Surname	Centre Number	Candidate Number
First name(s)		0

GCSE

C480UA0-1

S24-C480UA0-1

THURSDAY, 9 MAY 2024 – 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)	3	
1.(b)	3	
1.(c)(i)	1	
1.(c)(ii)	3	
1.(c)(iii)	2	
1.(c)(iv)	1	
1.(c)(v)	6	
2.(a)(i)	1	
2.(a)(ii)	2	
2.(a)(iii)	1	
2.(a)(iv)	2	
2.(a)(v)	2	
2.(b)(i)	1	
2.(b)(ii)	3	
3.(a)	1	
3.(b)(i)	4	
3.(b)(ii)	3	
3.(b)(iii)	2	
3.(b)(iv)	2	
4.(a)(i)	1	
4.(a)(ii)	3	
4.(a)(iii)	2	
4.(b)(i)	2	
4.(b)(ii)	2	
4.(c)(i)	1	
4.(c)(ii)	1	
5.(a)(i)	1	
5.(a)(ii)	1	
5.(a)(iii)	2	
5.(a)(iv)	2	
5.(b)(i)	3	
5.(b)(ii)	1	
5.(b)(iii)	3	
6.(a)	2	
6.(b)(i)	1	
6.(b)(ii)	3	
6.(b)(iii)	6	
Total	**80**	

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ADDITIONAL MATERIALS

In addition to this examination paper you will need:

- the 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 **6**.

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Answer **all** questions.

1. **Figure 1a** shows the relationship between igneous, sedimentary and metamorphic rocks in the rock cycle. The arrows labelled **A**, **B**, **C**, **D** and **E** represent geological processes.

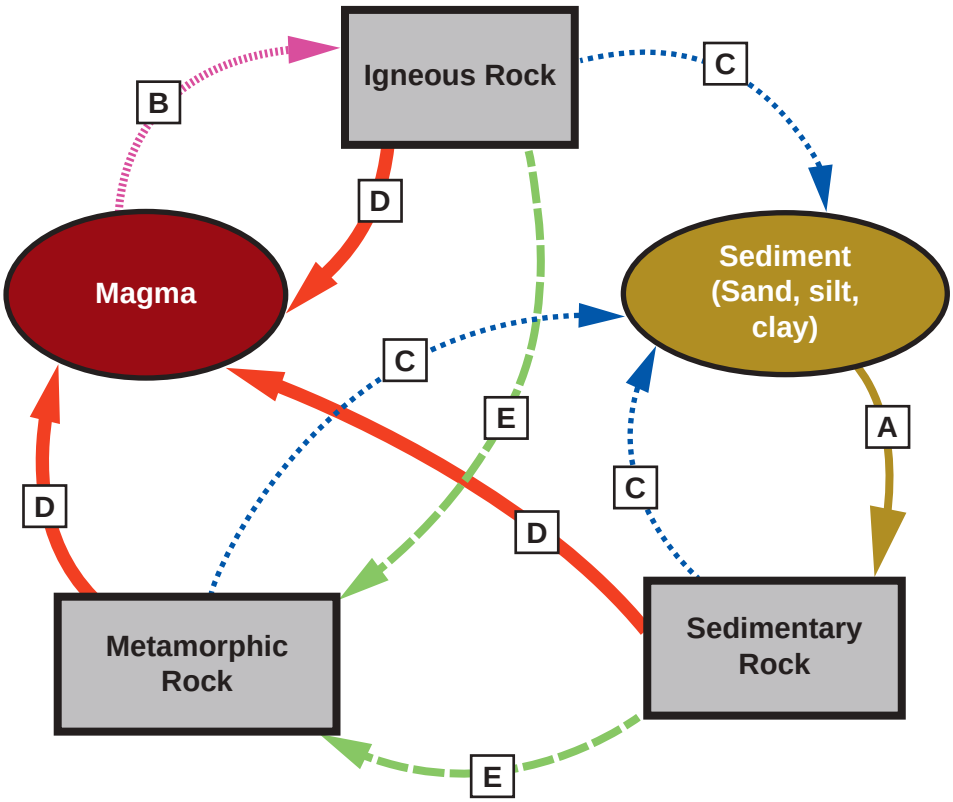

Figure 1a

(a) Refer to **Figure 1a**.
Complete **Table 1** by matching the letters **A**, **B**, **C**, **D** and **E** in **Figure 1a** with the correct geological processes. [3]

Geological Process	Letter on **Figure 1a**
weathering and erosion	
melting	
cooling and crystallisation	
deposition and burial	
recrystallisation	

Table 1

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(b) Geological processes take place at different rates from seconds (catastrophism) to millions of years (gradualism).
For each of the geological processes listed in **Table 2**, state whether it is a catastrophic or a gradual process by inserting either **ca** (catastrophic) or **gr** (gradual) in each box. [3]

Geological Process	Catastrophic **(ca)** or Gradual **(gr)**
formation of a volcanic island arc	•
formation of an antiform	•
formation of a thrust fault	•
formation of an unconformity	•
earthquake shaking triggering landslides	•
a pyroclastic flow	•

Table 2

(c) **Figure 1b** shows part of a borehole (not to scale) from a location in Scotland.
Figure 1c shows a microscope view of the schist from the lower part of the borehole.

