Surname	Centre Number	Candidate Number
First name(s)		2

GCE AS

B480U20-1

S24-B480U20-1

MONDAY, 20 MAY 2024 – MORNING

GEOLOGY – AS component 2
Foundation Geology

1 hour 30 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**14**	
2.	**12**	
3.	**18**	
4.	**16**	
5.	**12**	
6.	**18**	
Total	**90**	

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ADDITIONAL MATERIALS

Mineral Data Sheet
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 **1** and **4**.

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Answer **all** questions.

1. **Figure 1a** shows the percentages of different elements that make up the crust.

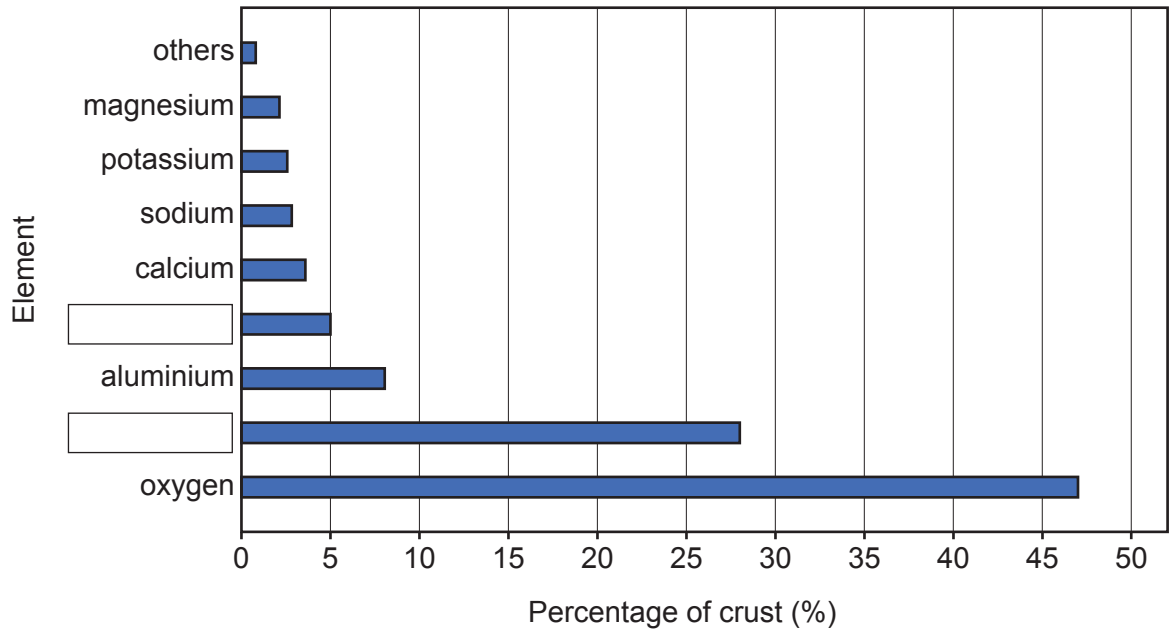

Figure 1a

(a) Complete the blank boxes in **Figure 1a** using **two** of the elements listed below. [2]

nickel iron silicon carbon hydrogen

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(b) Sedimentary rocks are derived from older rocks of the Earth's crust. **Figure 1b** shows photomicrographs of two sedimentary rocks, **A** and **B**.

