Surname	Centre Number	Candidate Number
First name(s)		2

GCE A LEVEL

A480U20-1

O20-A480U20-1

TUESDAY, 13 OCTOBER 2020 – MORNING

GEOLOGY – A level component 2

Geological Principles and Processes

1 hour 45 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**15**	
2.	**17**	
3.	**16**	
4.	**15**	
5.	**12**	
6.	**15**	
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.

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.

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 **3**(*b*) and **5**(*c*).

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

1. **Figure 1a** shows two specimens (**A** and **B**) from two different fossil groups.

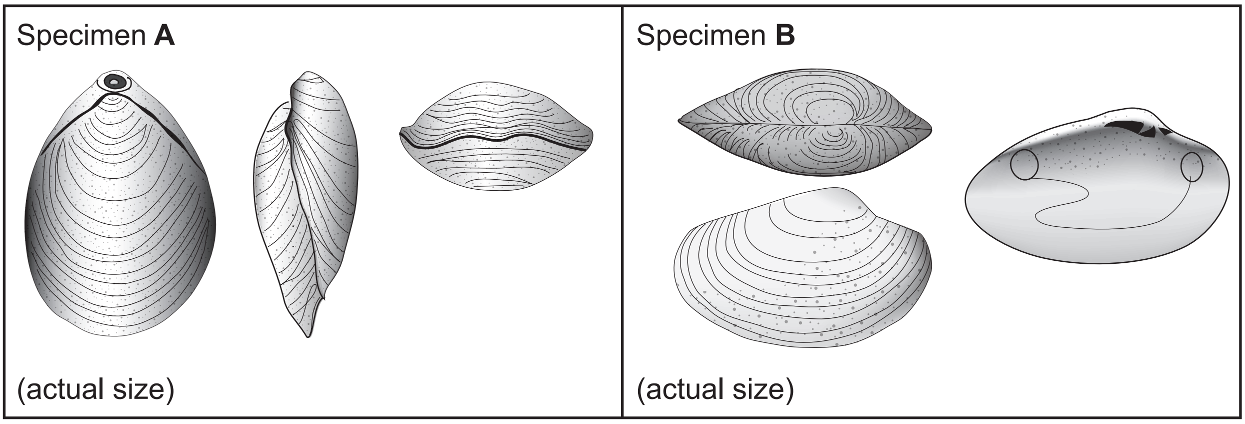

Figure 1a

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

(i) Complete **Table 1** using the appropriate letter (**A** or **B**) to indicate to which specimen the characteristic applies. [3]

Characteristic	Specimen
Formed of two valves	• **A** and **B**
Both valves are the same size	•
A plane of symmetry runs between the valves	•
One valve possesses a foramen	•

Table 1

(ii) Name the fossil group represented by specimen **A**. [1]

....

(iii) Identify the mode of life of specimen **B**. Explain the evidence for your answer. [4]

Mode of life: ....

Evidence: ....

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(b) **Figure 1b** shows the size-distribution of two populations (**1** and **2**) of fossil group **A** from two different bedding planes.

