Surname	Centre Number	Candidate Number
First name(s)		0

GCSE

C480UA0-1

Z22-C480UA0-1

THURSDAY, 19 MAY 2022 – AFTERNOON

GEOLOGY – Component 1

Geological Principles

Paper version of on-screen assessment

1 hour 15 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1(a)(i)	**2**	
1(a)(ii)	**1**	
1(b)(i)	**3**	
1(b)(ii)	**1**	
1(c)	**2**	
2(a)(i)	**1**	
2(a)(ii)	**2**	
2(b)(i)	**1**	
2(b)(ii)	**1**	
2(b)(iii)	**1**	
2(c)(i)	**1**	
2(c)(ii)	**1**	
3(a)	**2**	
3(b)(i)	**1**	
3(b)(ii)	**2**	
3(b)(iii)	**3**	
4(a)(i)	**1**	
4(a)(ii)	**1**	
4(b)	**3**	
4(c)	**6**	
5(a)(i)	**1**	
5(a)(ii)	**1**	
5(a)(iii)	**2**	
5(a)(iv)	**2**	
5(a)(v)	**2**	
5(b)	**6**	
6(a)(i)	**2**	
6(a)(ii)	**2**	
6(a)(iii)	**3**	
6(b)	**4**	
7(a)(i),(ii),(iii)	**4**	
7(b)(i)	**2**	
7(b)(ii),(iii)	**3**	
7(b)(iv)	**2**	
7(b)(v)	**2**	
7(c)	**2**	
7(d)	**4**	
Total	**80**	

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ADDITIONAL MATERIALS

In addition to this examination paper you will need:

- the Data Sheet
- a calculator
- a protractor
- 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 **4** and **5**.

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Answer **all** questions.

1. **Figure 1a** shows a partially completed sequence of the order of evolution of selected organisms.

(a) Refer to **Figure 1a** and the Data Sheet.

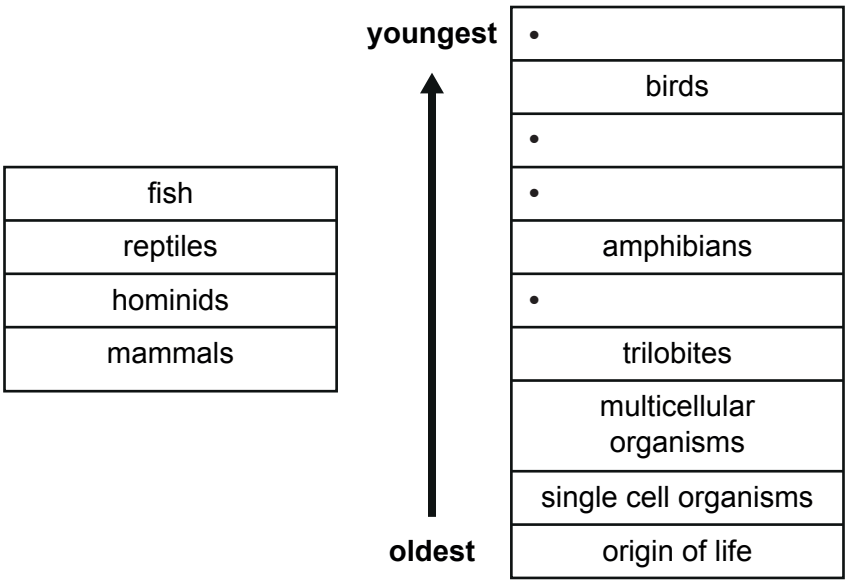

Figure 1a

(i) Complete **Figure 1a** by writing the names of the organisms in the table on the left in their correct positions in **Figure 1a**. [2]

(ii) State the name of the geological location where life (bacteria) is thought to have originated.

Tick (✓) only **one** box. [1]

beneath ice sheets ☐

around marine hydrothermal vents (black smokers) ☐

on land where lightning strikes are common ☐

in deep ocean trenches ☐

in freshwater lakes in the tropics ☐

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(b) **Figure 1b** shows *Archaeopteryx* which is an important fossil in understanding how organisms evolved over time. It existed 150 Ma ago.

