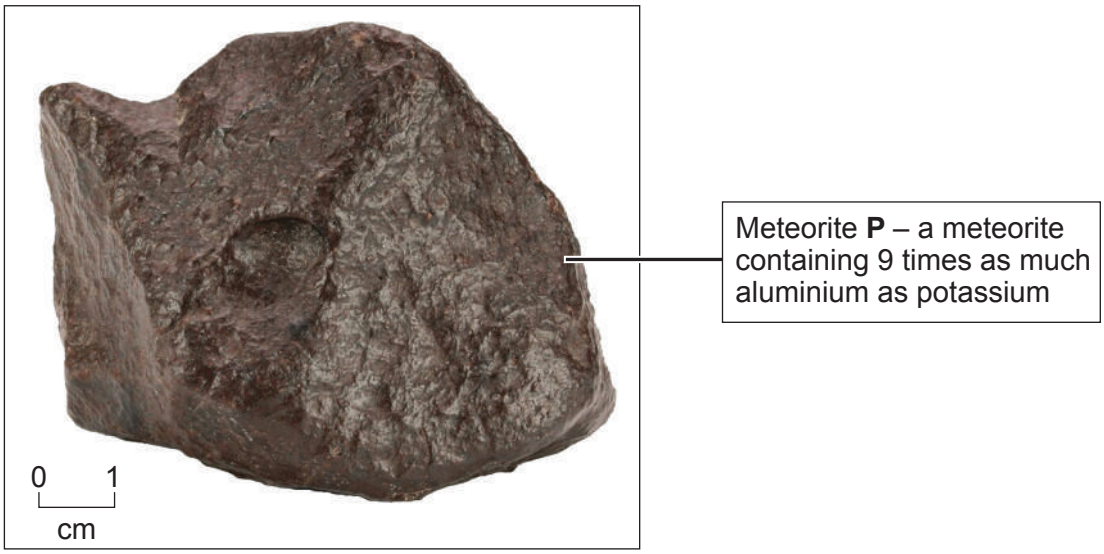


Figure 1a

Element	Abundance in the Earth's crust (%)	Abundance in meteorite **P** (%)	Abundance in meteorite **Q** (%)
•	46	32	
silicon	27	14	
aluminium	8.1	•	
iron	6.3	30	88
calcium	5.0	1.1	
•	2.9	12	
sodium	2.3	0.55	
potassium	1.5	•	
others	0.9	9.35	12

Table 1

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

(i) Using your knowledge, complete the 'Element' column of **Table 1** by stating the name of the **two** missing elements. [2]

(ii) Use the information in **Figure 1a** to complete **Table 1** by calculating the abundance of aluminium and potassium in meteorite **P**. [1]

(iii) Using the data in **Table 1**, state the type of meteorite represented by meteorite **Q**. [1]

.....

(iv) State which category of the Goldschmidt Classification system the main element of meteorite **Q** belongs to. Tick (✓) **one** box only. [1]

☐ Atmophile ☐ Lithophile ☐ Siderophile ☐ Chalcophile

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(b) **Figure 1b** shows how density varies with depth in the Earth. The mean density of the Earth's core is labelled on the graph.

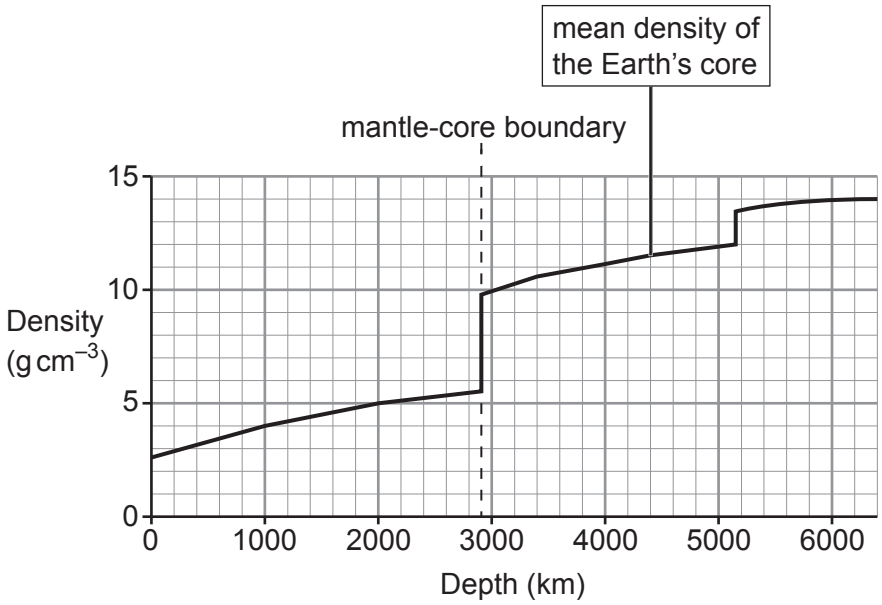


Figure 1b

(i) Meteorite **P** has a density of 3·3 g cm^{-3}. Using **Figure 1b**:

- State the depth at which the Earth has a density of 3·3 g cm^{-3}.
- Suggest which layer of the Earth is most likely to be represented by meteorite **P**. [2]

Depth ..... km

Layer .....

(ii) Suggest why the density of the Earth increases rapidly at a depth of 5155 km. [2]

.....

.....

(iii) Using **Figure 1b**, state the mean density of the Earth's core. [1]

..... g cm^{-3}

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(iv) Using your answer to part b(iii), and the information below, calculate the volume of the Earth's core (in cm^3). Show your working. Give your answer in standard form. [3]

Density:

$$\rho = \frac{m}{V}$$

ρ = mean density of the Earth's core ($g\,cm^{-3}$)
m = mass of the Earth's core (1.85×10^{27} g)
V = volume of the Earth's core (cm^3)

..... cm^3

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2. **Figure 2a** is a photograph of a rock outcrop taken facing south.