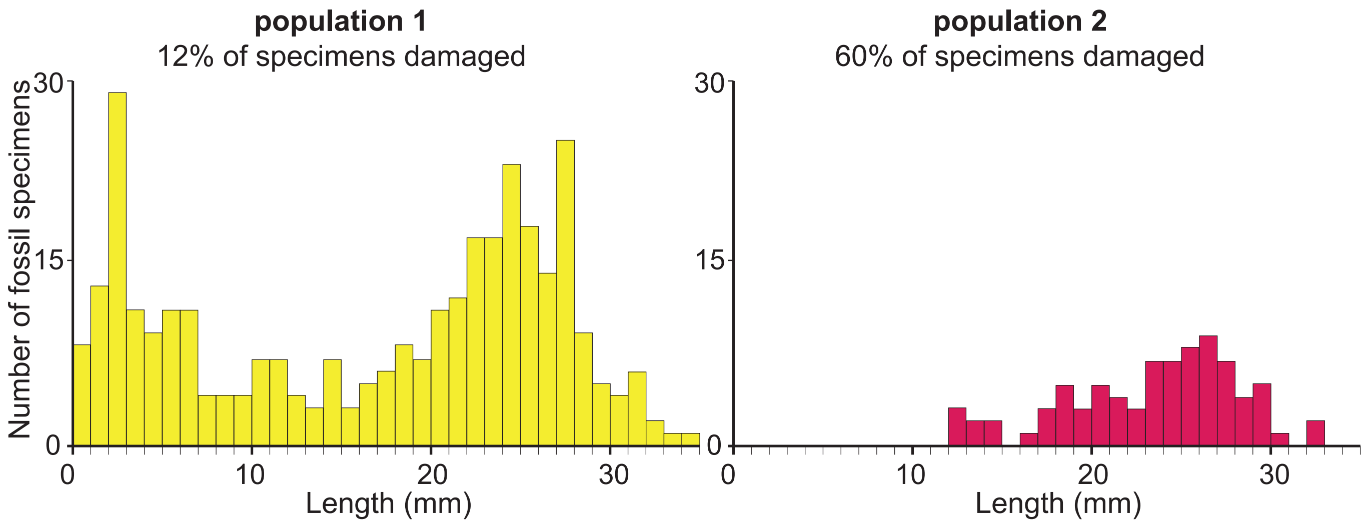

Figure 1b

Refer to **Figure 1b**.

(i) Describe **three** differences between population **1** and population **2**. [3]

1. ....

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2. ....

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3. ....

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(ii) A student concluded that *'population **2**, rather than population **1**, is more likely to represent a death assemblage'*. Evaluate the student's conclusion. [4]

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2. **Figure 2** is a phase diagram for the plagioclase feldspar minerals which form a solid solution series between a calcium-rich variety, anorthite ($CaAl_2Si_2O_8$) and a sodium-rich variety, albite ($NaAlSi_3O_8$). **Table 2a** shows data on the properties of the ions found in feldspar minerals.