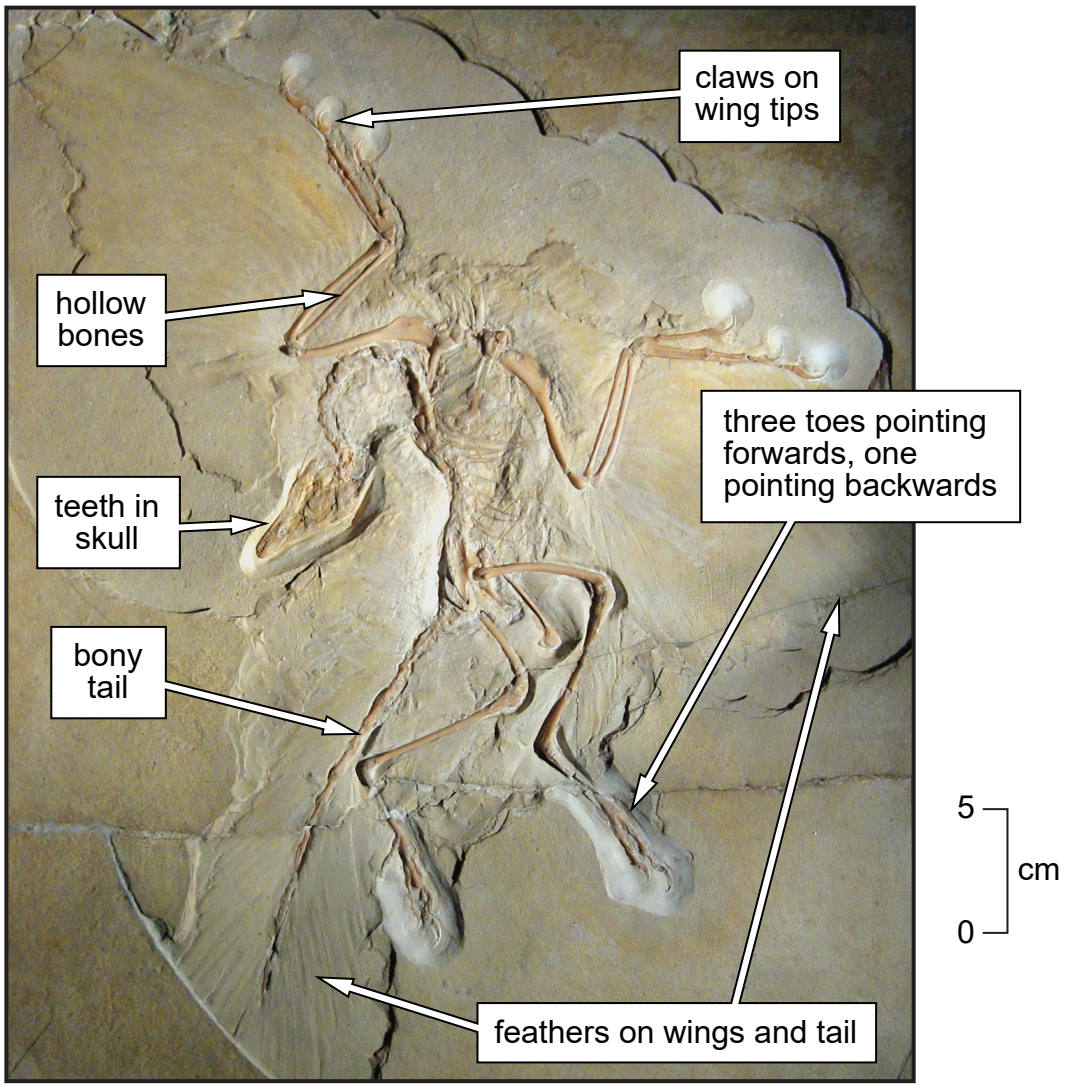

Figure 1b

Refer to **Figure 1b** and the Data Sheet.

(i) Explain how *Archaeopteryx* shows links in the fossil record between reptiles and birds. [3]

.....

.....

.....

.....

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(ii) State which **one** of the following statements is **false** regarding *Archaeopteryx*.

Tick (✓) only **one** box. [1]

it shows exceptional preservation ☐

it is regarded as a 'missing link' ☐

it was probably warm blooded ☐

it existed during the Jurassic period ☐

it is evidence for mass extinction ☐

(c) **Figure 1c** shows a fossil of an early hominid known as *Lucy*.

Figure 1d shows a timeline for the evolution of hominids over the last 9 Ma.

Figure 1c

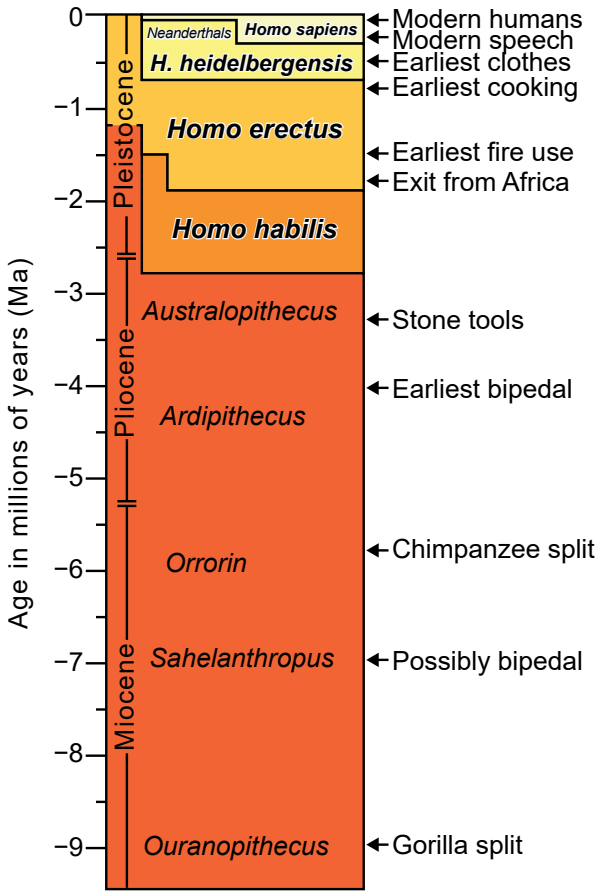

Figure 1d

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Refer to **Figures 1c** and **1d**.

State which **two** of the following statements are **false** regarding *Lucy* shown in **Figure 1c**.

Tick (✓) only **two** boxes. [2]

Lucy is identified as a specimen of *Australopithecus* ☐

Lucy probably used simple stone tools ☐

Lucy lived in Europe ☐

Lucy's ancestors evolved from gorillas 5.8 million years ago ☐

more than half of *Lucy*'s skeleton is missing ☐

the only living descendants of *Lucy* are *Homo sapiens* ☐

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2. **Figure 2a** shows the relationship between porosity and the depth of burial in two sedimentary rocks.

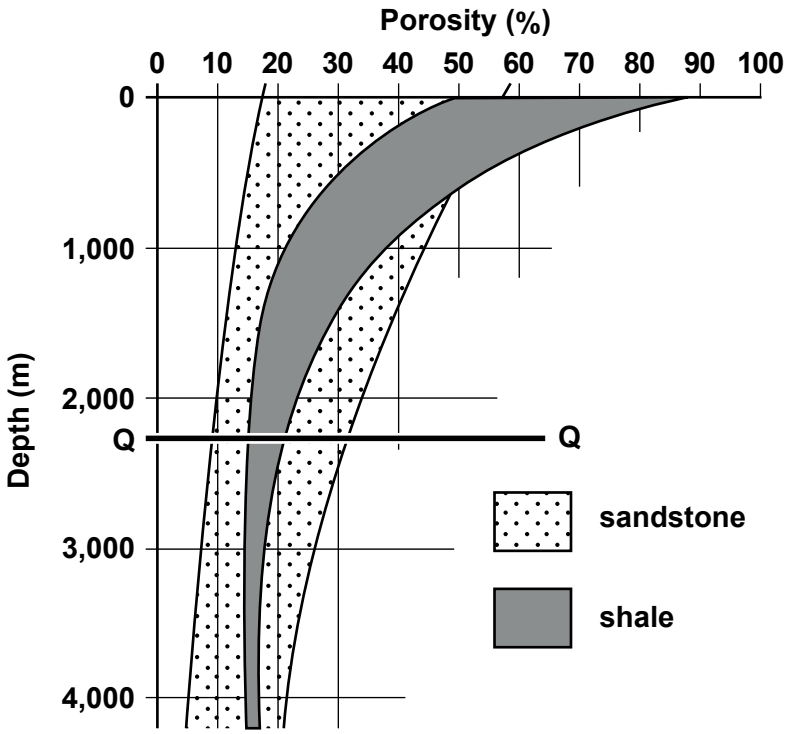

Figure 2a

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

(i) State the range of porosity for sandstone at depth **Q**. Tick (✓) only **one** box. [1]