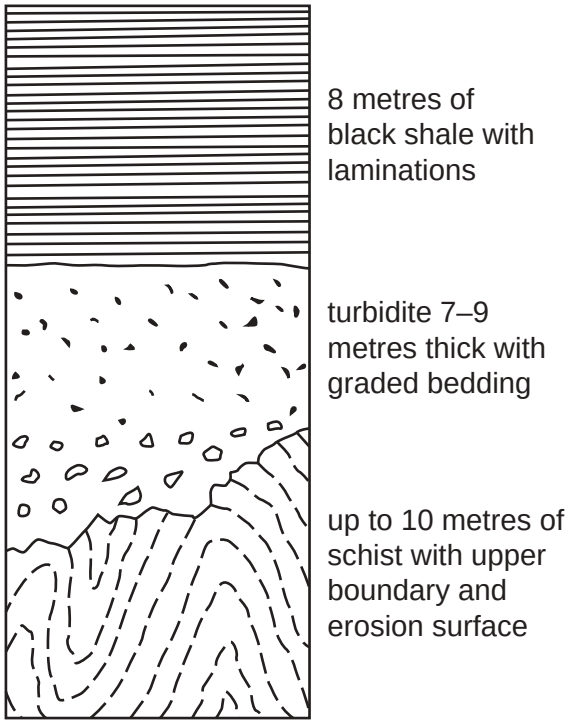

Figure 1b

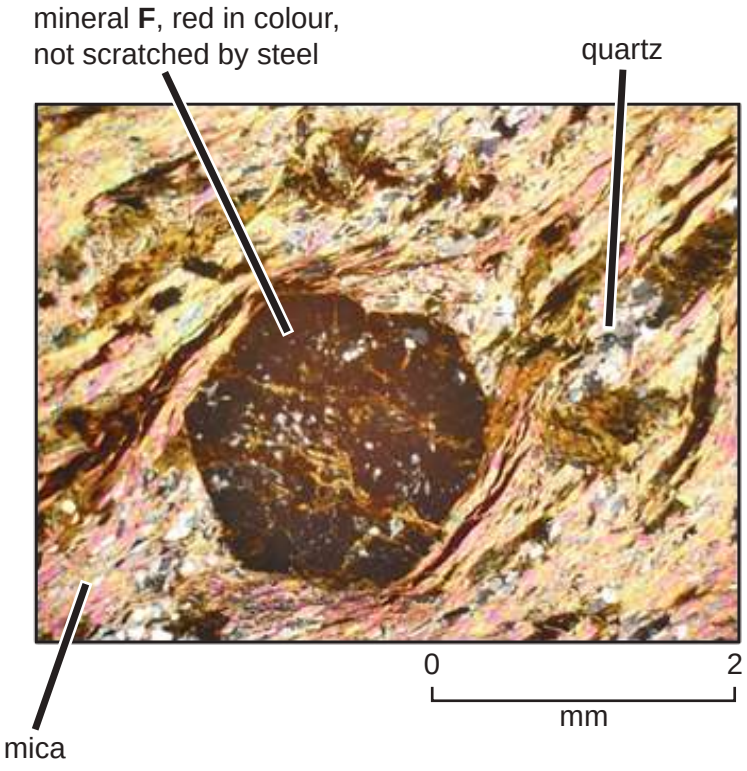

Figure 1c

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Refer to **Figure 1b** and **Figure 1c**.

(i) With reference to the Data Sheet, identify mineral **F**. [1]

.....

(ii) Describe the texture of the schist shown in **Figure 1c**. [3]

.....

.....

.....

.....

(iii) Calculate the magnification factor of mineral **F** using the following equation. Show your working. [2]

$$\text{magnification factor} = \frac{\text{size of image of mineral } \mathbf{F}}{\text{real size of mineral } \mathbf{F}}$$

.....

(iv) Re-arrange the equation above so that the real size of mineral **F** could be calculated. [1]

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(v) Explain how the rock sequence in **Figure 1b** provides evidence that geological processes occur at different rates. [QER 6]

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2. **Figure 2a** and **Figure 2b** show two different models to explain how oceanic lithosphere may be formed at ocean ridges.