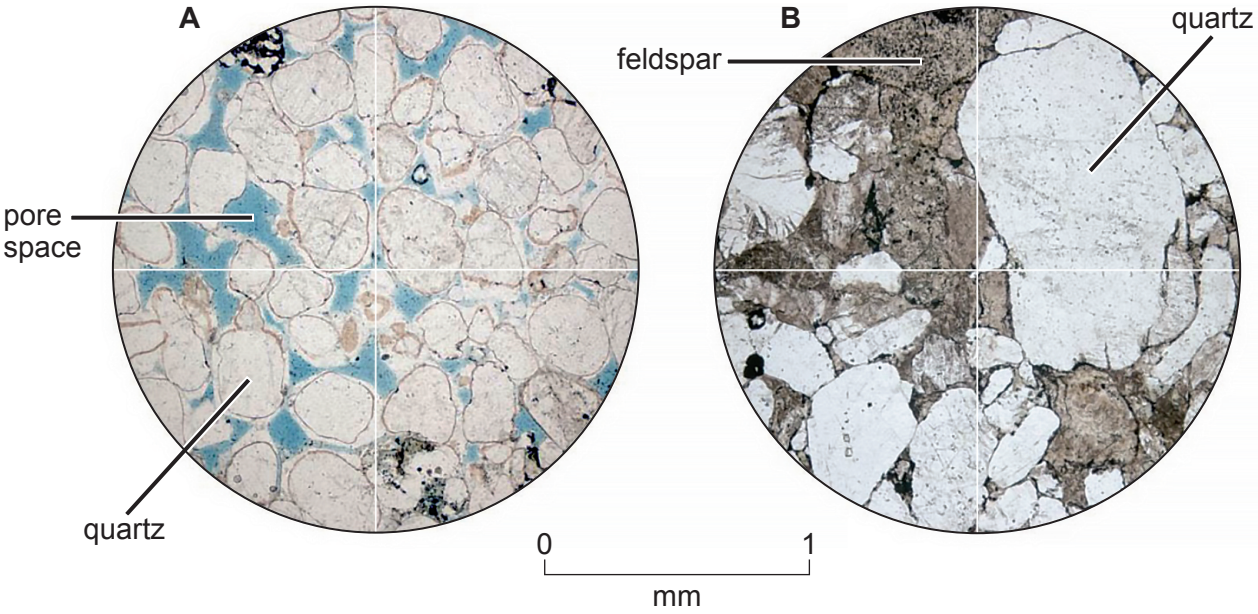

Figure 1b

(i) Name a rock from which rock **B** in **Figure 1b** could have been derived. [1]

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(ii) Compare the textures of the two sedimentary rocks shown in **Figure 1b**. [3]

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(c) (i) Explain the difference between porosity and permeability. [2]

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(ii) Refer to **Figure 1b**. Describe and explain the factors that affect the porosity and permeability of a sedimentary rock. [6 QER]

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2. **Figure 2** shows the time range and relative diversity of four types of cephalopod.