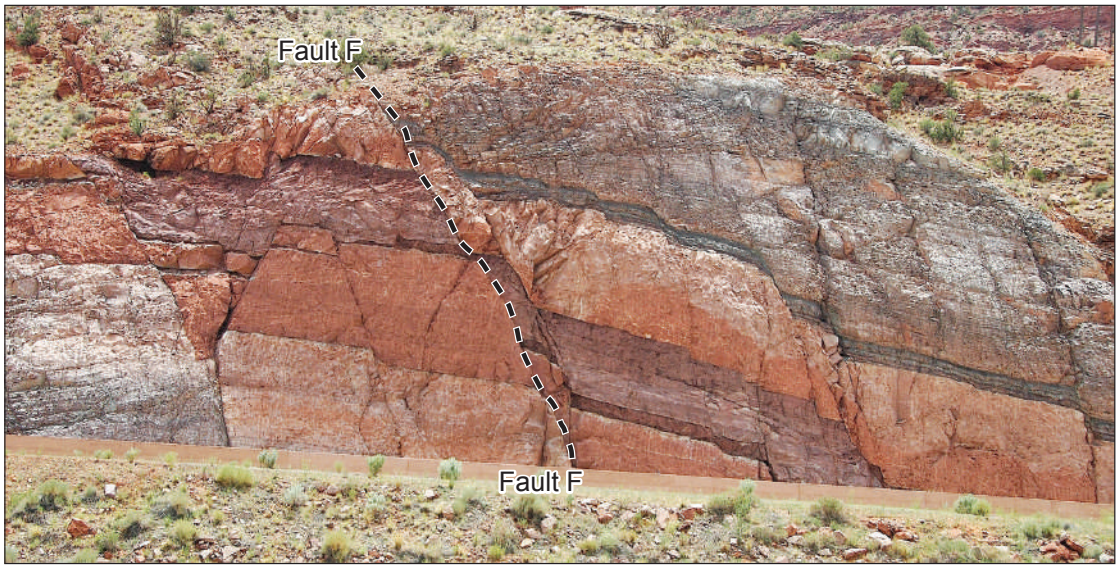


Figure 2a

0 5
m

Refer to **Figure 2a**.

(a) (i) Measure the throw of Fault **F** on **Figure 2a**. [1]

..... m

(ii) State the type of fault represented by Fault **F** (normal, reverse, thrust). Give a reason for your answer. [2]

Fault type: .....

Reason: .....

.....

(iii) A student stated,

'The faults in **Figure 2a** were formed by east-west tensional stresses.' Evaluate this statement. [2]

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(iv) At one time the throw of Fault **F** was greater than it is now. With reference to changing principal stress directions, explain how this reduction in throw occurred. [2]

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(b) **Figure 2b** shows photographs taken close to the location in **Figure 2a**. In each, a rock type has been outlined with a box (**Rock G** and **Rock H**).

Figure 2c shows photomicrographs of the texture and composition of **Rock G** and **Rock H**.