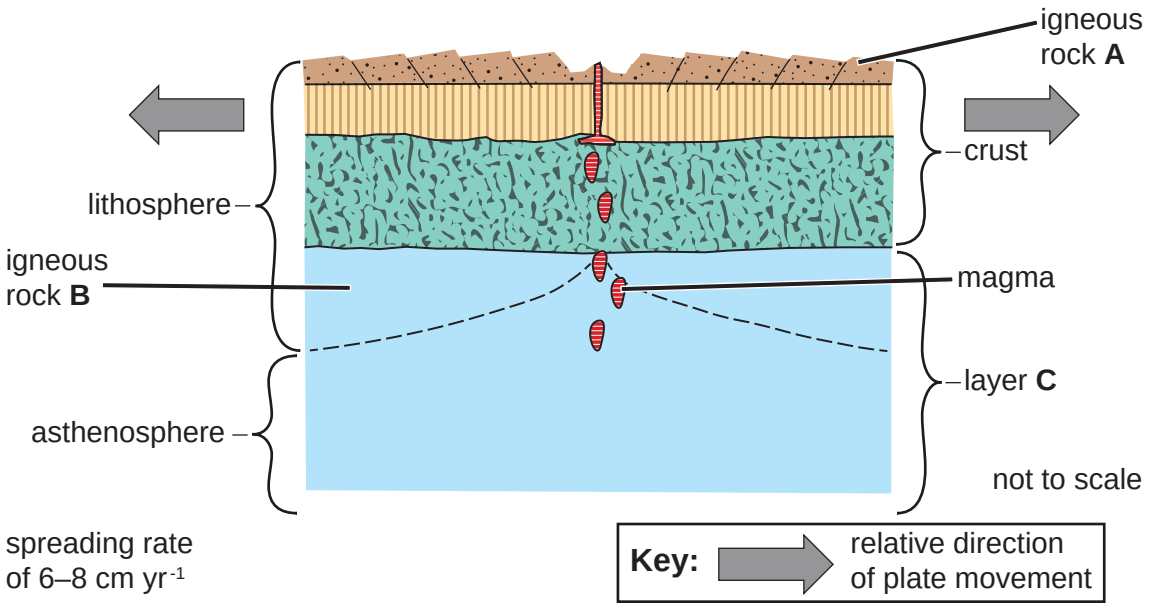

Figure 2a

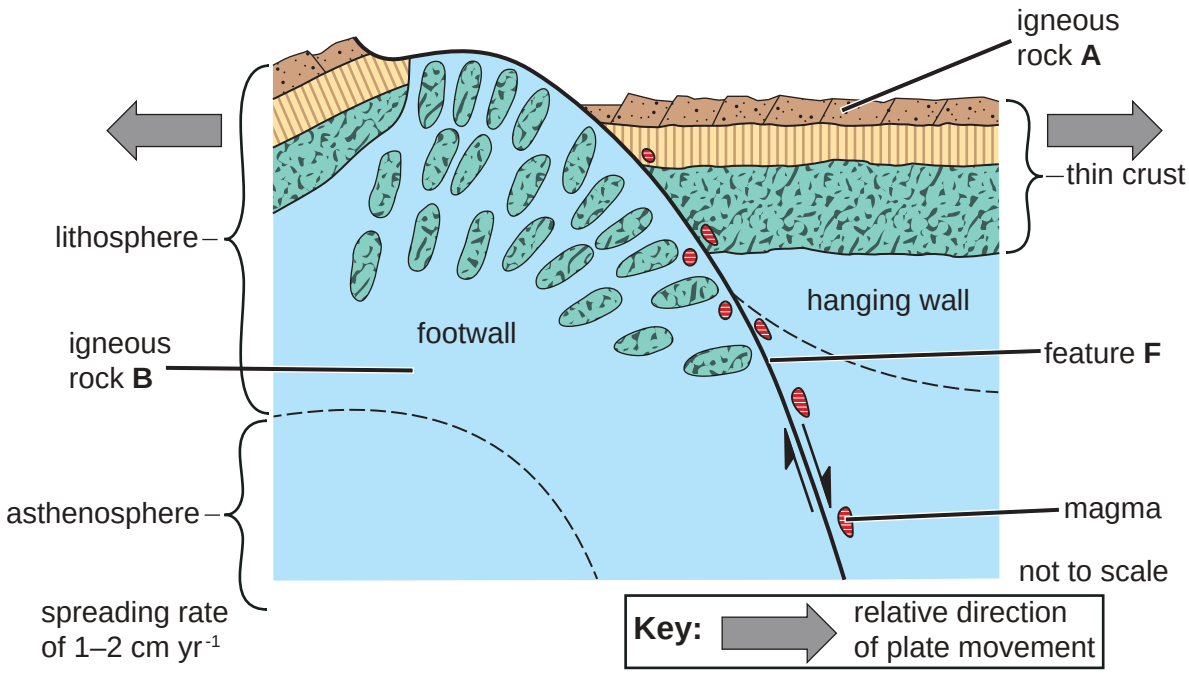

Figure 2b

Examiner only

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

(i) State the type of plate boundary that accounts for the formation of new oceanic lithosphere. Tick (✓) only **one** box. [1]

conservative plate boundary	☐
convergent oceanic-oceanic plate boundary	☐
divergent plate boundary	☐
convergent oceanic-continental plate boundary	☐
convergent continental-continental plate boundary	☐

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Figure 2c shows a cross-section of a structure found in igneous rock **A** on **Figure 2a** and **Figure 2b**.