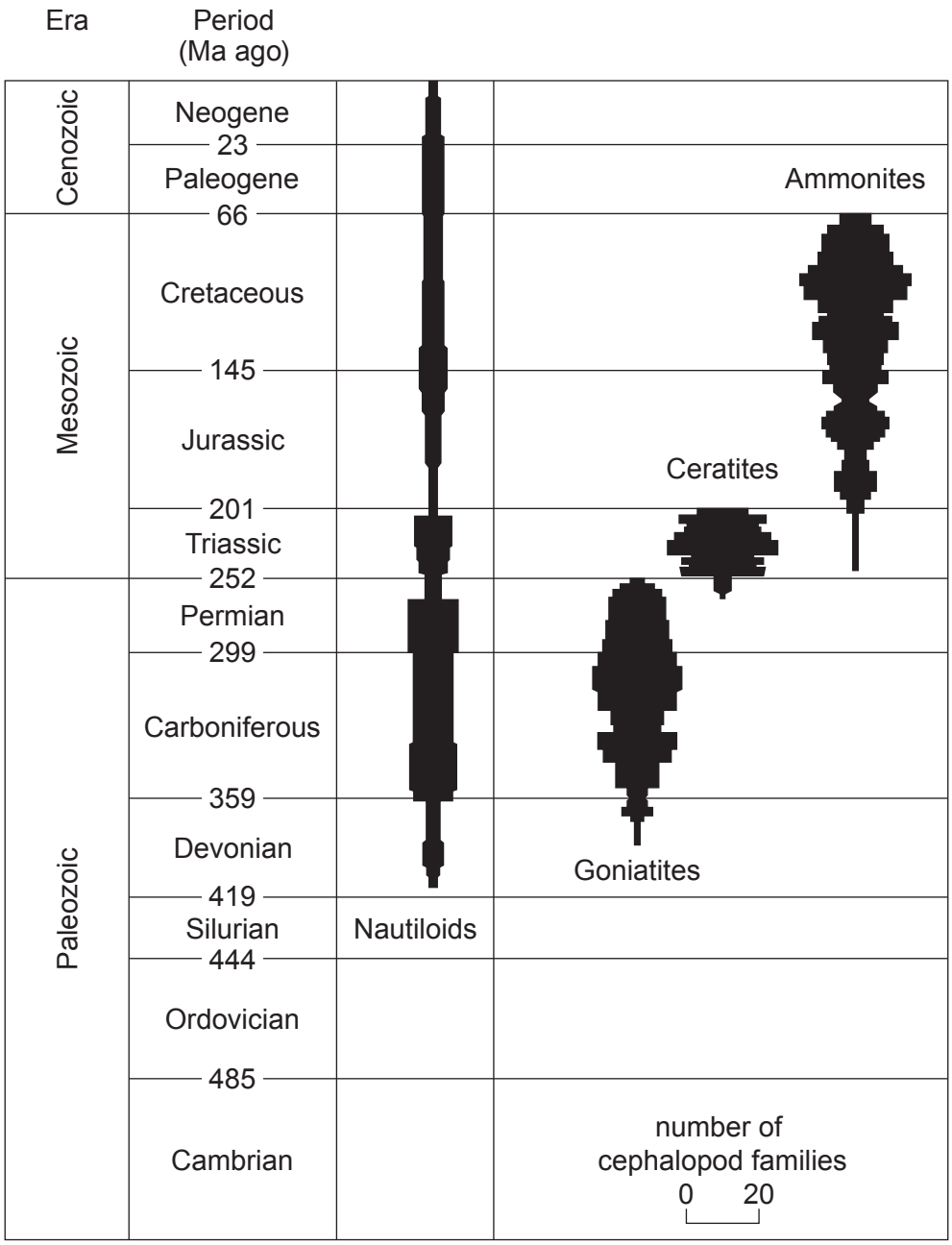

Figure 2

Refer to **Figure 2**.

(a) (i) State the duration of the Mesozoic era. [1]

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(ii) The age of the boundaries between geological periods on the geological column are calculated by radiometric dating. Explain how radiometric dating can determine the age of a rock. [3]

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(b) Some of the fossils in **Figure 2** can be used as zone fossils. State **three** key characteristics of a zone fossil. [3]

1. .....

2. .....

3. .....

(c) (i) State the name of the type of cephalopod which went extinct at the end of the Triassic period. [1]

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(ii) Evaluate how useful the fossils shown in **Figure 2** would be for the relative dating of rocks. [4]

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3. **Figure 3a** shows the distribution of selected mantle plume hot spots and plate boundaries. **Figure 3b** is a model showing the melting point curve of mantle peridotite, the normal geotherm through oceanic lithosphere and the geotherm at a mantle plume hot spot.