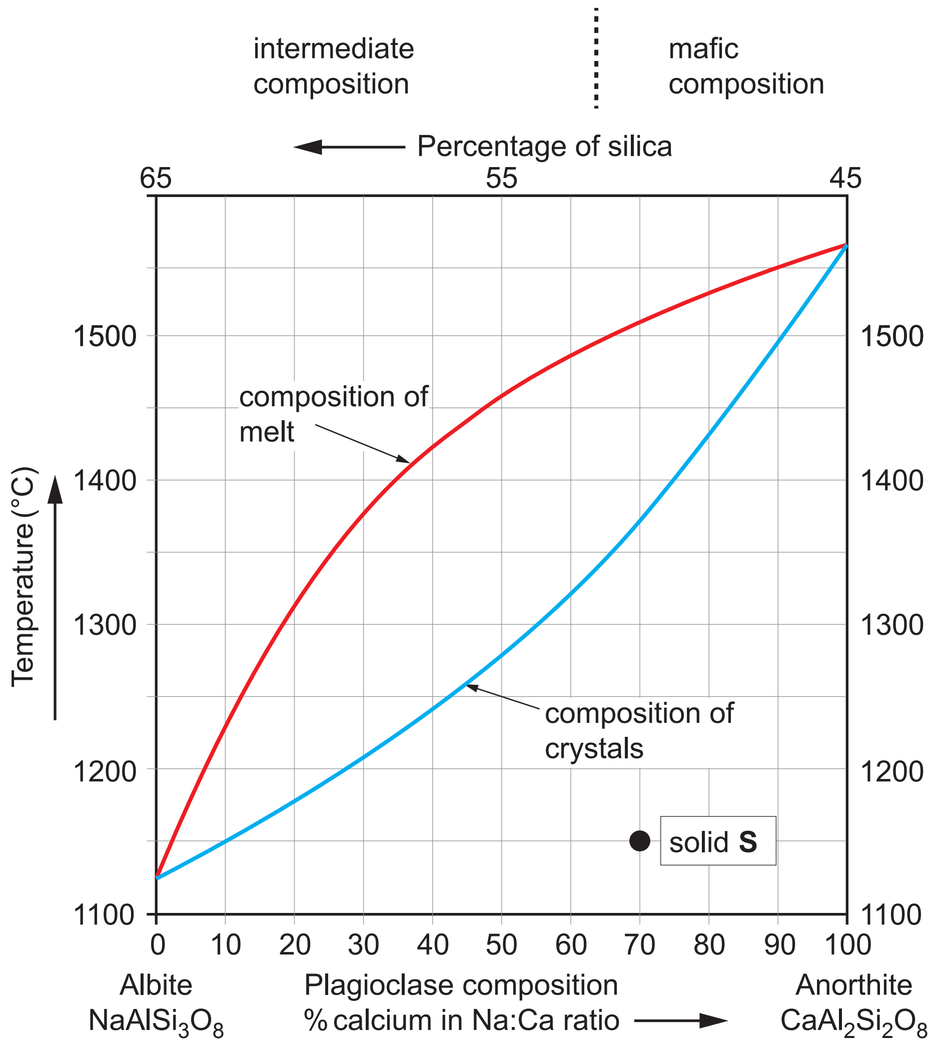

Figure 2

Ion	Al^{3+}	Ca^{2+}	K^{+}	Na^{+}	O^{2-}	Si^{4+}
Ionic charge (valency)	3+	2+	1+	1+	2–	4+
Ionic radius (10^{-10} m)	0.47	1.20	1.59	1.24	1.32	0.34

Table 2a

(a) Refer to **Figure 2**. State the melting point of pure anorthite and pure albite. Write your answers in **Table 2b**. [2]

melting point of pure anorthite	•	°C
melting point of pure albite	•	°C

Table 2b

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(b) Refer to **Table 2a**.

(i) Explain why orthoclase feldspar ($KAlSi_3O_8$) does not have a solid solution series with albite ($NaAlSi_3O_8$). [2]

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(ii) Explain why the plagioclase feldspars, anorthite ($CaAl_2Si_2O_8$) and albite ($NaAlSi_3O_8$), have a solid solution series. [3]

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

Solid **S** on **Figure 2** has the composition of 70 % anorthite at 1150 °C.

(i) Complete **Table 2c** to show how the compositions of the melt and crystals change as **solid S partially melts**. Assume that the solid crystals and melt at any temperature co-exist in equilibrium. [3]

Solid **S**	Temperature (°C)	Composition of melt (% anorthite)	Composition of crystals (% anorthite)	Silica content of melt (%)
Initial melting	1370	•	70	59
Partial melt	1450	48	83	•
Final melting	•	70	92	51

Table 2c

(ii) Describe how the relative proportion of Na^+, Ca^{2+} and silica in the melt and crystal phases at 1450 °C differ. [3]

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(d) During partial melting the less dense melt may migrate away from the crystals to form a new magma chamber.

Using **Figure 2**, **Table 2c** and your knowledge evaluate the statement, *'partial melting of subducted oceanic lithosphere generates andesitic magma'*. [4]

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3. **Figure 3a** is a geological map of an area showing the distribution of rock types, geological structures and metamorphic index minerals.