Figure 2c

(ii) State which **two** of the following apply to the structure shown in **Figure 2c**. Tick (✓) only **two** boxes. [2]

formed by explosive eruption ☐

formed by very slow cooling ☐

shows pillow lava ☐

shows columnar jointing ☐

formed by submarine eruption ☐

is a concordant sill ☐

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(iii) State the name of layer **C** in **Figure 2a**.
Tick (✓) only **one** box. [1]

- oceanic crust ☐
- mantle ☐
- continental crust ☐
- outer core ☐
- inner core ☐

(iv) State the names of igneous rock **A** and igneous rock **B** in **Figure 2a**. [2]

Igneous rock **A** ..... Igneous rock **B** .....

(v) Describe the process by which magma is formed in **Figure 2a**. [2]

.....

.....

.....

.....

(b) (i) State the type of geological feature labelled feature **F** on **Figure 2b**.
Tick (✓) only **one** box. [1]

- reverse fault ☐
- unconformity ☐
- normal fault ☐
- transform fault ☐
- rift valley ☐

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(ii) Describe **three** differences between the two models shown in **Figures 2a** and **2b**. [3]

Difference 1 .....

.....

Difference 2 .....

.....

Difference 3 .....

.....

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3. **Figure 3a** shows the tectonic setting of Mount St Helens in Washington state, USA, which erupted violently on May 18th 1980.

Table 3 shows the changing pattern of earthquake activity in the time before the eruption.

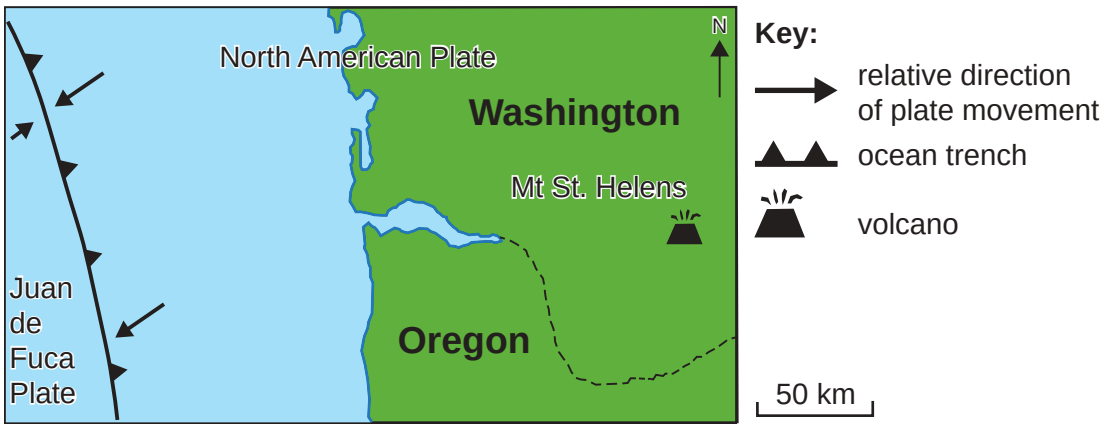

Figure 3a

Date	Number of earthquakes	Magnitude	Depth (km)
March 25th–27th	174	> 2.6	6–9
April to May	207	> 3.2	3–7
May 10th–17th	56	> 4.0	2–5
May 18th	1	5.1 then eruption	1.6

Table 3

Examiner only

(a) Refer to **Figure 3a**.

State the type of plate boundary shown in **Figure 3a**.
Tick (✓) only **one** box. [1]

divergent plate boundary ☐

convergent continental-continental plate boundary ☐

conservative plate boundary ☐

convergent oceanic-continental plate boundary ☐

convergent oceanic-oceanic plate boundary ☐

(b) Refer to **Table 3**.

(i) Describe how the depth and magnitude of the earthquakes changed from March 25th to May 18th. [4]

Depth .....

.....

.....

Magnitude .....

.....

.....

(ii) The changing pattern of earthquake activity coincided with the north face of the volcano bulging upwards and outwards. Explain the processes responsible for these observed changes. [3]

.....

.....

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(iii) Describe the use of **one** technique by which ground deformation of the northern bulge might have been monitored. [2]

.....

.....

.....

(iv) State **two** other monitoring techniques that might have been used in an attempt to predict the major eruption that occurred on May 18th 1980.
Tick (✓) only **two** boxes. [2]

borehole correlation using microfossils	☐
gas emissions	☐
groundwater changes	☐
soil analysis	☐
magnetic survey	☐
geological mapping	☐

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4. **Figure 4a** and **Figure 4b** show geological structures which might contain oil.