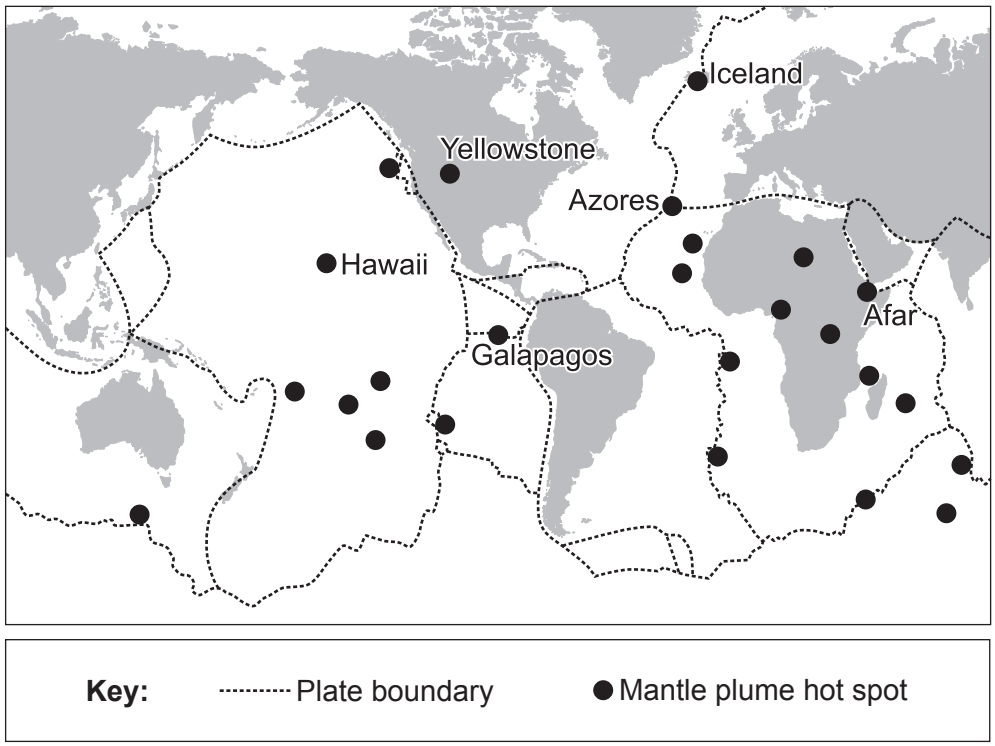

Figure 3a

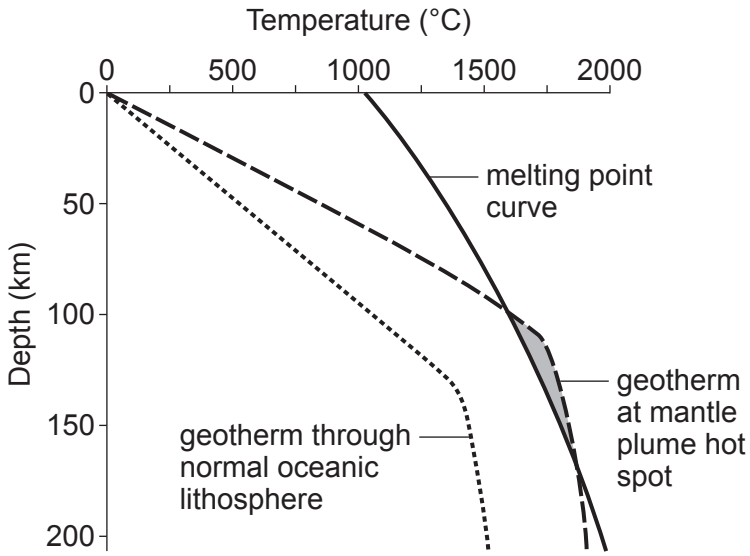

Figure 3b

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(a) (i) Refer to **Figure 3a**. Describe the correlation between the location of mantle plume hot spots and plate boundaries. [2]

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(ii) Refer to **Figure 3b**. Intraplate volcanoes may form at mantle plume hot spots. Explain how magma is formed at these locations. [3]

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Turn over.

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(b) Mantle plumes can be identified by seismic tomography. **Figure 3c** is a seismic tomography cross-section beneath the area around the Hawaiian hot spot.
Figure 3d is a scatter graph of the age of volcanoes related to the Hawaiian hot spot and the distance from the active volcanism on Hawaii (Mt Kilauea).
Figure 3d also shows a map of the Hawaiian Island chain.

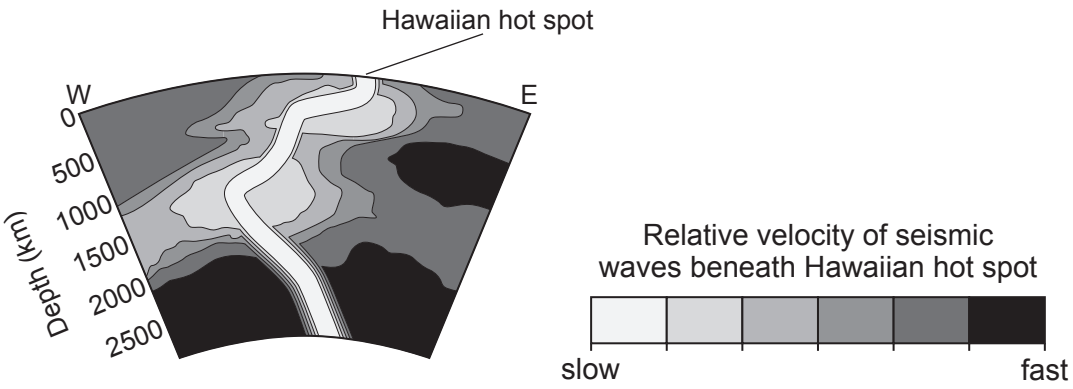

Figure 3c

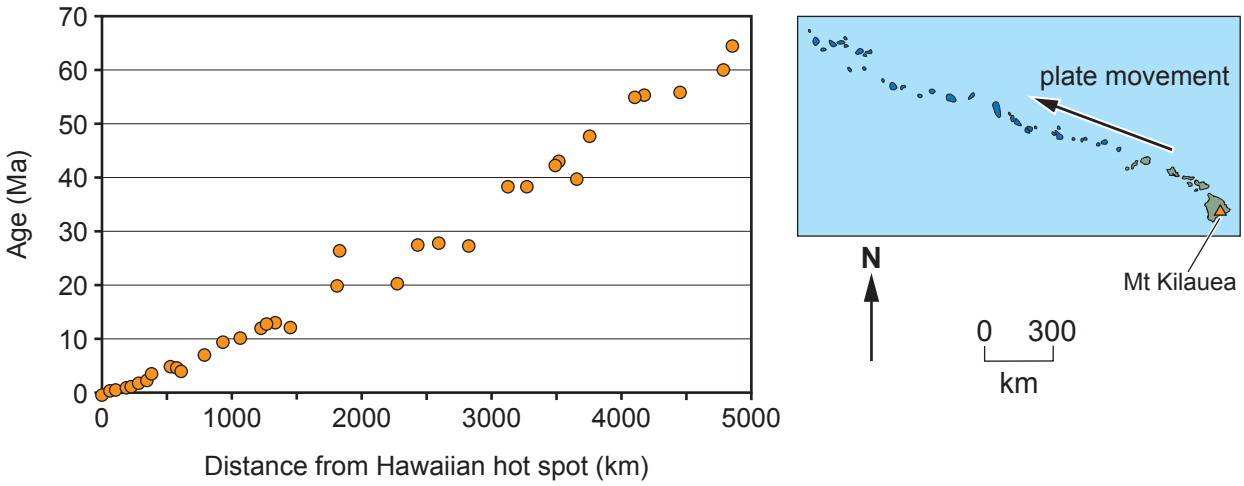

Figure 3d

(i) Explain how the seismic tomography data in **Figure 3c** can be used to confirm the presence of a mantle plume beneath Hawaii. [4]