12% to 44% ☐

9% to 32% ☐

5% to 25% ☐

10% to 37% ☐

11% to 30% ☐

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(ii) State which **two** of the following statements are most likely to explain why sandstones have a range of porosity values at depth **Q**. Tick (✓) only **two** boxes. [2]

variation in the type of cement ☐

variation in the degree of sorting ☐

variation in the amount of recrystallization ☐

variation in mineral content ☐

variation in grain shape ☐

variation in present day weathering at the Earth's surface ☐

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(b) **Figure 2b** shows the depth and temperature of oil and gas formation.

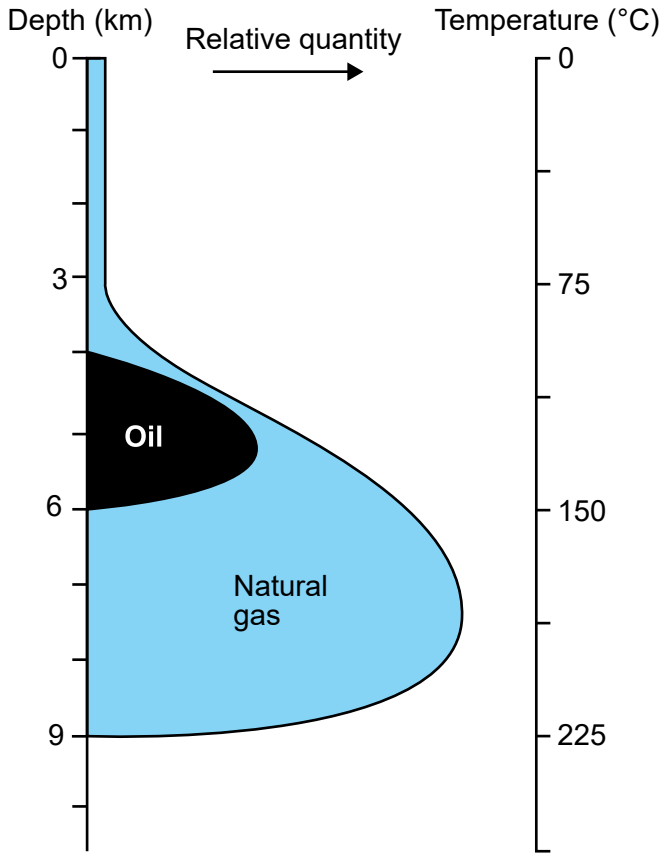

Figure 2b

Refer to **Figure 2b**.

(i) State the temperature at which oil generation is at its maximum. [1]

..... °C

(ii) Give **one** reason why oil may rise to accumulate in a sandstone at a depth of 3 km. [1]

.....

(iii) Refer to **Figure 2a**. Give **one** reason why sandstone at a depth of 3.5 km may **not** form a suitable reservoir rock for oil. [1]

.....

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(c) (i) Fracking is carried out at depths typically between 1.8 km and 3.0 km. Use **Figure 2a** to estimate the range of porosity values expected for shales between these depths. [1]

shale porosity range from 13% to ..... %

(ii) Extracting gas from shales by fracking has resulted in some environmental problems.

State which **one** of the following has been caused by this process. Tick (✓) only **one** box. [1]

subsidence	☐
pollution of groundwater	☐
landslides	☐
tsunamis	☐
flooding	☐

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3. **Figure 3** shows the natural long-term carbon cycle in which plate tectonics and chemical weathering are the main controls of atmospheric carbon dioxide.

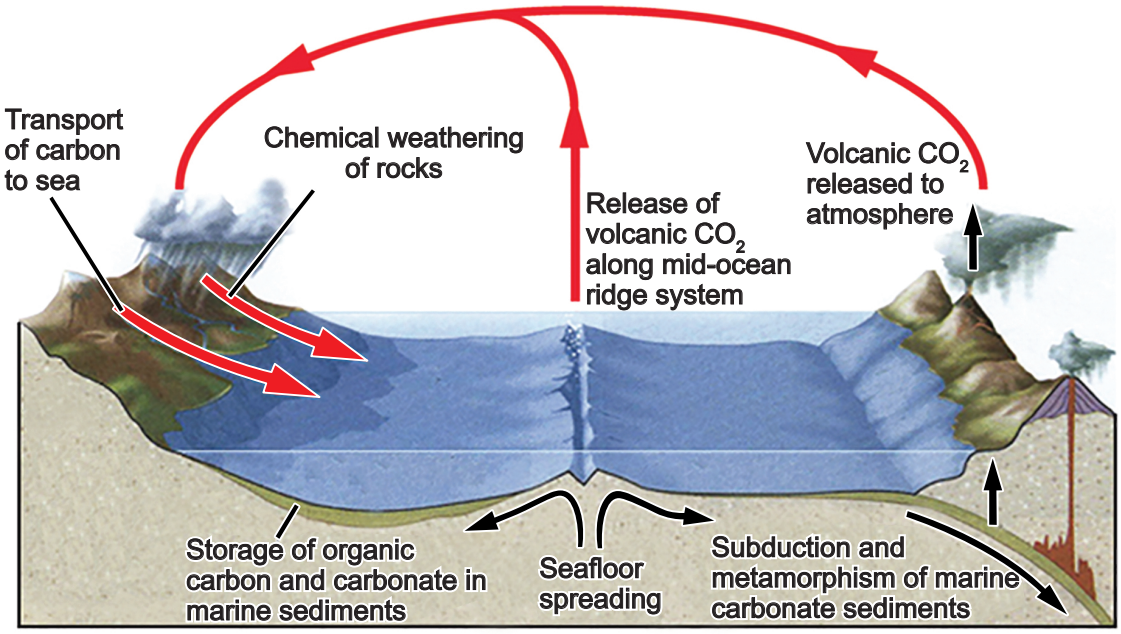

Figure 3

Refer to **Figure 3**.