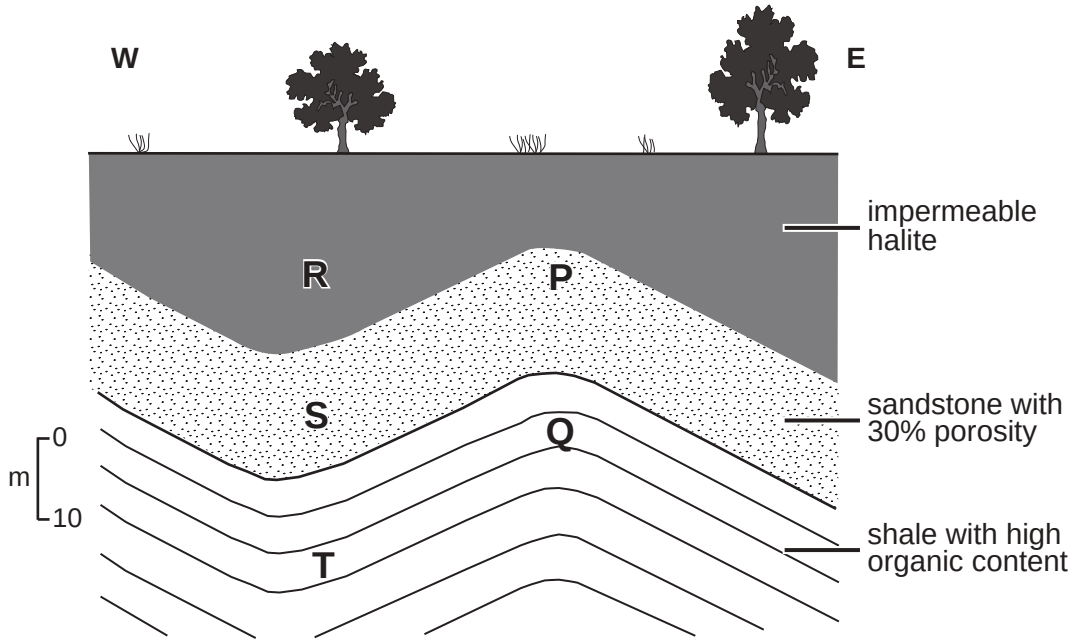

Figure 4a

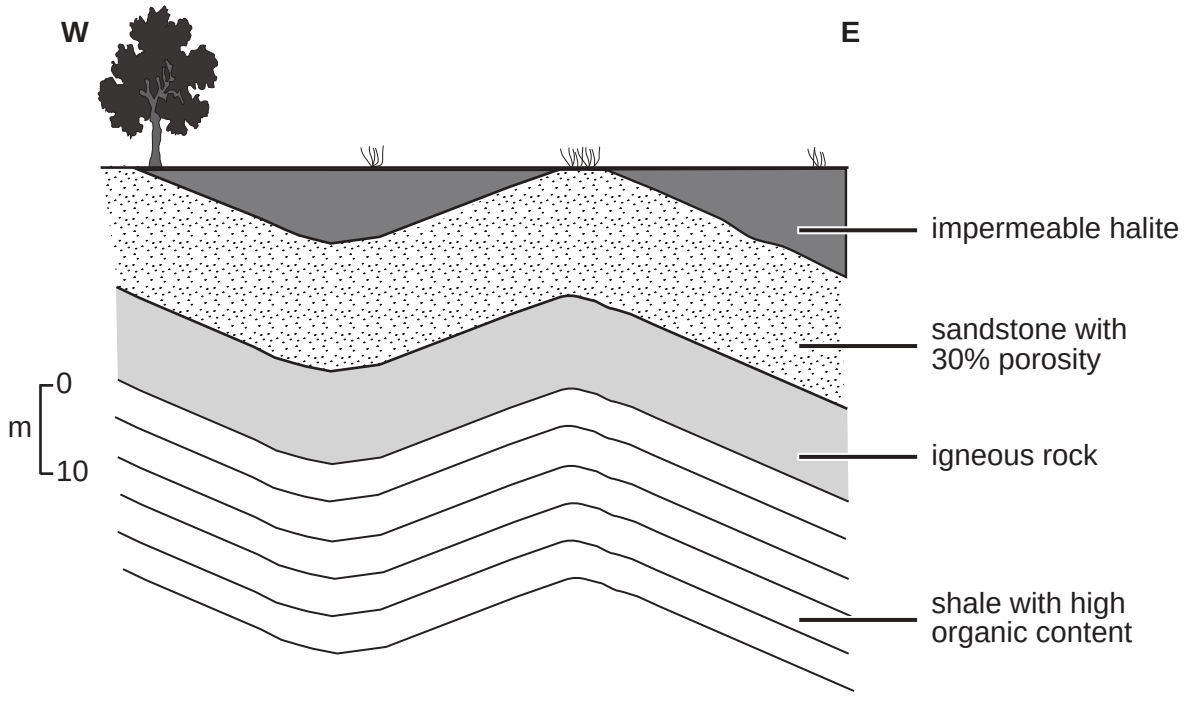

Figure 4b

Examiner only

(a) Refer to **Figure 4a** and **Figure 4b**.