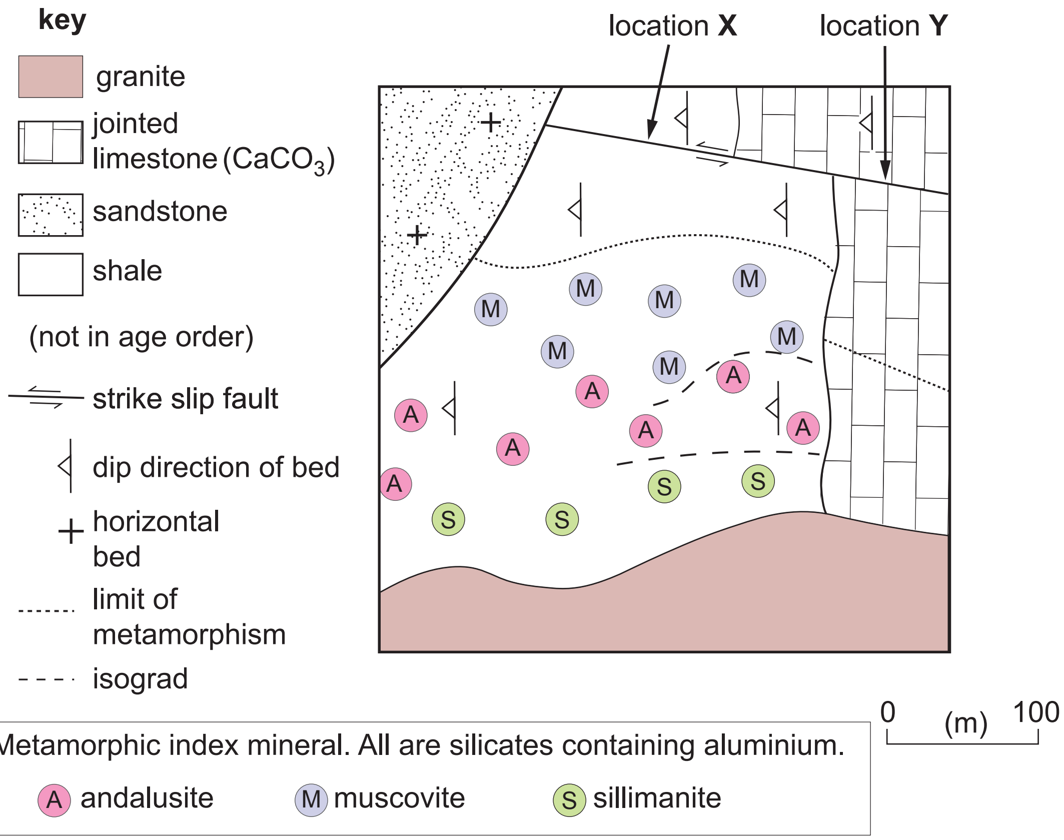

Figure 3a

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

An isograd is a line joining points of equal metamorphic grade as identified by a change in metamorphic index mineral.

(i) Complete the **two** isograds on **Figure 3a** between the muscovite-andalusite and andalusite-sillimanite zones. [2]

(ii) Draw an arrow (⟵) on **Figure 3a** to show the direction of increasing metamorphic grade. Explain your answer. [2]

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(iii) Explain why it is not possible to identify these isograds in: [4]

the sandstone sequence

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the jointed limestone sequence

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(iv) Explain why rock type has affected the width of the metamorphic aureole in **Figure 3a**. [2]

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(b) **Figure 3b** shows photographs of two rock specimens (rocks **X** and **Y**) obtained from **location X** and **location Y** on **Figure 3a**.