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(ii) Use the data in **Figure 3d** to calculate the mean rate of plate movement over the past 60 million years. Show your working. [3]

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(iii) Using your knowledge, explain the use of magnetic anomalies to calculate the rate of plate movement. [3]

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(c) The mechanisms of plate movement are still a matter of debate. Using your knowledge, evaluate the contributions of ridge push and slab pull to plate movement. [3]

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4. **Figure 4a** is a photograph of a cliff with evidence of rock deformation.

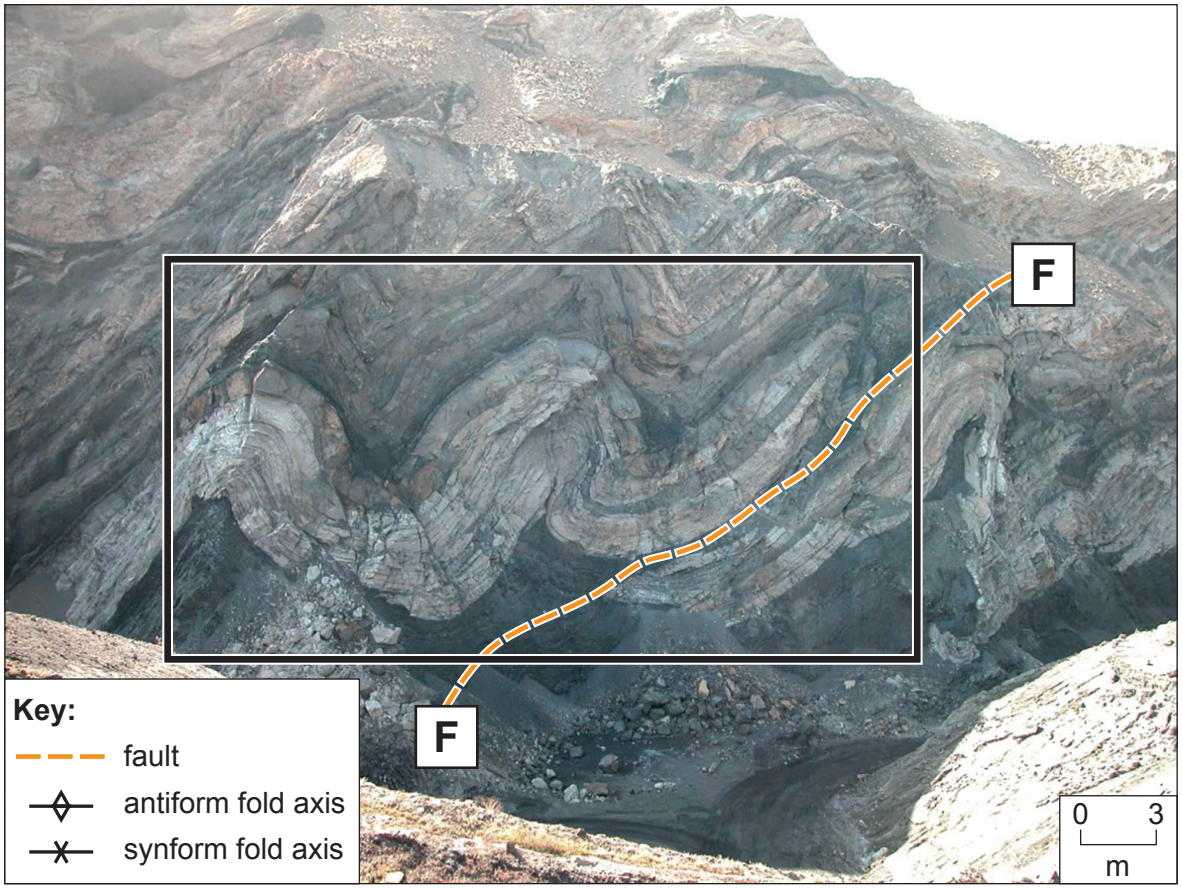

Figure 4a

(a) (i) Draw a sketch of the area in the box on **Figure 4a** in the space below. [3]

(ii) Draw **one** fold axis on your sketch with the correct symbol. [2]

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(b) A student stated that the folds in **Figure 4a** are all asymmetrical and have angular hinge shapes. Evaluate this statement. [3]

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(c) **Figure 4b** is a model showing the relationship between stress and strain when a rock is subjected to a compressive stress.