(i) State in which of the locations **P**, **Q**, **R**, **S** or **T**, oil is most likely to have been trapped in **Figure 4a**.

Tick (✓) only **one** box. [1]

P ☐ **Q** ☐ **R** ☐ **S** ☐ **T** ☐

(ii) With reference to the rock types and structures, explain why oil is likely to occur in **Figure 4a**. [3]

.....

.....

.....

.....

.....

(iii) State **two** reasons why oil is unlikely to occur in **Figure 4b**. [2]

Reason 1 .....

.....

Reason 2 .....

.....

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(b) **Figure 4c** shows the depths and temperatures at which oil and gas may be formed.

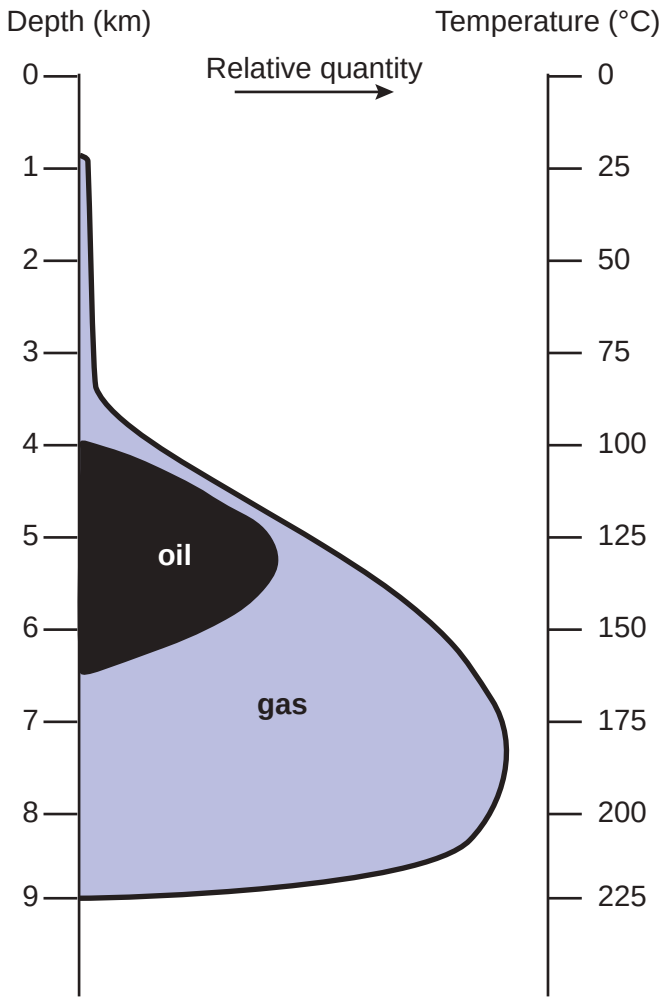

Figure 4c

Refer to **Figure 4c**.

(i) State the depth and temperature at which the maximum amount of oil is generated. [2]

Depth ..... km Temperature ..... °C

(ii) Calculate the average rate of temperature increase with depth. Give your answer in $°C\,km^{-1}$.
Show your working. [2]

..... $°C\,km^{-1}$

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(c) **Figure 4d** shows the relationship between oil reserves and oil resources.

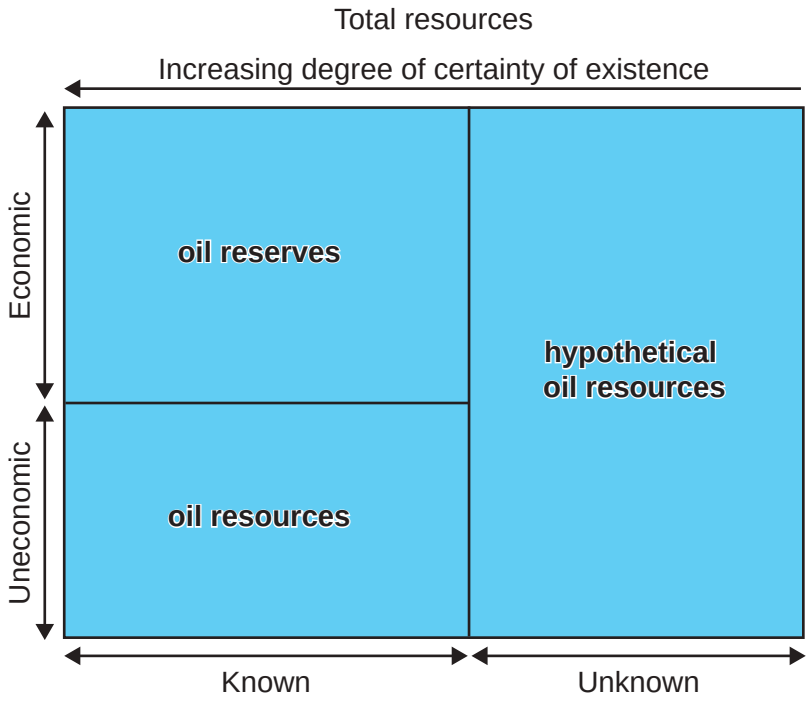

Figure 4d

(i) State which **one** of the three areas labelled on **Figure 4d** represents oil deposits yet to be discovered or evaluated. [1]

.....