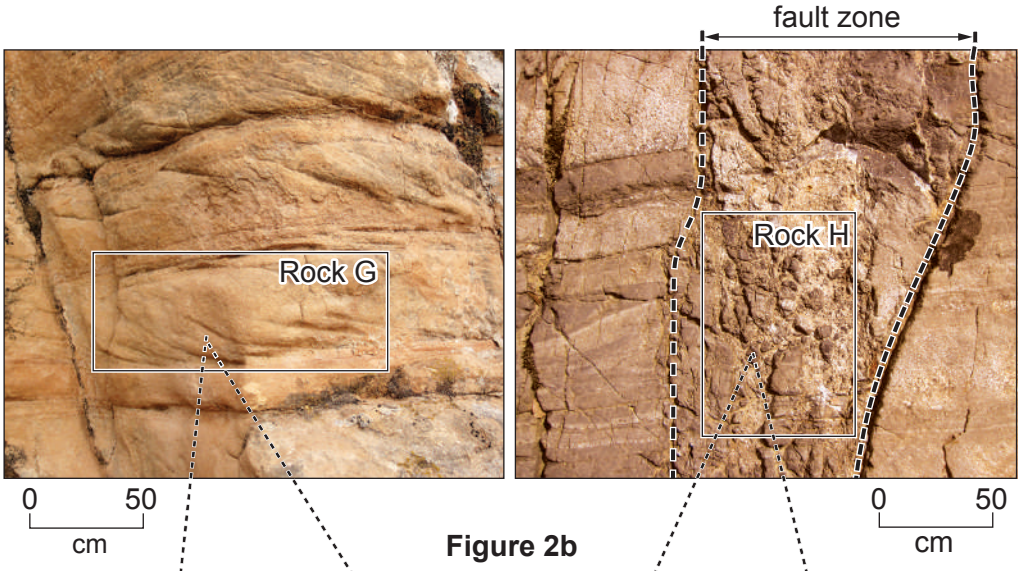


Figure 2b

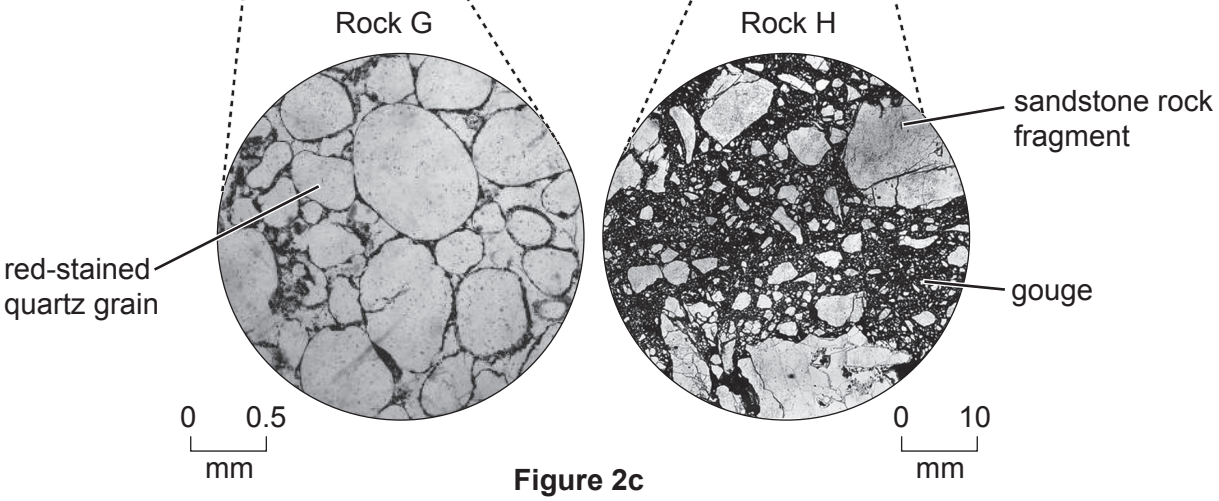


Figure 2c

Refer to **Figure 2b** and **Figure 2c**. Explain how the texture, composition and structure of **Rock G** and **Rock H** are related to their modes of formation. [6 QER]

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3. **Figure 3a** is a map of part of the Hawaiian chain of basaltic volcanoes across the Pacific Plate. Labels show the centre of several important volcanoes.
Figure 3b shows the estimated rate of eruption along the Hawaiian chain.