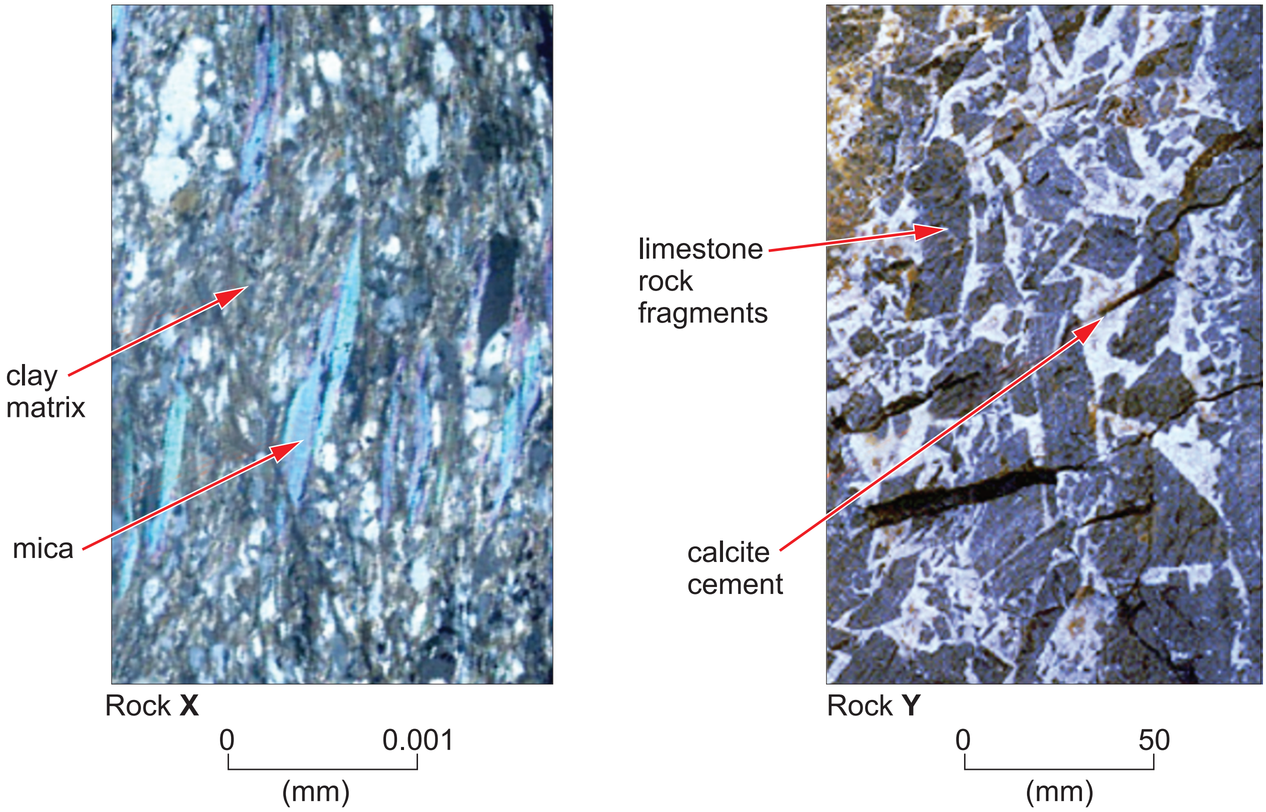

Figure 3b

Refer to **Figure 3a** and **Figure 3b**. Explain how the texture and composition of rock **X** and rock **Y** are related to their mode of formation. [6 QER]

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4. **Figure 4a** is a graph showing the changes in global sea level and mean global temperature during the Phanerozoic.

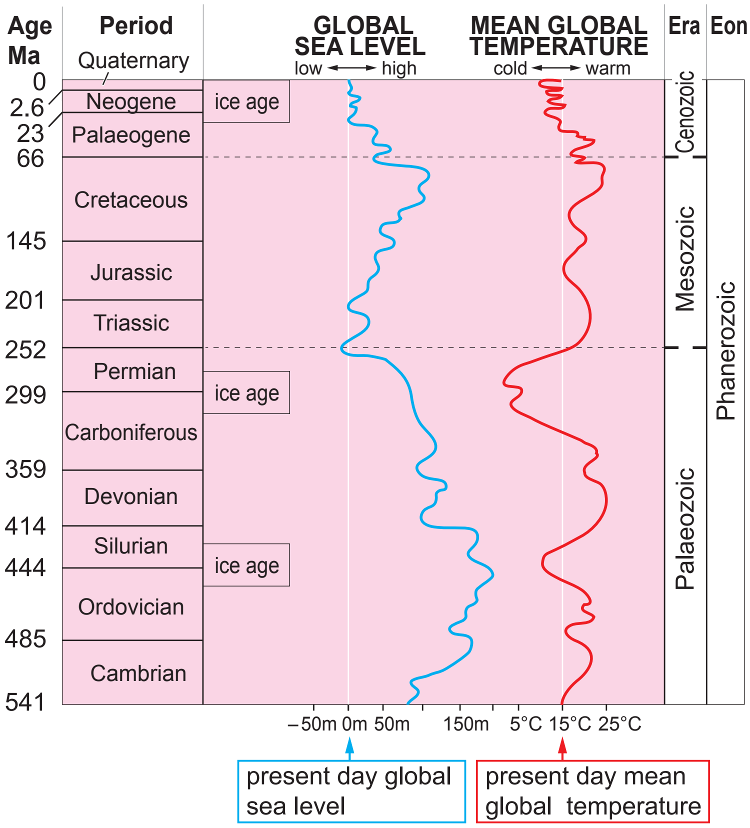

Figure 4a

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

(i) Describe the changes in global sea level during the past 252 Ma. [3]

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(ii) Explain why global sea levels might be expected to be low when global temperatures were colder than today. [2]

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(b) A student stated that *'global sea level is only controlled by global temperature'*. With reference to **Figure 4a** only, evaluate the validity of the student's statement. [3]

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(c) **Figure 4b** shows the position of Earth's continents and oceans in the early Jurassic and late Cretaceous.