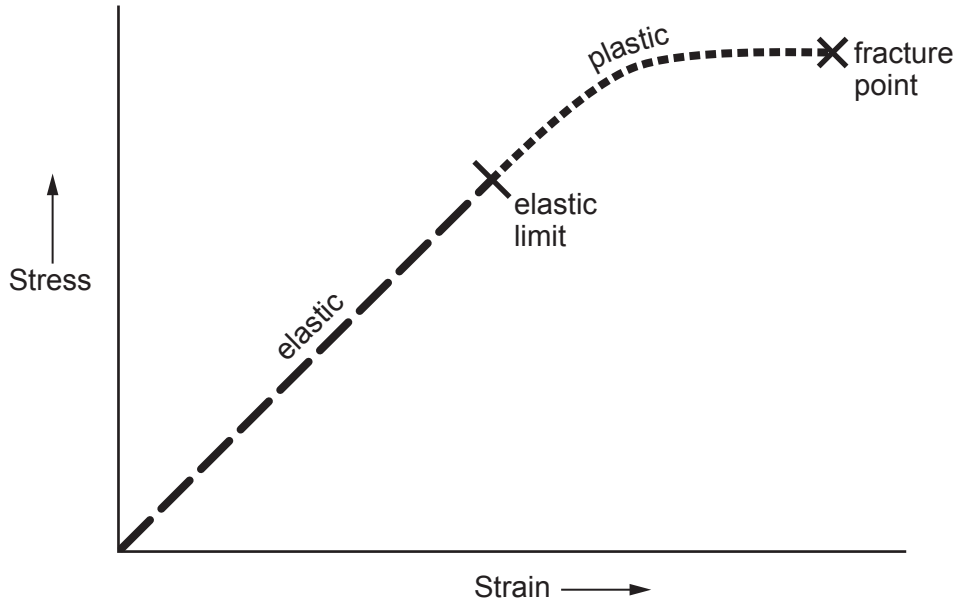

Figure 4b

(i) Define the terms stress and strain. [2]

Stress: .....

Strain: .....

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(ii) Suggest how the deformational history of the rock sequence in **Figure 4a** might be explained by the stress-strain graph in **Figure 4b**. [6 QER]

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5. **Figure 5** shows fossil **T**.