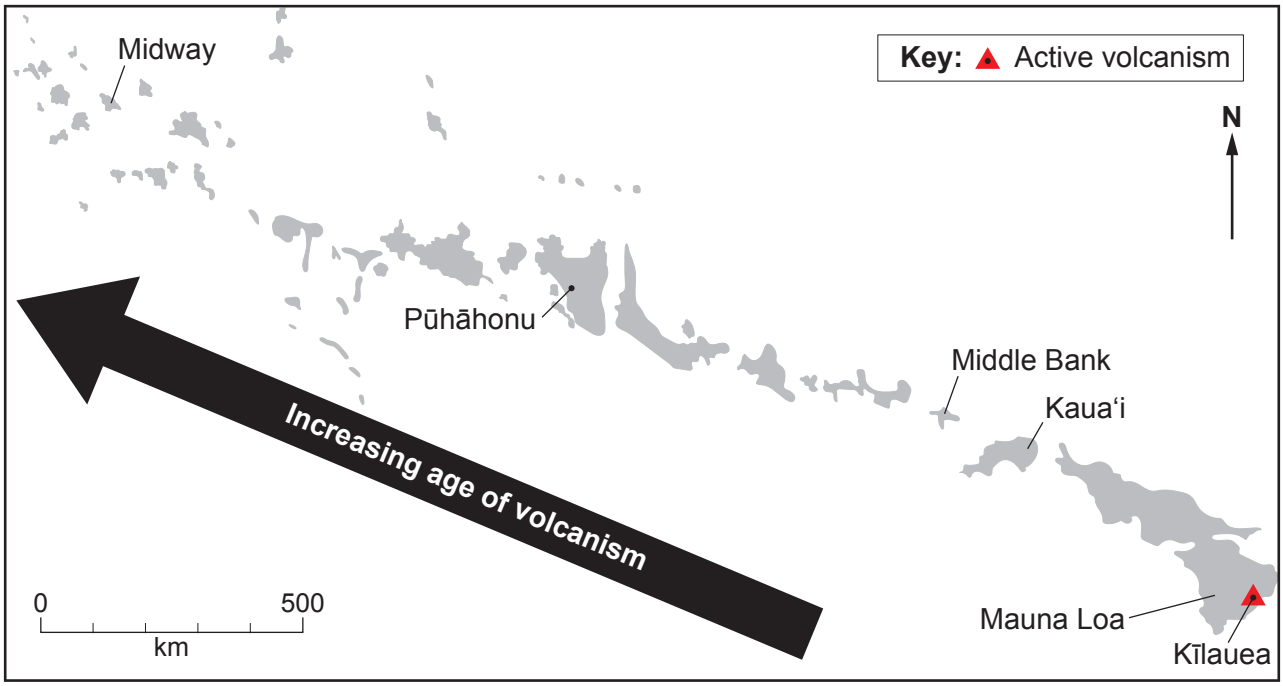


Figure 3a

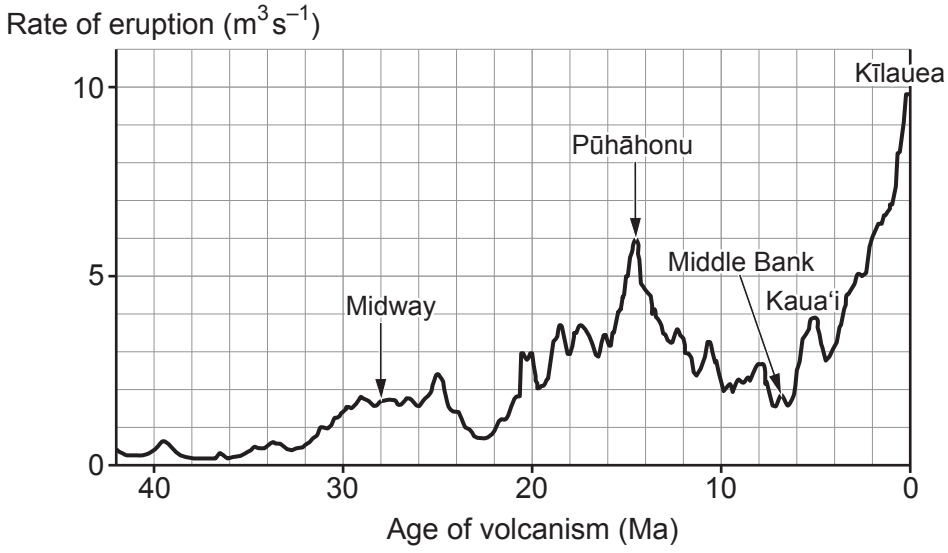


Figure 3b

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Refer to **Figure 3a** and **Figure 3b.**

(a) One theory for the origin of the Hawaiian chain is that these volcanoes formed above a fixed mantle plume, currently located beneath Kīlauea, over which the Pacific Plate has steadily moved.

(i) Using **Figure 3a,** state the distance the Pūhāhonu volcano has travelled from the fixed mantle plume. [1]

..... km

(ii) Using your answer to question **3**(a)(i) and **Figure 3b**, calculate the mean rate of movement of the Pacific Plate (in $cm\,yr^{-1}$) since the formation of the Pūhāhonu volcano. Show your working. [2]

..... $cm\,yr^{-1}$

(iii) Describe the relationship between the rate of eruption and age of volcanism in **Figure 3b**. [3]

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(iv) Name and describe **one** volcanic hazard that could be associated with the present-day volcanism at Kīlauea. [2]

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(b) An alternative theory for the formation of the Hawaiian chain of volcanoes, without involving a mantle plume, involves stretching and thinning of the Pacific Plate lithosphere.

(i) Outline the evidence in **Figure 3a** that supports the more widely accepted plume theory. [3]

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(ii) Suggest how the alternative (non-plume) theory might have generated basaltic magma. [2]

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(c) **Figure 3c** is a phase diagram for the olivine solid solution series. Crystals of olivine were obtained from the basalt rock erupted from Pūhāhonu.

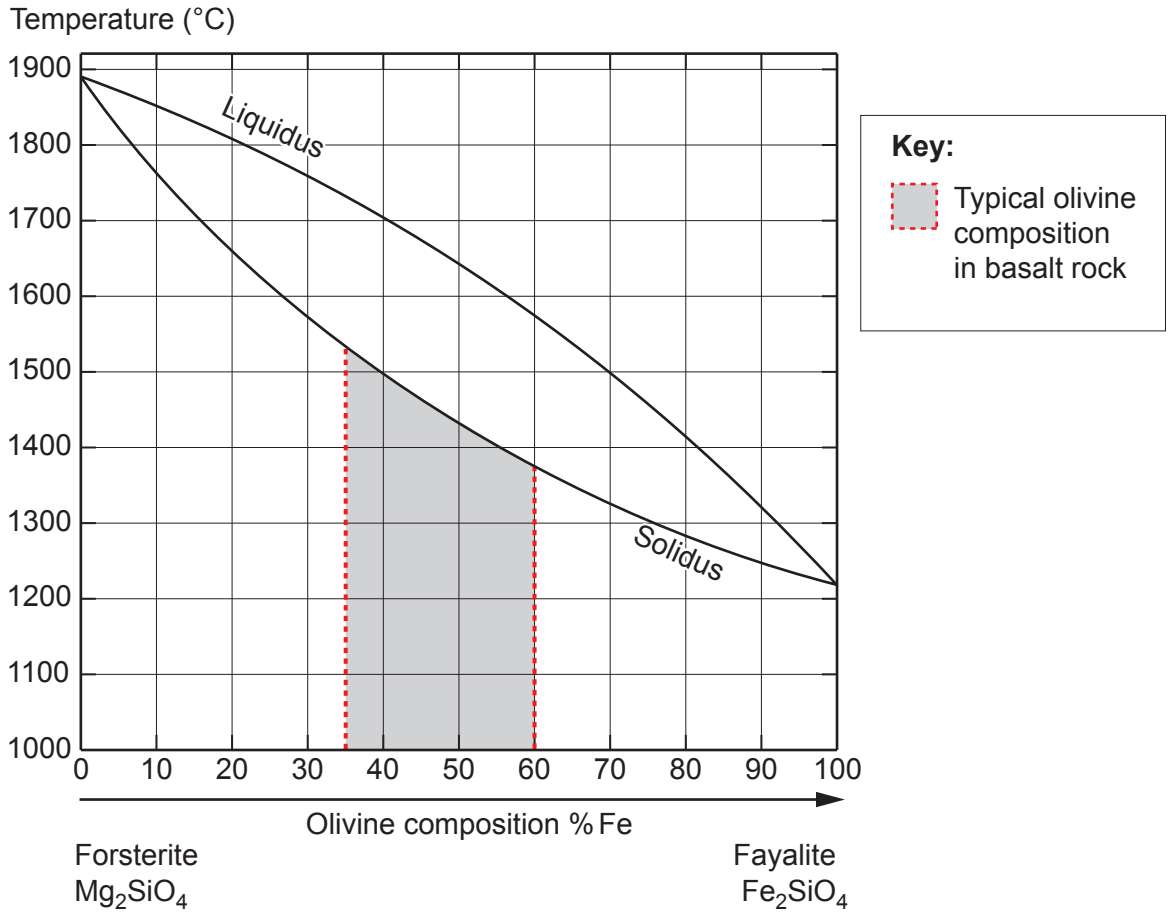


Figure 3c

Refer to **Figure 3c**.