(a) State which **two** of the following statements **do not explain** how carbon is added to marine sediments. Tick (✓) only **two** boxes. [2]

chemical weathering of rocks ☐

release of volcanic CO_2 along divergent plate boundaries ☐

precipitation of calcium carbonate from solution as limestone in the tropics ☐

transport of carbon in solution by rivers to the sea ☐

metamorphism of limestone ☐

use of calcium carbonate by marine organisms to build their shells or skeletons ☐

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(b) **Table 1** shows the relative amounts of CO_2 released by volcanoes each year compared to the amount released by human activity.

Source of CO_2	Tonnes of CO_2
Volcanic emissions	200 million
Human activity	24 billion
Total	24.2 billion

Table 1

(i) State the main source of CO_2 released into the atmosphere each year by human activity. [1]

.....

(ii) Refer to **Table 1**. Calculate the percentage of CO_2 out of the total of human activity and volcanic emissions, which comes from human activity. Show your working. [2]

..... %

(iii) Explain **one geological** strategy that may enable the storage of CO_2 emissions from human activity in the future and prevent them from entering the atmosphere. [3]

.....

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4. **Figures 4a** and **4b** show the results of a jelly lava flow experiment. In both cases 10 cm^3 of jelly was poured onto an inclined board and the distance it travelled after 30 seconds was recorded.

Method

Figure 4a shows variations in jelly temperature from 20°C to 60°C on a board inclined at 40°

High viscosity was simulated by adding two teaspoons of sand to the jelly sample. Medium viscosity added one teaspoon of sand and low viscosity had no sand added.

Figure 4b shows variations in viscosity from low to high for jelly at 40°C on a board inclined at 40°.

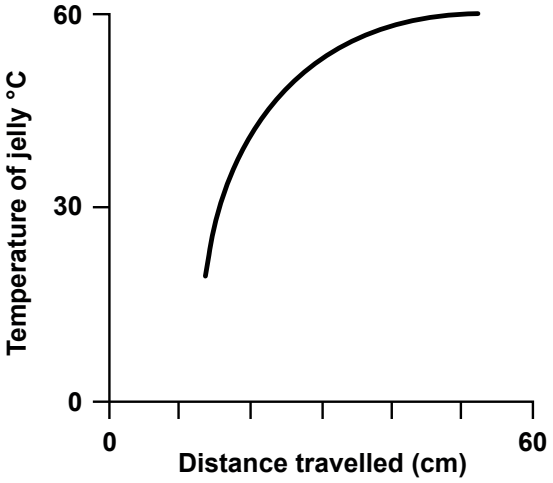

Figure 4a

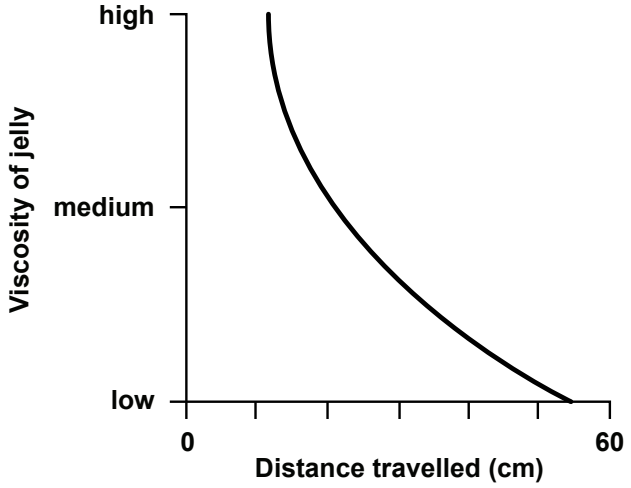

Figure 4b

Refer to **Figures 4a** and **4b**.

(a) (i) State which **one** of the following statements best describes the results shown in **Figure 4a** and **Figure 4b**. Tick (✓) only **one** box. [1]

as temperature decreases, there is an increase in distance travelled in **Figure 4a** ☐

as viscosity increases, the distance travelled increases in **Figure 4b** ☐

Figure 4a and **Figure 4b** both show a positive correlation ☐

there is a negative correlation between viscosity and distance travelled in **Figure 4b** ☐

as temperature increases and viscosity decreases, the distance travelled decreases ☐

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(ii) Suggest why jelly below 20°C was not used in the experiment for the data shown in **Figure 4a**. [1]

.....

.....

(b) **Figure 4c** shows the shape and structure of volcanoes **J** and **K**.

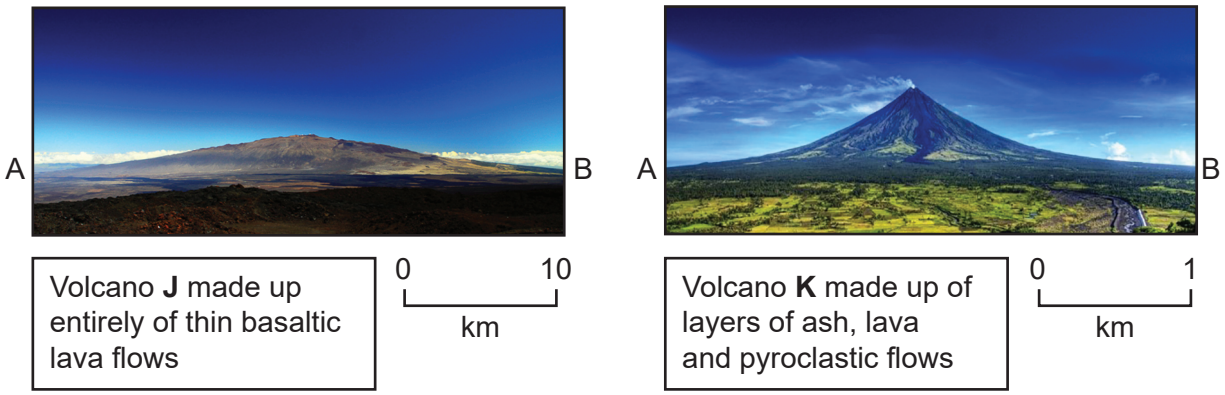

Figure 4c

Refer to **Figure 4c**.