(ii) State how an **increase** in the price of oil affects the position of the boundary between oil reserves and oil resources on **Figure 4d**.
Tick (✓) only **one** box. [1]

the boundary would move up ☐

the boundary would move to the left ☐

the boundary would move to the right ☐

the boundary would remain unchanged ☐

the boundary would move down ☐

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5. **Figure 5a** and **Figure 5b** show sedimentary rocks which provide evidence for global climate change throughout geological time.

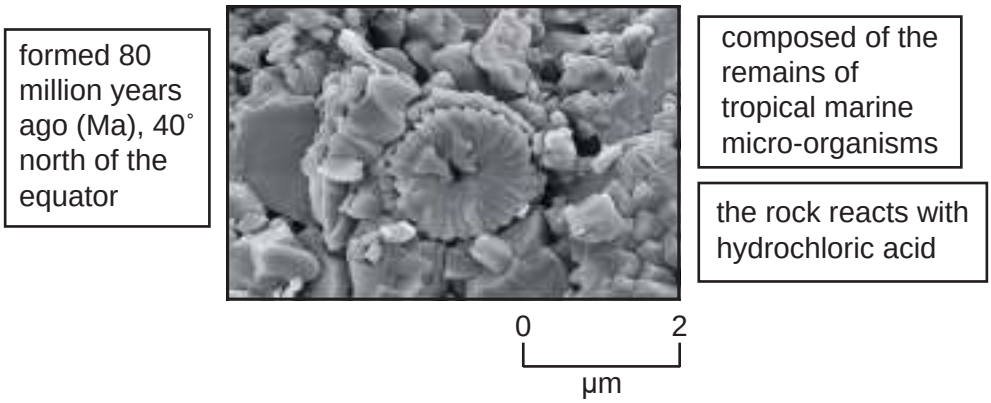

Figure 5a

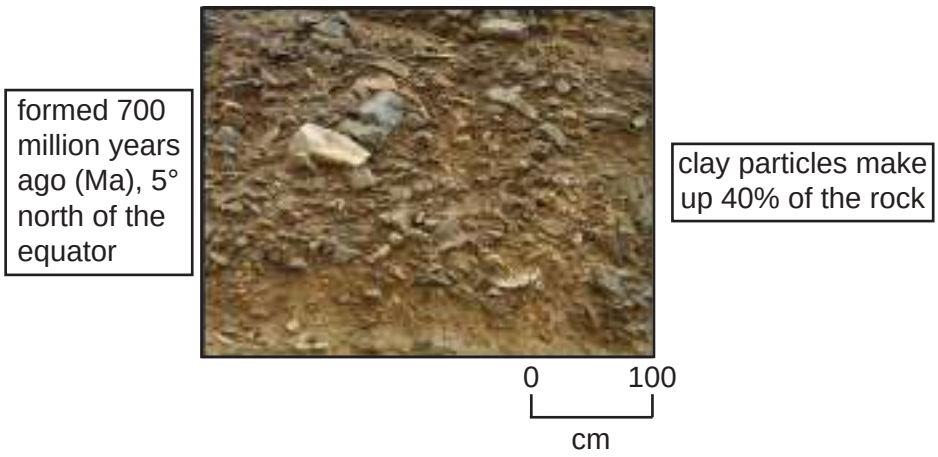

Figure 5b

Refer to the Data Sheet.

(a) (i) State the name of the geological **era** to which the rock shown in **Figure 5a** belongs. [1]

.....

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(ii) State the name of the instrument most likely used to produce the image of the rock in **Figure 5a**. [1]
Tick (✓) only **one** box.

electron microprobe ☐

scanning electron microscope ☐

ground penetrating radar ☐

magnetometer ☐

hand lens ☐

(iii) A student concluded that the rock in **Figure 5a** is chalk (a type of limestone). State **two** reasons to support this conclusion. [2]

Reason 1 .....

.....

Reason 2 .....

.....

(iv) The rock in **Figure 5a** is thought to indicate the Earth was in extreme greenhouse conditions at this time. State which **two** of the following would **not** result from greenhouse conditions. [2]
Tick (✓) only **two** boxes.

higher sea levels than now ☐

glaciers shrinking/retreating ☐

more land above sea level than now ☐

less ice at the poles than now ☐

limestone forming outside the tropics ☐

higher albedo than now ☐

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(b) Refer to **Figure 5b**.