(i) State the temperature at which pure forsterite crystallises. [1]

..... °C

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(ii) Olivine crystals from the extinct Pūhāhonu volcano have a composition of 25% iron (Fe). Complete **Table 2** below to show the characteristics of the Pūhāhonu melt as it cooled. Assume that the melt remained in equilibrium with the crystals as they formed. [3]

	Temperature of melt (°C)	Composition of crystals (%Fe)	Composition of melt (%Fe)
Initial crystallisation	1780	•	25
Crystallisation at 1700 °C	1700	16	•
Final crystallisation	•	25	

Table 2

(iii) Suggest how the compositional data in **Table 2** supports the conclusion that the Pūhāhonu volcano erupted very high temperature lava. [1]

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4. **Figure 4a** shows a graphic log produced from a borehole of marine sedimentary rocks.

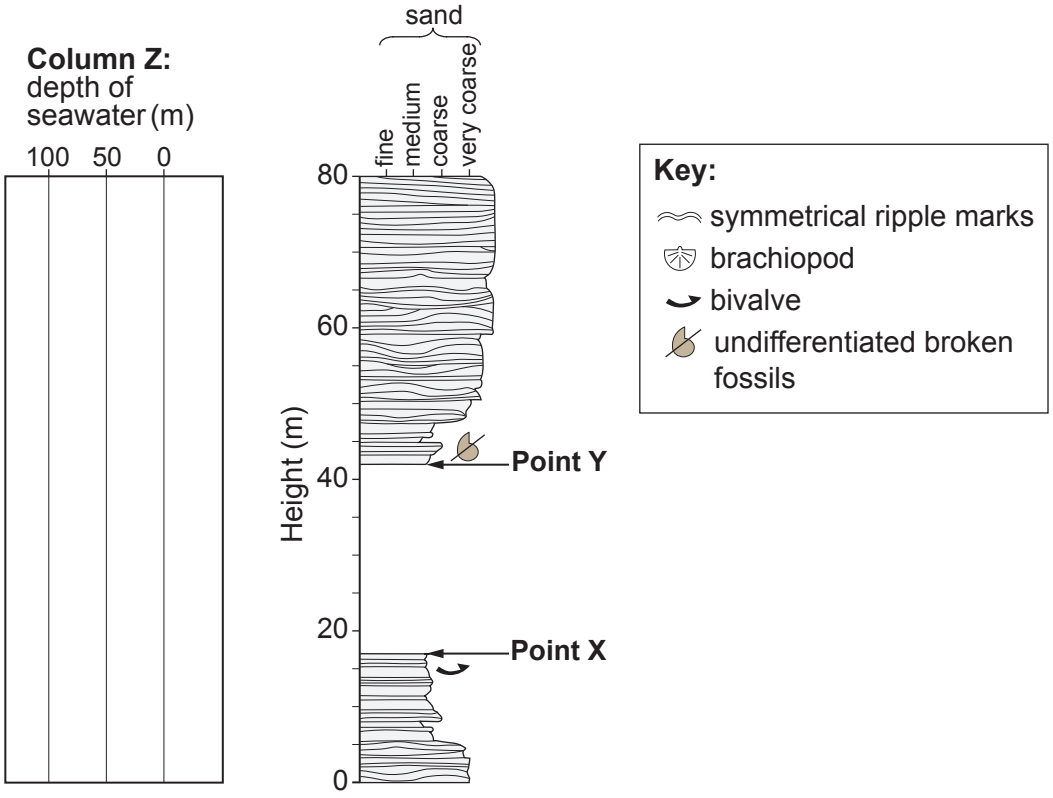


Figure 4a

Refer to **Figure 4a**.

(a) (i) Using the description of the three sedimentary rocks in **Table 3**, complete the graphic log shown in **Figure 4a**. [3]

Description of beds
"Measuring up the sequence from **point X** to **point Y**, there is 8 m of medium-grained sandstone, followed by 5 m of coarse-grained sandstone containing brachiopod fossils, and finally another 12 m of medium-grained sandstone with symmetrical ripple marks."

Table 3

(ii) The finest sediments in **Figure 4a** were deposited in seawater no deeper than 50 m. Sketch a line in **Column Z** of **Figure 4a** to show the changes in the depth of seawater represented by this graphic log. [2]

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(b) **Figure 4b** is a regional model showing the distribution of marine sedimentary rocks where the sequence in **Figure 4a** was deposited.