Complete **Table 2** which describes the differences between volcanoes **J** and **K**. [3]

Description	Volcano **J**	Volcano **K**
width of base A–B (km)	•	3.5
slope of sides (°)	•	30
type of lava/magma	basaltic	•

Table 2

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(c) Refer to **Figures 4a**, **4b** and **4c**.

Explain how the type of volcanic activity (passive or violent) depends on the composition and viscosity of the lava. [6 QER]

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5. **Figure 5a** shows how the latitude of Britain has changed over the last 550 million years.

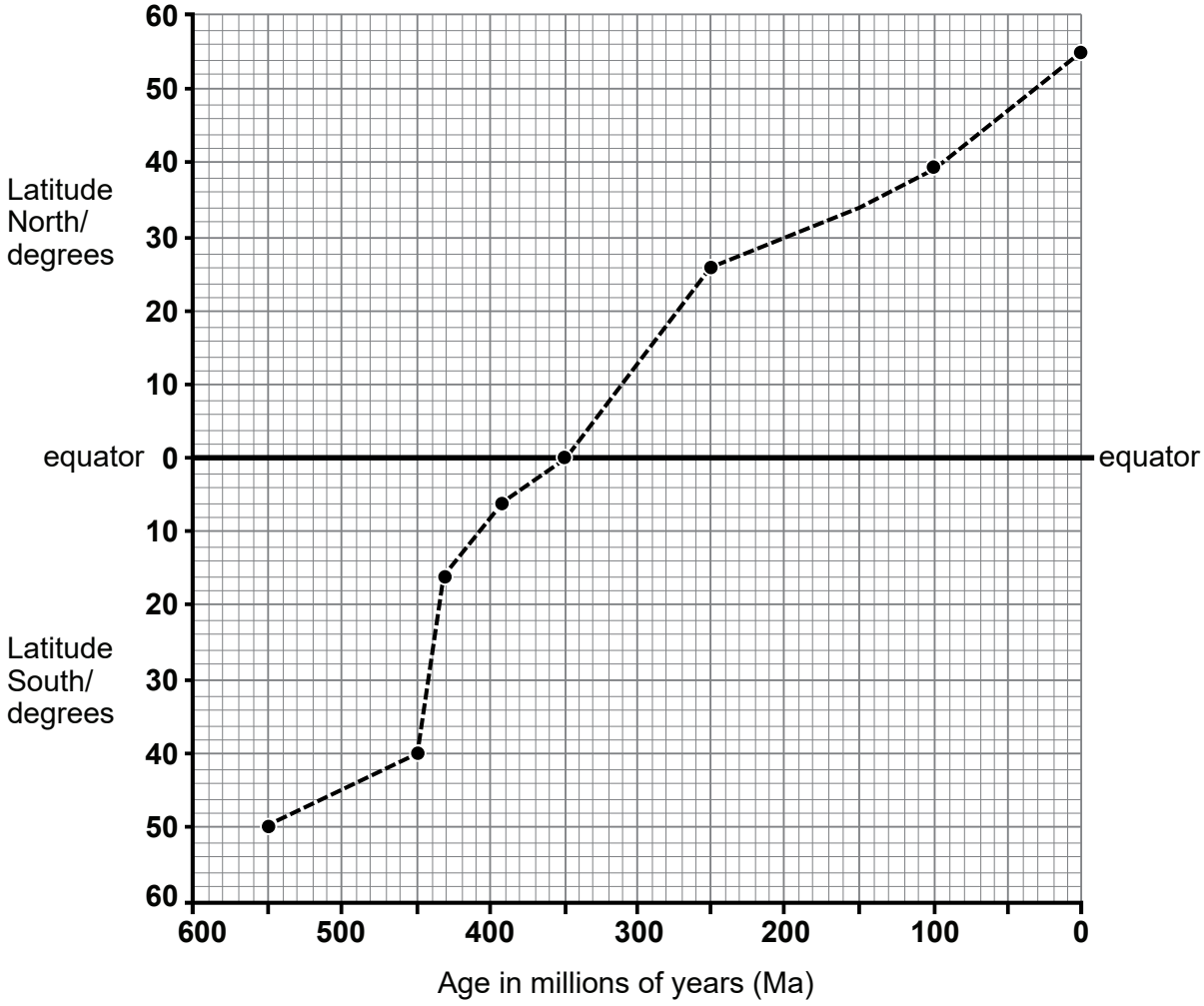

Figure 5a

(a) Refer to **Figure 5a** and the Data Sheet.

(i) State the latitude of Britain 200 Ma ago. [1]

.....

(ii) State the name of the geological **era** when Britain crossed the equator. [1]

.....

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(iii) State which **two** of the following statements are shown by the information in **Figure 5a**. [2]

Tick (✓) only **two** boxes.

drift was towards the South Pole during the Mesozoic ☐

drift was away from the equator during the Silurian ☐

the rate of drift was the most rapid between 450 Ma and 430 Ma ☐

the rate of drift was constant ☐

Britain has crossed a total of 105º of latitude during the last 550 Ma ☐

during the Precambrian, Britain showed longitudinal drift ☐

(iv) Calculate the mean rate of latitudinal change in degrees per 50 million years between 450 Ma and 200 Ma. Show your working. [2]

..... ° 50 Ma^{-1}

(v) State which **two** of the following scientists **have not** contributed to our understanding of continental drift or plate tectonics. Tick (✓) only **two** boxes. [2]

Harry Hess ☐

Alfred Wegener ☐

Lord Kelvin ☐

Fred Vine ☐

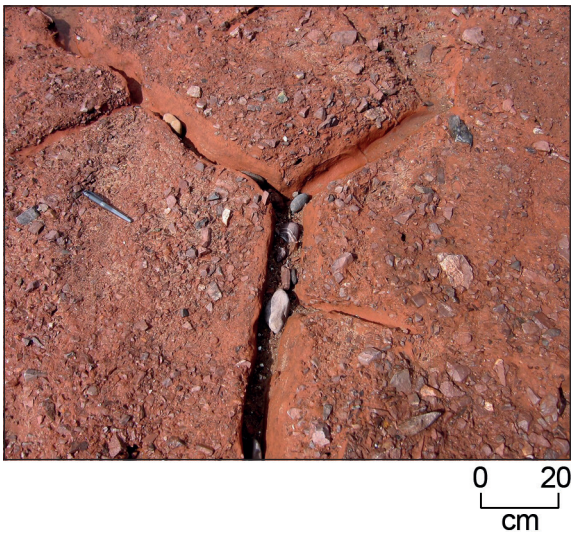
John Joly ☐

J. Tuzo Wilson ☐

(b) **Figures 5b**, **5c** and **5d** show rock types found in the UK from the Carboniferous, Permian and Quaternary geological periods respectively.