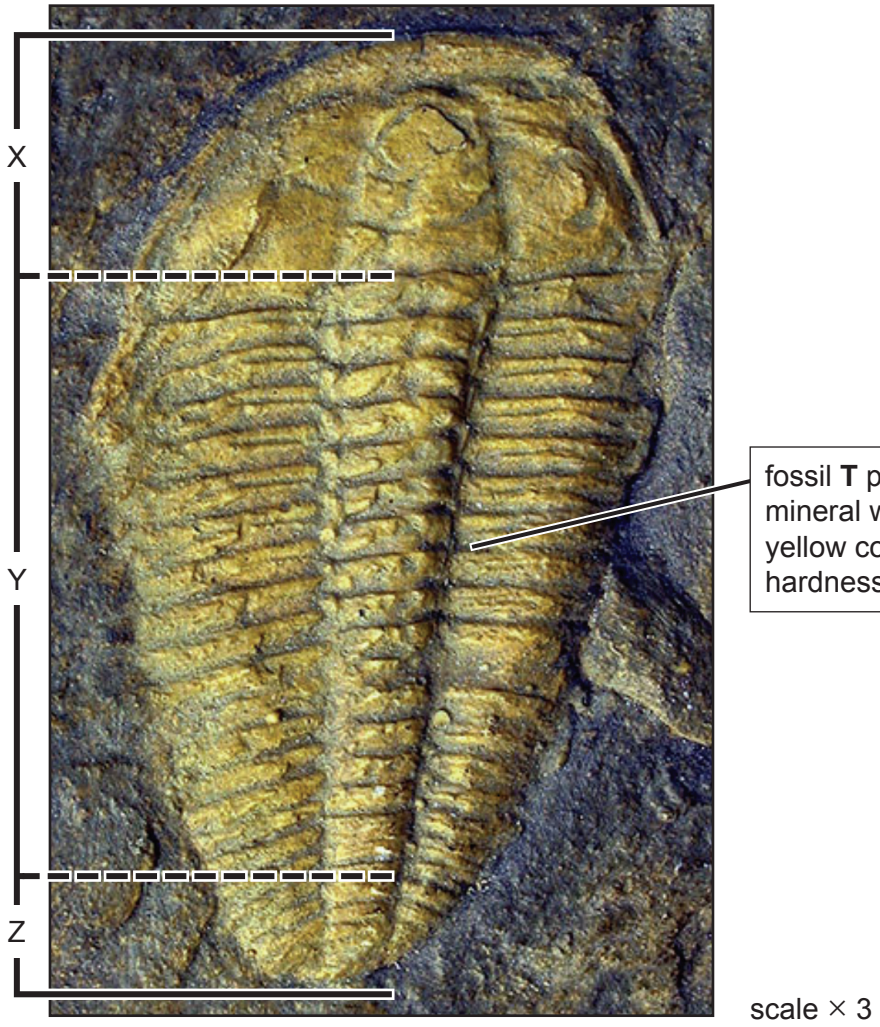

Figure 5

Refer to **Figure 5**.

(a) (i) State the name of the fossil group represented by fossil **T**. [1]

.....

(ii) Name morphological features X, Y and Z. [2]

X: .....

Y: .....

Z: .....

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(iii) Using the scale, calculate the actual length of fossil **T**. Show your working. [3]

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(b) A student stated that fossil **T** had a pelagic mode of life. Evaluate this statement. [3]

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(c) Fossil **T** is preserved as a brassy yellow mineral. Explain how this has happened. [3]

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6. **Figure 6a** shows the seismic layers of the oceanic lithosphere and two proposed models (**model 1** and **model 2**) used to explain these changes in seismic (P-wave) velocities. **Table 1** is an explanation of the two models in **Figure 6a**.

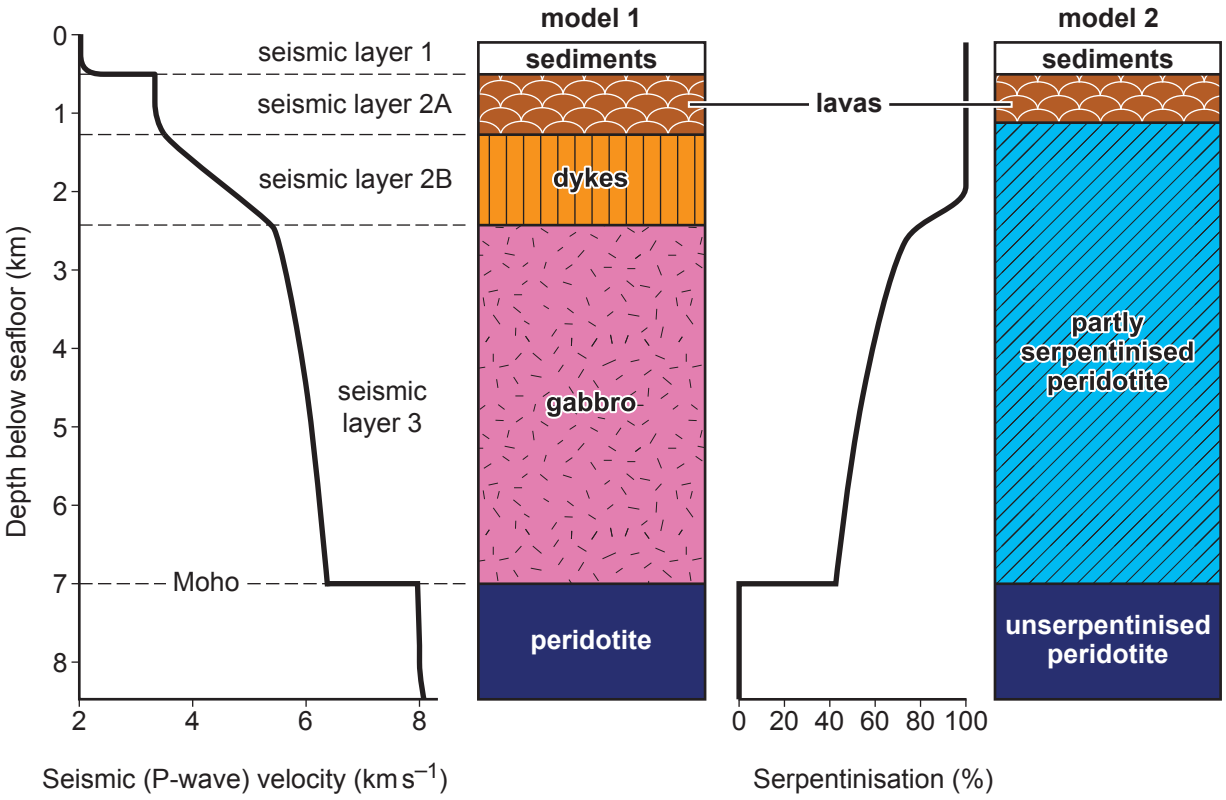

Figure 6a

Model 1 suggests that the seismic wave velocities reflect the differences in composition and physical properties of a layered oceanic crust.