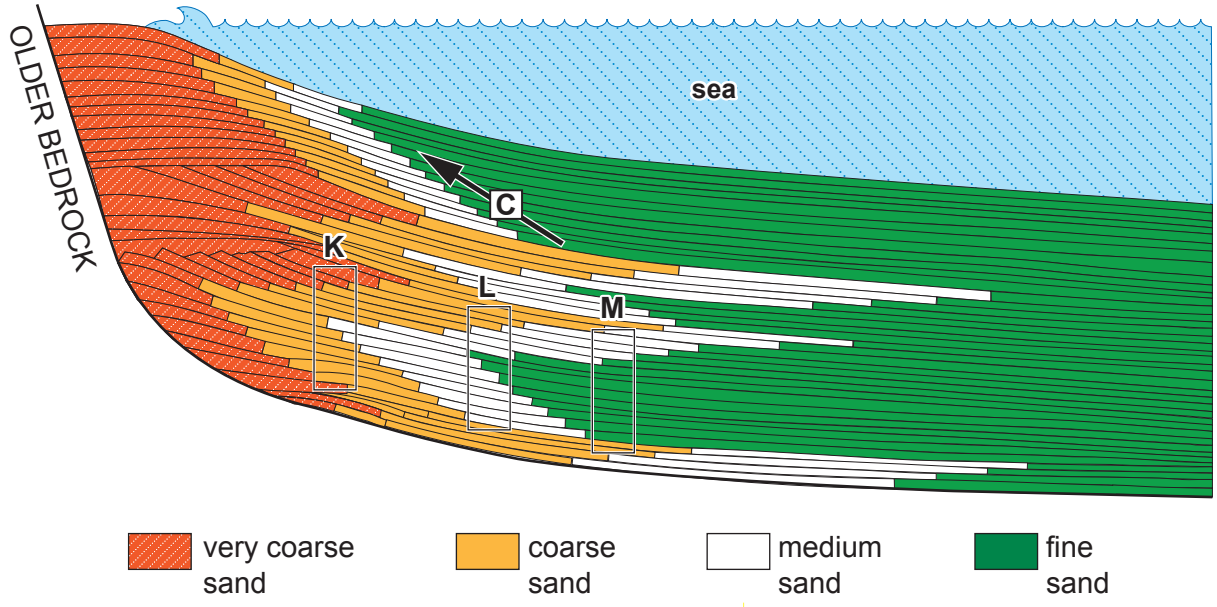


Figure 4b

(i) Refer to **Figure 4a** and **Figure 4b**.
The graphic log in **Figure 4a** is a record of the sedimentary rocks from a borehole at one of three locations in **Figure 4b**. State at which location (**K**, **L**, **M**) the graphic log was recorded. Tick (✓) **one** box and give **two** reasons for your answer. [3]

☐ **K** ☐ **L** ☐ **M**

Reason 1: .....

.....

Reason 2: .....

.....

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(ii) State whether arrow **C** on **Figure 4b** demonstrates an episode of:

- marine transgression
- marine regression
- constant sea level.

Give a reason for your answer. [2]

Arrow **C** demonstrates an episode of .....

Reason: .....

.....

(iii) State what is meant by 'Walther's Law'. [1]

.....

.....

(iv) A student stated:

- 'Walther's Law can be applied when interpreting the lithofacies in **Figure 4b**,
- and overall, **Figure 4b** represents an environment of decreasing energy conditions.'

Evaluate the student's statement. [3]

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(c) **Figure 4c** is a photograph of a sedimentary structure observed in beds of sandstone shown in **Figure 4a** but not shown in the key.



Figure 4c

(i) Name the sedimentary structure shown in **Figure 4c**. [1]

.....

(ii) For one sedimentary structure that can be used to show the previous direction of the movement of air or water, other than that shown in **Figure 4c**,

- describe its appearance and
- explain how it can be used to indicate the direction of movement of air or water.

You may wish to illustrate your answer with a labelled diagram(s). [5]

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5. **Figure 5a** shows changes in atmospheric carbon dioxide levels since the year 1000. **Figure 5b** shows these changes in greater detail since the year 1880. Each figure shows a different proposed boundary for defining the onset of the Anthropocene Epoch.