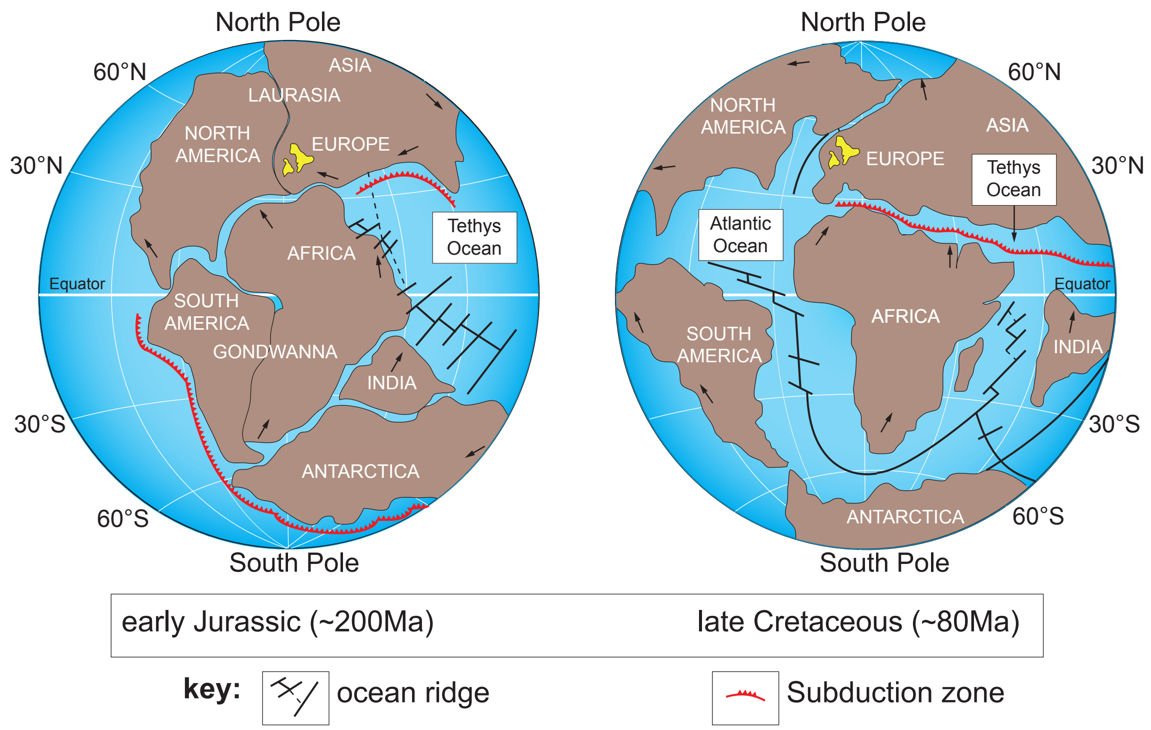

Figure 4b

In the late Cretaceous the Atlantic and Tethys oceans were at two different stages of the J.T. Wilson Cycle. Use the evidence on **Figure 4b** to suggest which of these oceans show evidence of being at a later stage of development. [3]

Ocean at later stage of development ....

Explanation ....

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(d) A student stated that, *'global sea levels were higher when ocean ridges were more extensive'*.

(i) Refer to **Figure 4a** and **Figure 4b** only. Evaluate this statement. [2]

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(ii) Suggest why global sea levels might be expected to be higher when ocean ridges were more extensive. [2]

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5. **Table 3** shows some mineral properties.

Mineral	Chemical formula	Number of cleavage planes	Hardness	Relative density	Magnetic susceptibility ($10^{-8}\,m^3\,kg^{-1}$)	Electrical resistivity ($\Omega\,m$)
Cassiterite*	SnO_2	2 poor	6 – 7	7.0	16	$10^4 - 10^5$
Gold*	Au	none	2.5 – 3	15.0 – 19.3	0	$10^{-7} - 10^{-8}$
Magnetite*	Fe_3O_4	none	5.5 – 6.5	5.2	20 000 – 110 000	$10^{-1} - 10^3$
Sphalerite*	ZnS	6 good	3.5 – 4	4.0	0 – 19	$10^4 - 10^5$
Calcite	$CaCO_3$	3 good	3	2.7	0 – 1.4	$10^{10} - 10^{12}$
Quartz	SiO_2	none	7	2.7	0 – 0.6	$10^{10} - 10^{12}$

*metalliferous ore mineral

Table 3

(a) Refer to **Table 3** only.