An alternative model for slow-spreading ridges (**model 2**) suggests that seismic wave velocities depend upon the percentage of the mantle that has been altered from peridotite to serpentinite (serpentinisation).

Table 1

Refer to **Figure 6a**.

(a) (i) State the name of the rocks which are most likely to form the lavas and dykes of the oceanic crust. [2]

Lavas .....

Dykes .....

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(ii) With an arrow labelled **X** (⟵ **X**), label on **model 1** the most likely position of the boundary between the crust and mantle. [1]

(iii) Calculate the percentage increase in velocity of the P-waves from the surface to a depth of 6 km. Show your working. [3]

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(iv) Explain why the velocity of P-waves increase as they travel through the crust. [2]

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(v) The age and thickness of ocean sediments in **Figure 6a** varies across an ocean basin. Using your knowledge, describe how you would expect the age and thickness to vary. Explain your answer. [3]

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(b) **Figure 6b** is a photomicrograph of 70% serpentinised mantle peridotite as in **model 2** on **Figure 6a**.

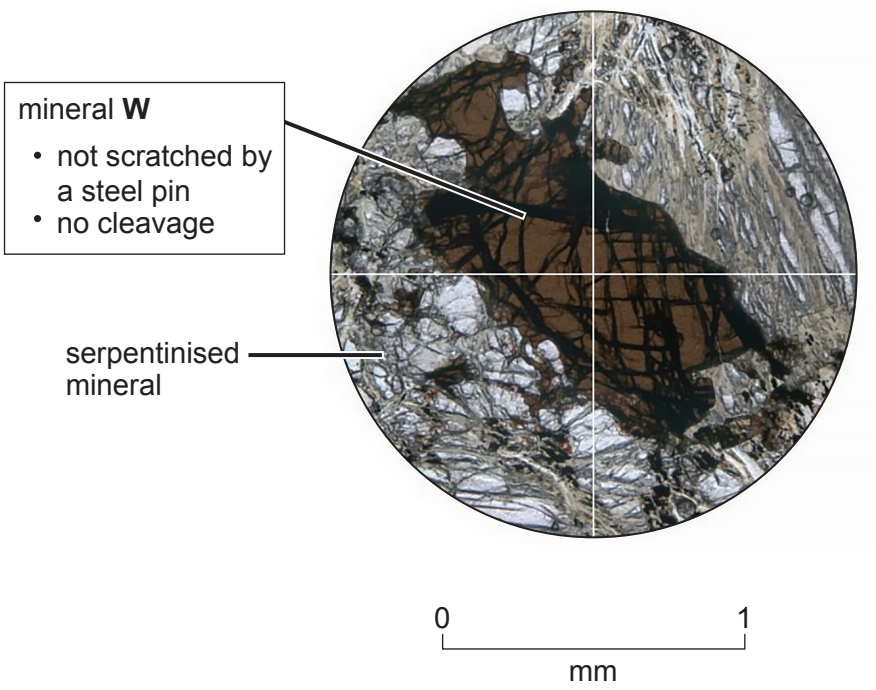

Figure 6b

(i) State the name of mineral **W**. You may wish to refer to the Mineral Data Sheet. [1]

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(ii) Refer to **Figure 6a**. Estimate the velocity at which P-waves would travel through the rock shown in **Figure 6b** which has been 70% serpentinised. [1]

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(iii) With an arrow labelled **Y** (⟵ **Y**), label on **model 2** the most likely position of the boundary between the crust and mantle. [1]

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(iv) Explain how **model 2** challenges our understanding of the cause of the Mohorovičić discontinuity (Moho). [2]

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(v) Describe how **model 1** or **model 2** in **Figure 6a** could be tested. Give a reason for your answer. [2]

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END OF PAPER

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

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

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Acknowledgments

Figure 1b virtualmicroscope.org. Acknowledgment not found
Figure 4a https://www.easternct.edu/cunninghamw/ees-356-teaching-resources/structuralgeologyphotoglossary.html. Photograph Zhang Jin
Figure 5 https://www.arcgis.com/apps/MapJournal/index.html?appid=621ca59bf5444d3d8d444638e61c1d1f. Photograph G.L. Pillola
Figure 6a www.seafloorspreading.com. Christopher MacLeod, Cardiff University
Figure 6b virtualmicroscope.org. Acknowledgment not found