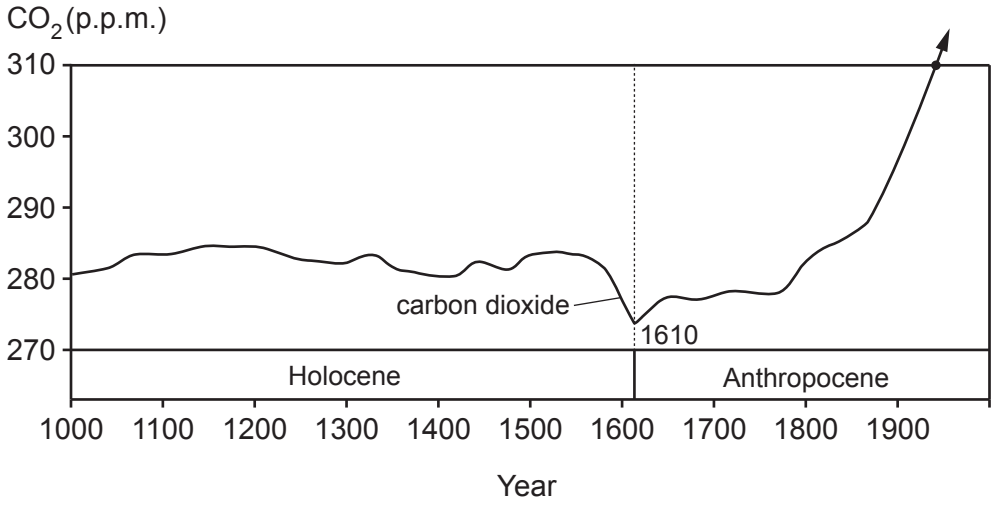


Figure 5a

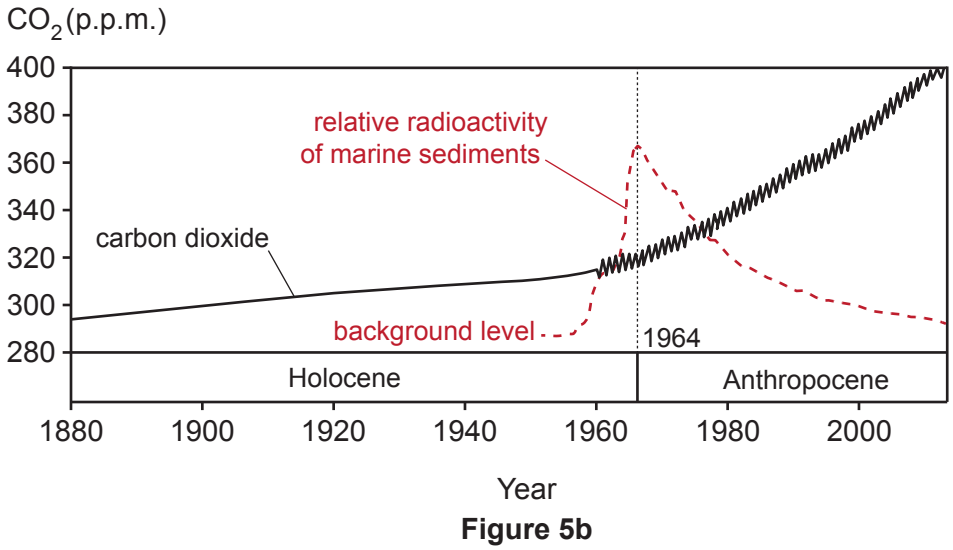


Figure 5b

(a) (i) State **one** natural source of carbon dioxide. [1]

.....

(ii) Describe the change in atmospheric carbon dioxide concentration since the year 1500, shown in **Figure 5a**. [3]

.....

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(b) A student stated:

'The beginning of the Anthropocene Epoch should be defined by the appearance and increased abundance of anthropogenic (human-made) deposits.'

Explain and evaluate the statement using **Figure 5a**, **Figure 5b** and/or your own knowledge of possible anthropogenic markers in the geological record. [6 QER]

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6. **Figure 6a** is a photograph of a plant fossil (**J**).
Figure 6b is a photograph of a present-day plant (**K**) with similar morphological characteristics.

Plant fossil J

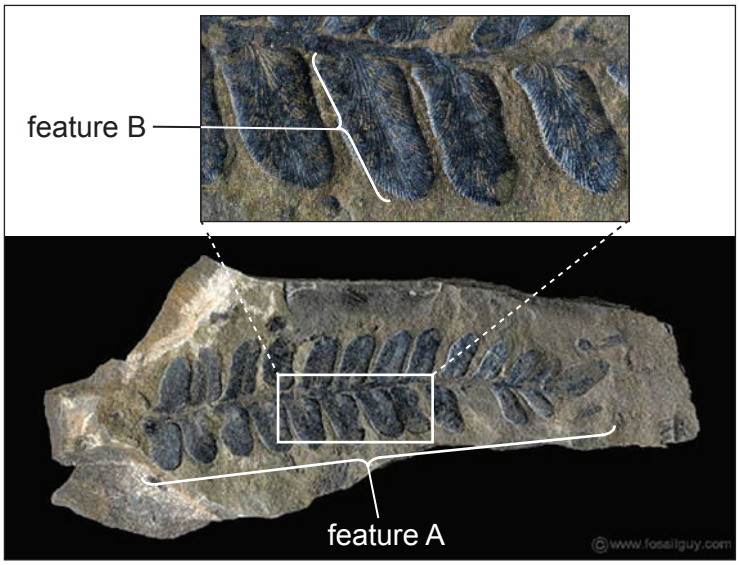


Figure 6a

Present-day plant K

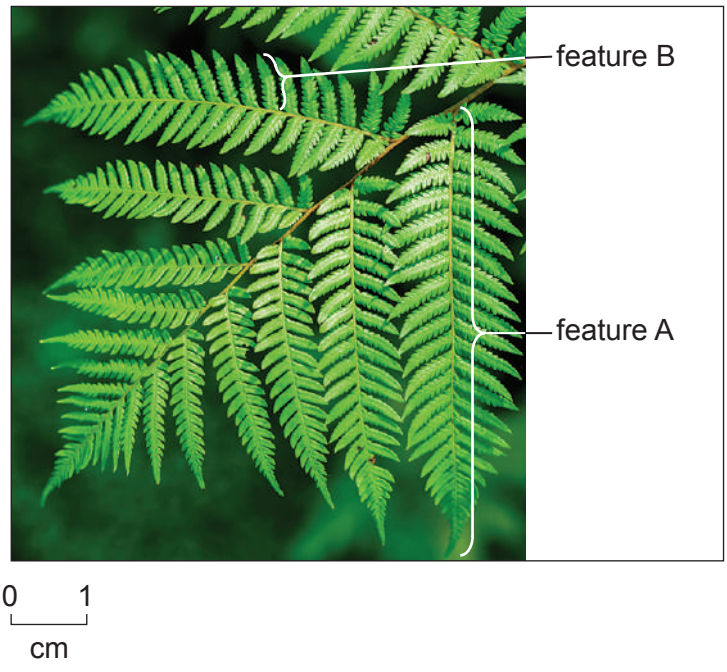


Figure 6b

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(a) (i) Plant fossil **J** appeared in the fossil record after the Devonian period and was extinct by the end of the Permian period. Tick (✓) the most likely age of plant fossil **J**. [1]

☐ **Silurian** ☐ **Carboniferous** ☐ **Triassic**

(ii) State the principle that allows geologists to infer the most likely mode of life of extinct species based on the study of present-day species. [1]

.....

(iii) Give **one** similarity and **one** difference between the morphology of plant fossil **J** and present-day plant **K**. Refer to features **A** and **B** shown in **Figure 6a** and **Figure 6b**. [2]

Similarity: .....

.....

Difference: .....

.....

(iv) Suggest the limitations in comparing the morphology of the plants shown in **Figure 6a** and **Figure 6b**. [2]

.....

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(v) Name and describe the fossilisation process that led to the preservation of plant fossil **J**. [3]

Fossilisation process: .....

Description: .....

.....

.....

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(b) **Figure 6c** shows leaf surface area data collected from several different types of plant. **Figure 6d** shows how typical leaf surface area varies with latitude.