Explain how gold and magnetite can be distinguished in hand specimen. [2]

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(b) Gold and magnetite can be concentrated in sedimentary placer deposits.

(i) Explain how the properties of gold and magnetite enable them to be concentrated in sedimentary placer deposits. [3]

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(ii) Name **one** other metalliferous ore mineral from **Table 3** which may also be found in placer deposits. [1]

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(c) Exploration for metalliferous ore deposits may be undertaken using a variety of geophysical techniques.

Use the data in **Table 3** to suggest the most suitable **geophysical** techniques that could be used to explore for metalliferous ore deposits. Explain your answers. [6 QER]

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6. **Figure 6a** shows a map of the Cocos plate area. **Table 4** shows the dimensions of the Cocos plate.

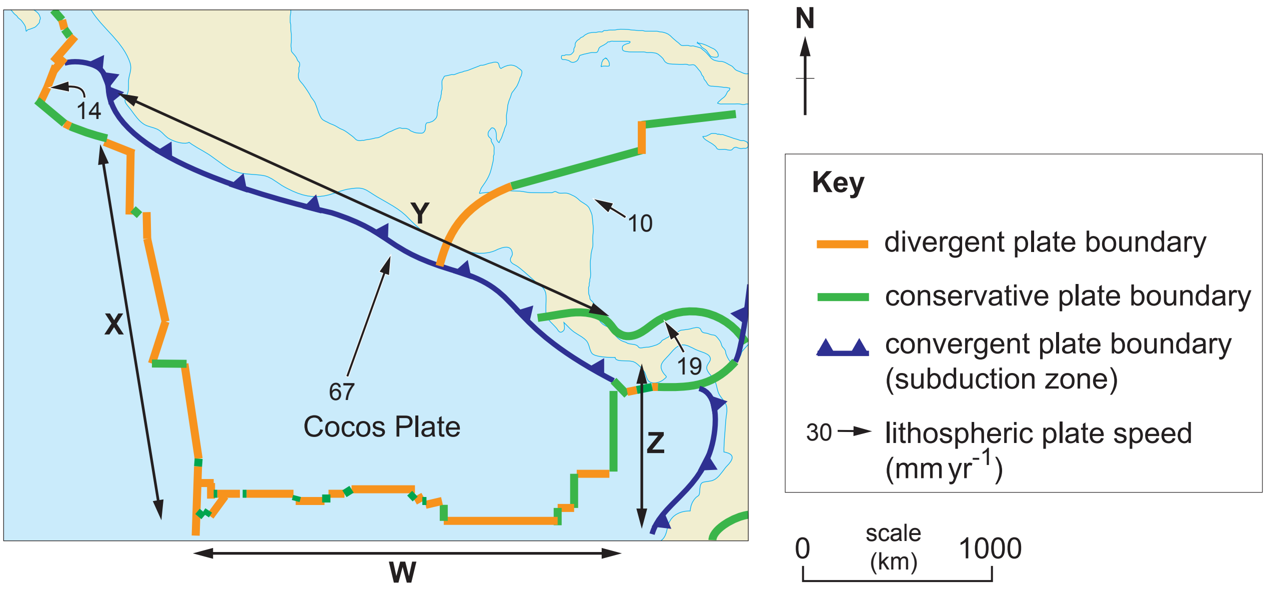

Figure 6a

Refer to **Figure 6a**.