Carboniferous coal showing a well-preserved tropical fern fossil.

Figure 5b



Permian breccia with red haematite cement showing desiccation cracks.

Figure 5c

Quaternary till with angular grains. Grains vary in size from less than 0.05 mm up to 50 cm.

Figure 5d

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Describe and explain how the change in latitude of Britain through geological time shown in **Figure 5a** is supported by the rock types shown in **Figures 5b**, **5c** and **5d**.
[6 QER]

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6. **Figure 6** shows a diagram of the South Pole-Aitken Basin, the largest meteorite impact crater in the Moon's crust. Three other impact craters within the South Pole-Aitken Basin are also shown.

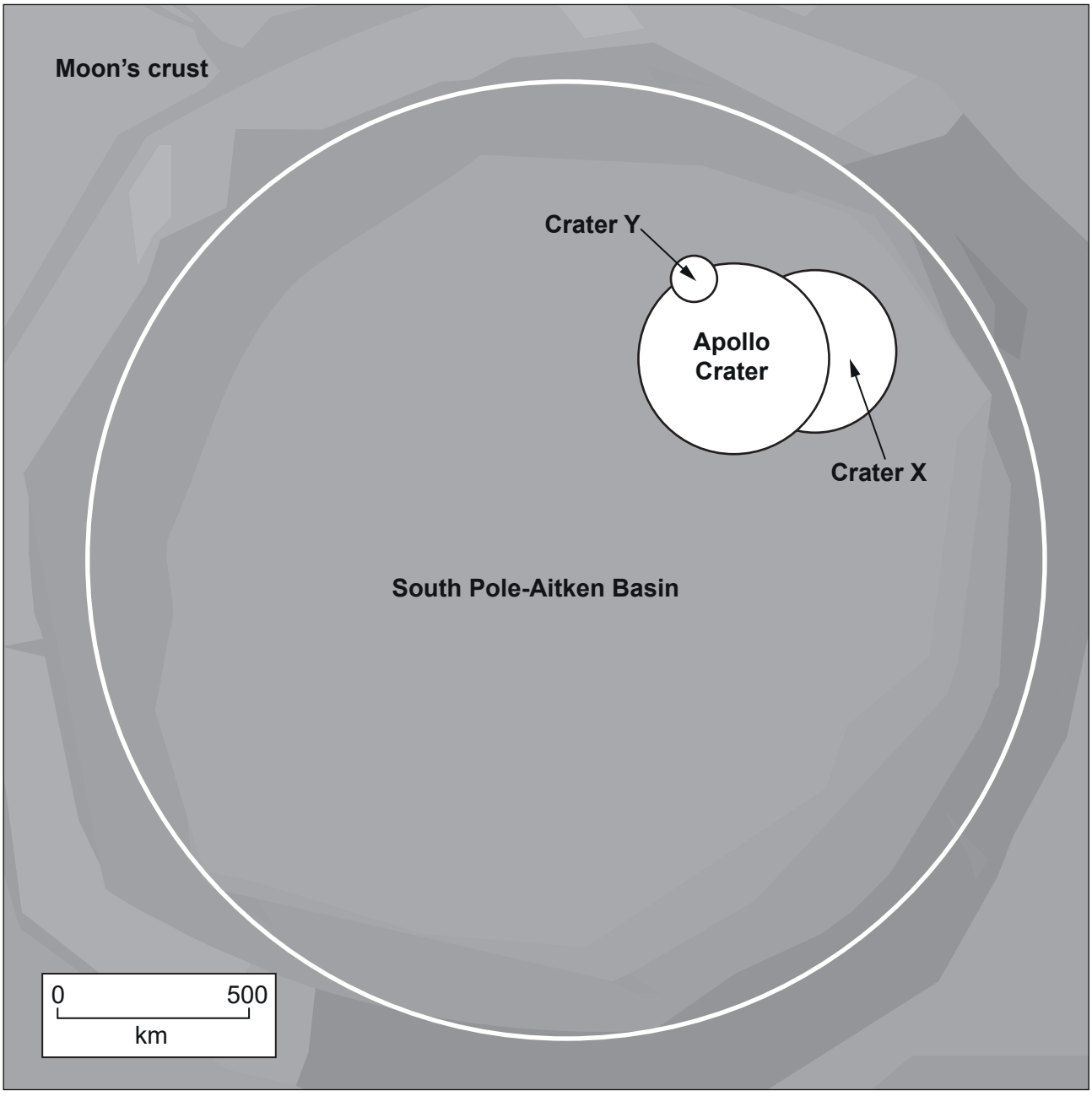

Figure 6

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(a) (i) Calculate the circumference of the South Pole-Aitken Basin shown in **Figure 6**.

Show your working. Formula to calculate circumference is $C = 2\pi r$ [2]

C = circumference	r = radius	π = 3.142

..... km

(ii) The South Pole-Aitken Basin is thought to have been formed by a meteorite with a diameter of 170 km, yet the crater is only 6 km deep into the Moon's crust. State which **two** of the following statements might explain this observation. Tick (✓) only **two** boxes. [2]

the meteorite was travelling at a very high velocity	
the crater has been infilled due to extensive erosion and deposition of sediment	
the meteorite collided with the Moon at a very shallow angle	
a series of small meteorites all collided with the Moon at the same time	
the meteorite collided with the Moon at a steep angle	
the meteorite was travelling at a low velocity	

(iii) Put the formation of the following geological features into the correct age order to explain the cross-cutting relationships shown in **Figure 6**. [3]

Apollo crater

Moon's crust

South Pole-Aitken Basin

crater **Y**

crater **X**

Youngest	
Oldest	

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(b) Describe and explain how the formation of large craters on Earth may have influenced the evolution of life on Earth. [4]

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7. **Figure 7a** is a map of Southeast Asia showing two plate boundaries labelled **A** and **B**.