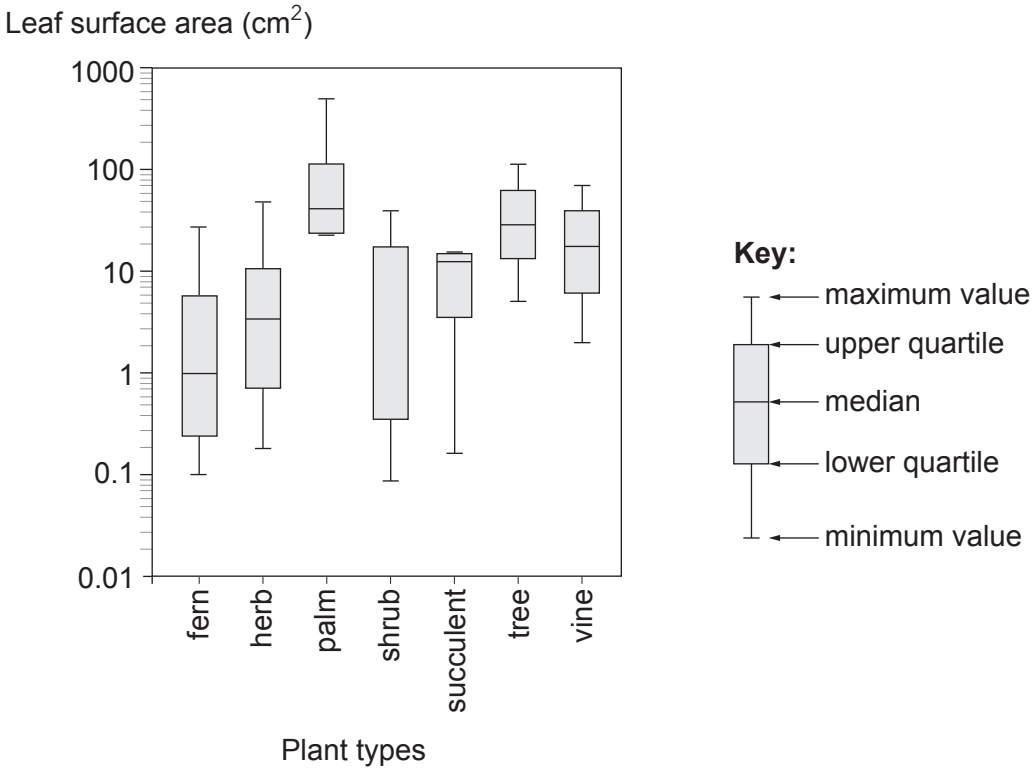


Figure 6c

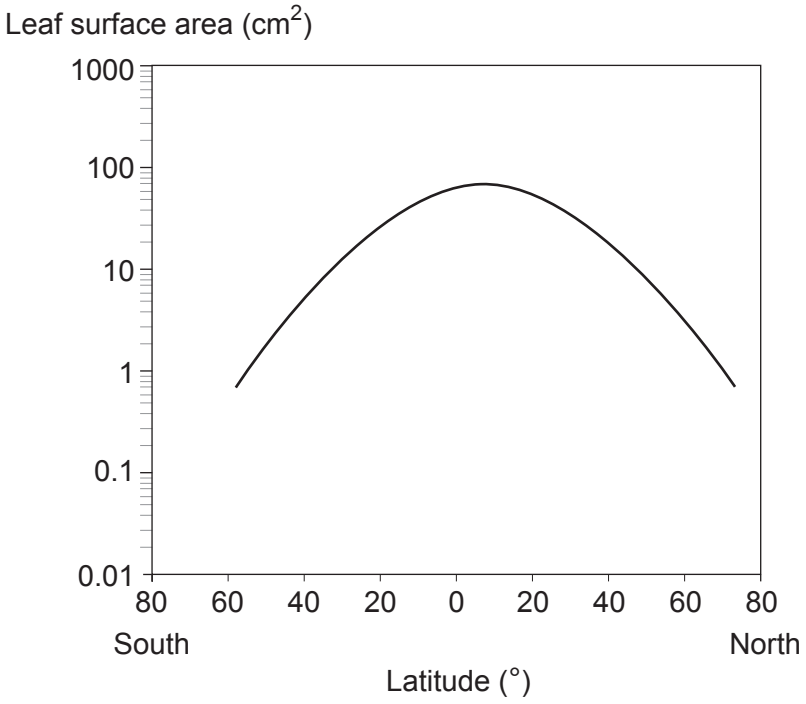


Figure 6d

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Refer to **Figure 6c**.

(i) State the range in leaf surface area of fern leaves in **Figure 6c**. [2]

..... to ..... cm^2

(ii) A median surface area of 4 cm^2 was calculated for shrub leaves. Draw a line on **Figure 6c** to show this. [1]

(c) Refer to **Figure 6d**.

(i) Describe the relationship between typical leaf surface area and latitude. [2]

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(ii) With reference to global climates, suggest why this relationship may exist. [2]

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END OF PAPER

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Acknowledgements

Figure 2a

https://www.flickr.com/photos/jsjgeology/8471260787/in/set-72157632763455730. Photograph James St John

Figure 2b

https://www.flickr.com/photos/jsjgeology/48863311216. Photograph James St John
https://www.flickr.com/photos/jsjgeology/21426722099. Photograph James St John

Figure 2c

http://suvratk.blogspot.com/2016/10/photomicrograph. Photograph Suvrat Kher
Plate 20-B, U.S.Geological Survey Professional paper 194. 1940. – ID. Johnston, W.D., Jr. 303 – jwdj0303 – U.S. Geological Survey

Figure 6a

https://www.science.org/doi/full/10.1126/science.aal4760. Acknowledgement not found

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