(a) Label with an arrow on **Figure 6a** the location of: [3]

- an ocean trench (**O**⟶)
- a transform fault (**T**⟶)
- deep focus earthquakes (**D**⟶)

(b) (i) Using the scale provided measure the length of edge **Y**. Write your answer in **Table 4**. [1]

Dimensions of the Cocos plate	
length of edge **W** (km)	2280
length of edge **X** (km)	1960
length of edge **Y** (km)	•
length of edge **Z** (km)	920
surface area of the Cocos plate (x 10^6 km^2)	3.0

Table 4

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(ii) Use the data in **Table 4** to calculate the length of the subduction zone **Y** as a percentage of the circumference of the Cocos plate. Show your working. [3]

.... %

(c) **Figure 6b** and **Figure 6c** are graphs showing lithospheric plate data.

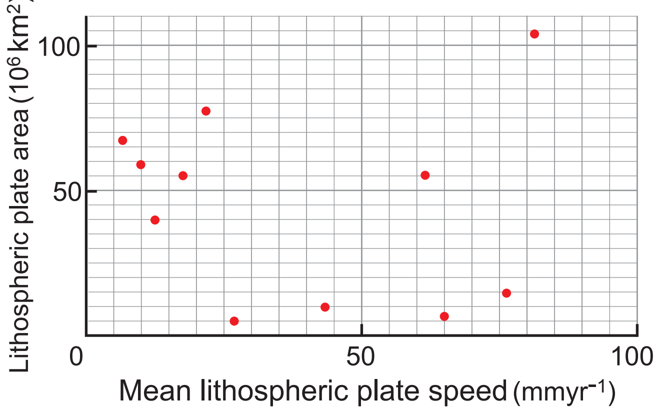

Figure 6b

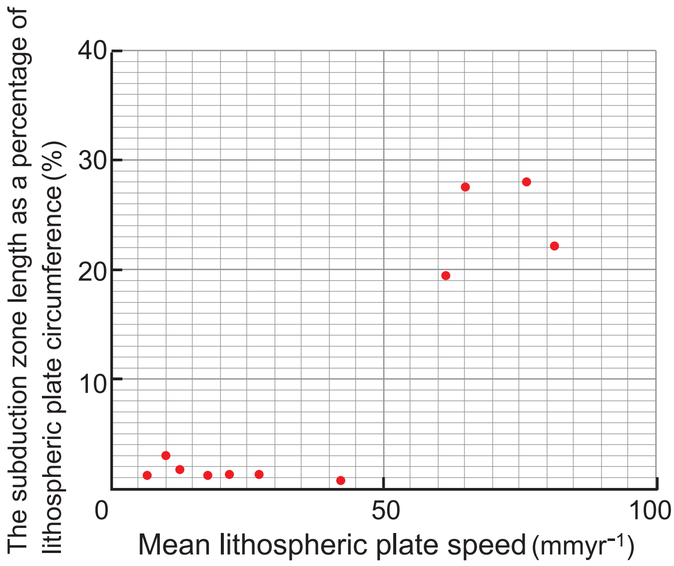

Figure 6c

(i) Using the data in **Figure 6a**, **Table 4** and your answer to *(b)*(ii) plot for the Cocos plate:

- a point on **Figure 6b**
- a point on **Figure 6c**. [2]

(ii) Use **Figure 6b** and **Figure 6c** to evaluate the degree of correlation between mean lithospheric plate speed and:

- the lithospheric plate area
- the subduction zone length as a percentage of lithospheric plate circumference. [3]

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(d) Evaluate the extent to which the data on **Figure 6c** supports the theory of slab pull for causing lithospheric plate motion. [3]

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END OF PAPER

Acknowledgements

Figure 1a	British Caenozoic fossils. British Natural History Museum
Figure 1b	Modified from: Postmortem durability and population dynamics. A. Tomasovych. 2004. Palaios, v19, 477-496
Figures 3a and 3b	http://www.rci.rutgers.edu/~schlisch/structureslides and https://www.sciencedirect.com/science/article/pii/S0040195117303268
Table 3	Data on magnetic susceptibility from www.alaska-gold.com/RF003p0189.pdf
Figures 4a and 4b	http://www.open.edu/openlearn/science-maths-technology/science/geology/geological-processes-the-british-isles/content-section-3#fig003-002
Table 4	http://www.open.edu/openlearn/science-maths-technology/science/geology/plate-tectonics/content-section-5.1
Figures 6a, 6b and 6c	http://www.open.edu/openlearn/science-maths-technology/science/geology/plate-tectonics/content-section-5.1