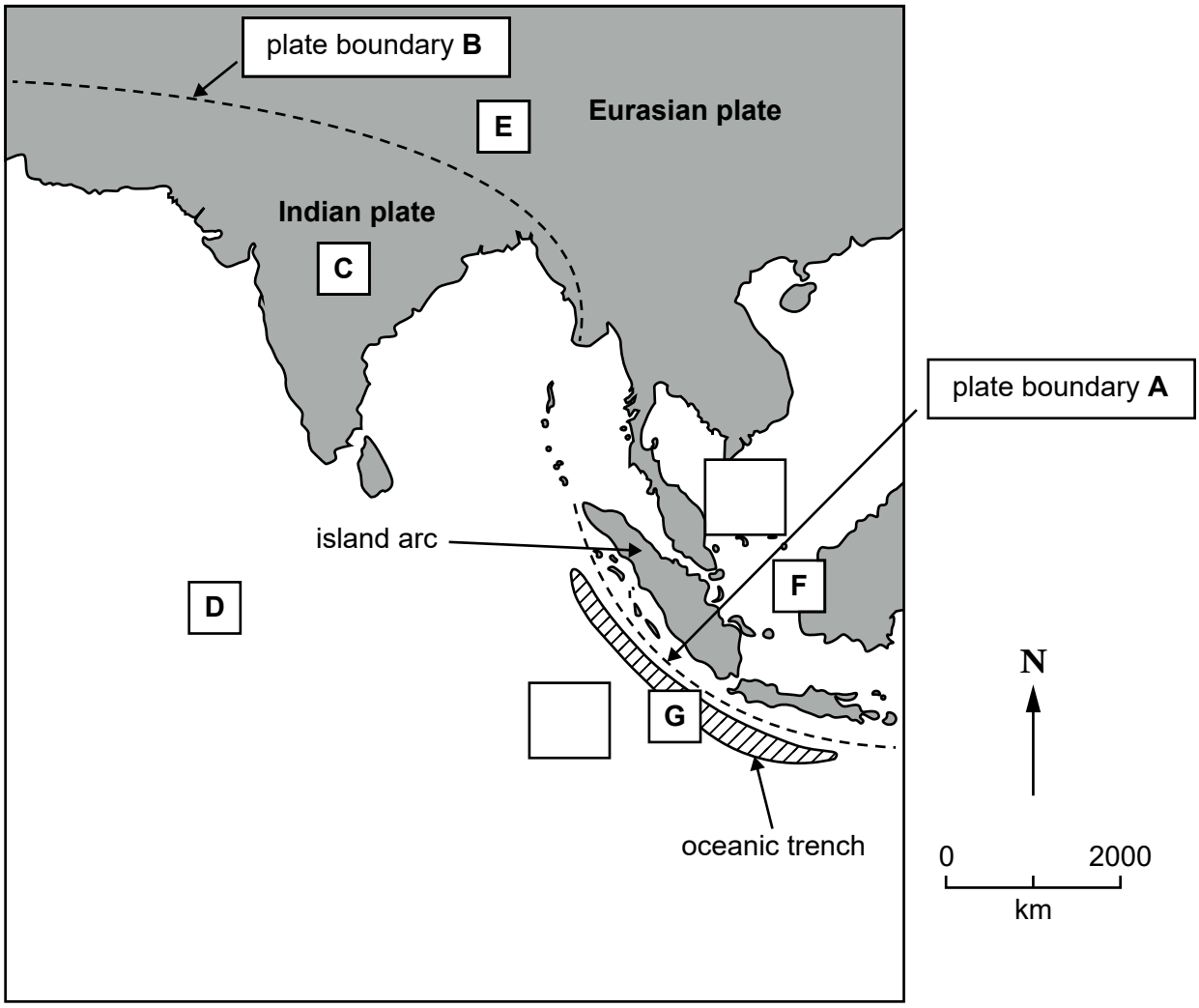


Figure 7a

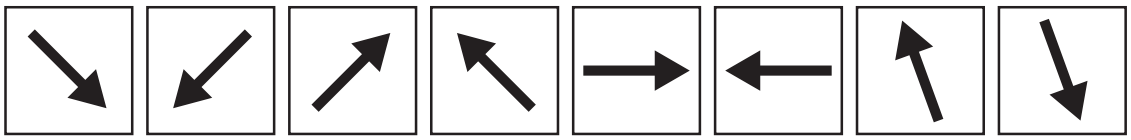
Examiner only

(a) Refer to **Figure 7a**.

(i) Draw a line from plate boundary **A** and plate boundary **B** to the correct type of plate boundary. [2]

plate boundary **A**	convergent continental-continental boundary
	divergent boundary
plate boundary **B**	convergent oceanic-oceanic boundary
	conservative boundary
	convergent oceanic-continental boundary

(ii) Insert an arrow in each of the blank boxes on **Figure 7a** to show the direction of relative plate movement for plate boundary **A**. Choose **two** of the arrows below. [1]



(iii) State at which **one** of the following locations you would expect to find deep focus earthquakes. [1]

Tick (✓) only **one** box.

Location **C**	Location **D**	Location **E**	Location **F**	Location **G**
☐	☐	☐	☐	☐

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(b) **Figure 7b** shows a cross-section through plate boundary **B** on **Figure 7a**.