(i) Describe the texture of the rock shown in **Figure 5b**. [3]

.....

.....

.....

.....

(ii) State the name of the rock shown in **Figure 5b**. [1]

.....

(iii) Explain why the rock in **Figure 5b**, deposited at a latitude of 5° North, is strong evidence for the Earth being in icehouse conditions 700 million years ago (Ma). [3]

.....

.....

.....

.....

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6. **Table 4** compares some characteristics of the Earth with those of Mars.

	Earth	Mars
gravity relative to Earth	1	0.337
atmosphere	dense	thin
atmosphere gases	nitrogen, oxygen, carbon dioxide	95.3% carbon dioxide
average surface temperature	15ºC	–60ºC
plate tectonic activity	active	none
active volcanoes	1500	none
erosional agents	wind, water, ice	wind

Table 4

(a) Refer to **Table 4**.
State which **two** of the following statements are **correct** regarding the comparison between Earth and Mars.
Tick (✓) only **two** boxes. [2]

Weathering processes on Mars today are likely to be more effective than those on Earth ☐

The average surface temperature on Mars today is higher than that of the Earth ☐

If astronauts landed on Mars, they would weigh about 1/3 of their body weight on Earth ☐

There are more subduction zones on Mars than on Earth ☐

Marine sedimentary rocks are being formed more extensively on Mars today than on Earth ☐

The Earth is volcanically active compared to Mars ☐

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(b) **Figure 6** shows Olympus Mons on Mars, the largest volcano in the solar system. The Hawaiian Islands are superimposed in red for comparison of scale. The largest volcano on Earth, Mauna Loa is shown on Big Island.
Table 5 compares Olympus Mons to Mauna Loa.

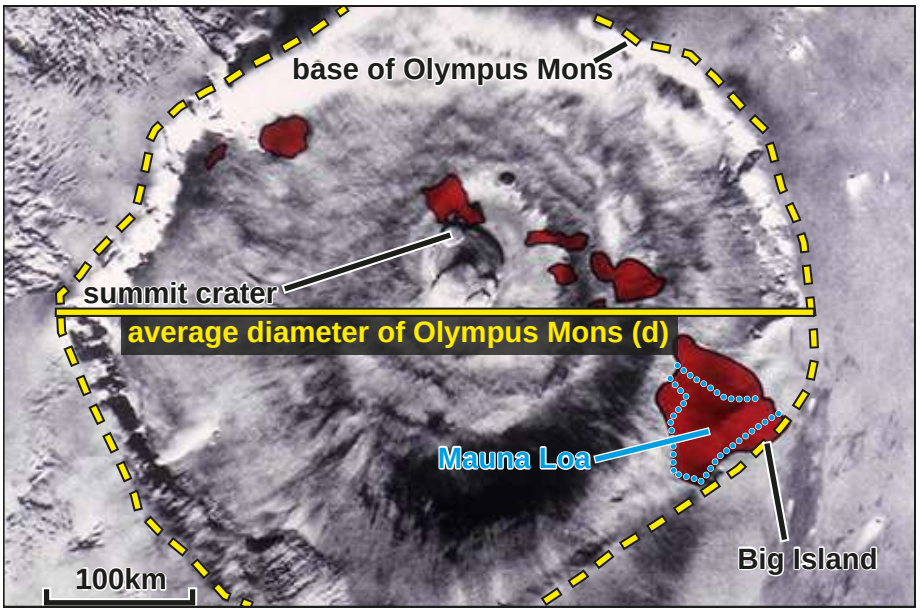

Figure 6

Volcano	Height (m)	Area (km^2)	Years since last eruption
Mauna Loa	9170	5271 km	35
Olympus Mons	22 287	-	25 000 000

Table 5

Refer to **Figure 6** and **Table 5**.

(i) Calculate the difference in height between Mauna Loa and Olympus Mons. [1]

..... m

(ii) Calculate the area of Olympus Mons. Show your working. [3]
Formula to calculate area is $A = \pi r^2$

A = area	r = radius	π = 3.142

..... km^2

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(iii) With reference to **Table 4** and rock cycle processes, explain why it is very unlikely that volcanoes the size of Olympus Mons have or could ever be formed on Earth. [QER 6]

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Acknowledgements

Figure 1c https://geosec.biz/. Acknowledgement not found

Figures 2a and 2b www.seafloorspreading.com. Christopher MacLeod, Cardiff University

Figure 2c https://teara.govt.nz/en/photograph/8323/. Photograph Lloyd Homer

Figure 5a http://www9.open.ac.uk/emsuite/sites/open.ac.uk.emsuite/files/styles/images/sem/. Photograph The Open University

Figure 5b http://jacquesa14.free.fr/themes/paleoclimat/index.htm. Acknowledgement not found

Figure 6 https://www.lpi.usra.edu/publications/slidesets/hawaii/slidepages/slide_01.html. Photograph Lunar and Planetary Institute

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