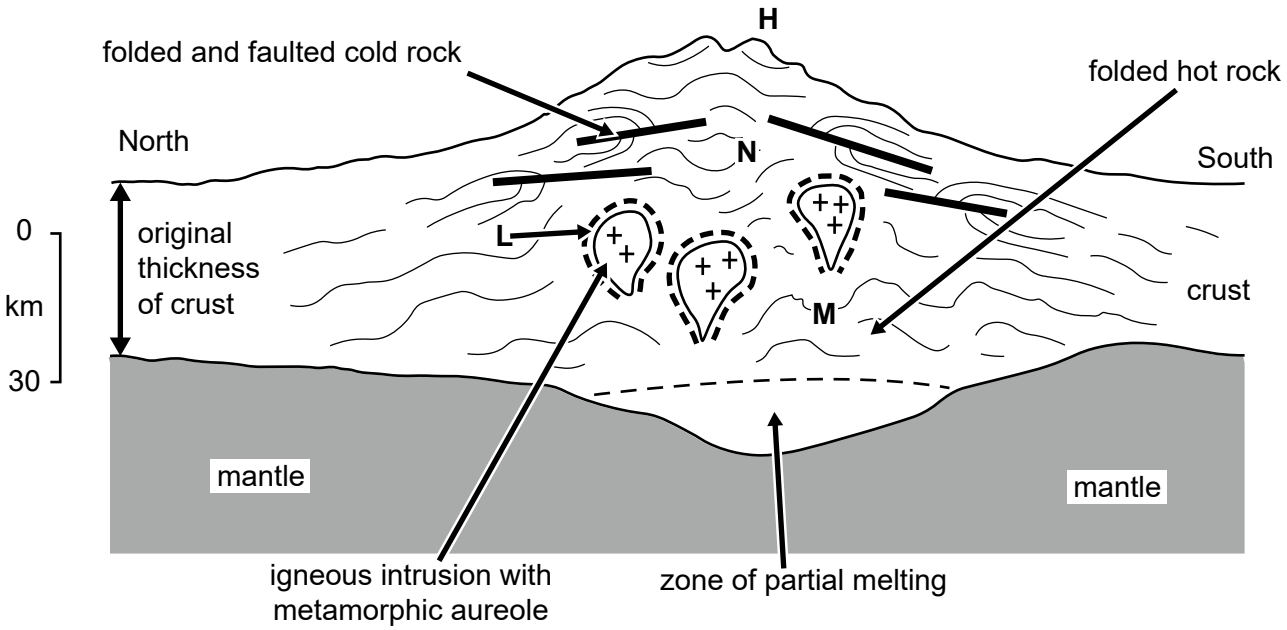

Figure 7b

(i) State which **two** of the following statements best describe the faults shown on **Figure 7b**.
Tick (✓) only **two** boxes. [2]

formed by tension ☐

normal faults ☐

strike-slip faults ☐

formed by compression ☐

formed by shear stress ☐

thrust faults ☐

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(ii) State the most likely type of magma to be formed in the zone of partial melting shown on **Figure 7b**. [1]

.....

(iii) Calculate the minimum percentage increase in thickness of the crust shown below location **H** on **Figure 7b**. Use the formula below. Show your working. [2]

$$\frac{\text{present day thickness of crust below } \mathbf{H} - \text{original thickness of crust}}{\text{original thickness of crust}} \times 100$$

..... % increase in thickness

(iv) Complete **Table 3** which compares the type of metamorphism at locations **L** and **M** on **Figure 7b**. [2]

Location	Type of metamorphism	Temperature and pressure conditions
L	contact	•
M	•	high temperature and high pressure

Table 3

(v) Draw a line from location **L** and location **M** to the rock types which are most likely to be found at these locations. You should choose a different rock type for each location. [2]

location **L**	basalt
	shale
	schist
location **M**	metaquartzite
	peridotite

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(c) **Figure 7c** is a microscope view of slate found at location **N** on **Figure 7b**.

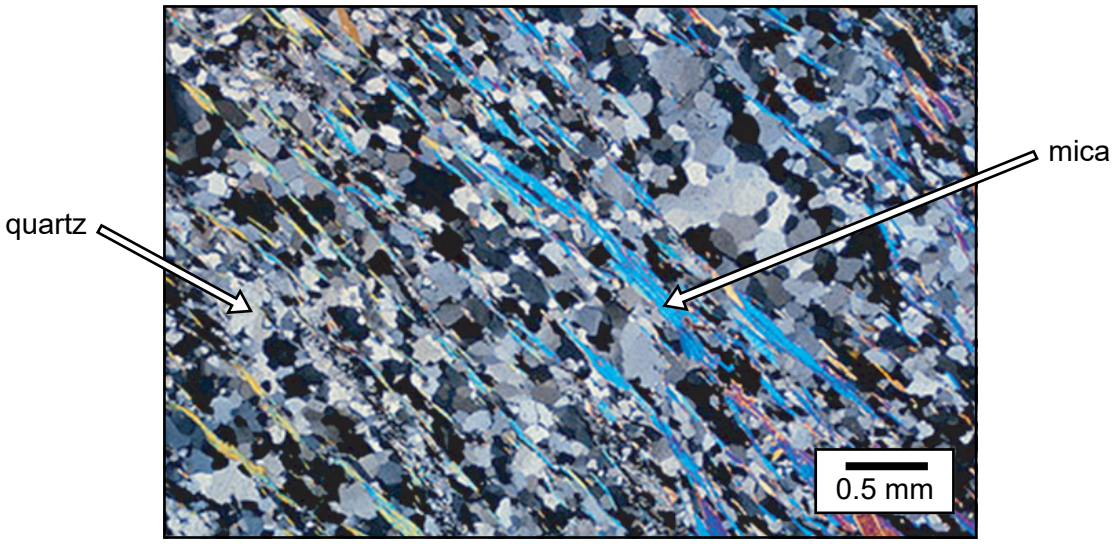

Figure 7c

Refer to **Figure 7c**. Explain why the rock shown in **Figure 7c** has correctly been identified as slate. [2]

.....

.....

.....

.....

(d) With reference to **Figure 7a** and **Figure 7b**, explain why: [4]

- only shallow focus earthquakes occur at plate boundary **B**

.....

.....

.....

.....

- there is no volcanic activity at plate boundary **B**

.....

.....

.....

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END OF PAPER

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

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Acknowledgements:

Figure 1b https://commons.wikimedia.org/wiki/File:Archaeopteryx_lithographica_(Berlin_specimen).jpg

Figure 1c and **Figure 1d** https://en.wikipedia.org/wiki/Lucy

Figure 3 http://stratus.astr.ucl.be/textbook/chapter2_node14

Figure 4c
Volcano **J** https://educalingo.com/en/dic-en
Volcano **K** http://gpi.savba.sk/GPIweb/ogg/index.php/en/research/geodynamics/item

Figure 5b http://www.threesources.com/archives/015043.html

Figure 5c http://www.southampton.ac.uk/~imw

Figure 5d https://www.bgs.ac.uk/discoveringGeology/climateChange/general/pastClimatesEvidence.html

Figure 7c https://www.researchgate.net/figure/Thin-sections-of-studied-rock-samples-

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