Surname	Centre Number	Candidate Number
Other Names		0

GCSE

4250/01

S17-4250-01

GEOLOGY

Theory Paper
(Paper version of on-screen assessment)

WEDNESDAY, 24 MAY 2017 – MORNING

1 hour 30 minutes

For Examiner's use only		
Section	**Maximum Mark**	**Mark Awarded**
1.	**7**	
2.	**15**	
3.	**15**	
4.	**18**	
5.	**17**	
6.	**18**	
7.	**10**	
Total	**100**	

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ADDITIONAL MATERIALS

In addition to this examination paper you will need a:

- Data Sheet;
- calculator.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Answer **all** questions.

Write your answers in the spaces provided.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets alongside each question.

You are reminded that assessment will take into account the quality of written communication *(QWC)* used in your answers to **Section 4 Q7** and **Section 5 Q5**.

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Answer **all** *questions in each section.*

Section 1 – answer questions 1 – 4

Figure 1 shows the variation in global sea level over the last 500,000 years. The present sea level is shown by the horizontal line marked as 0 m.

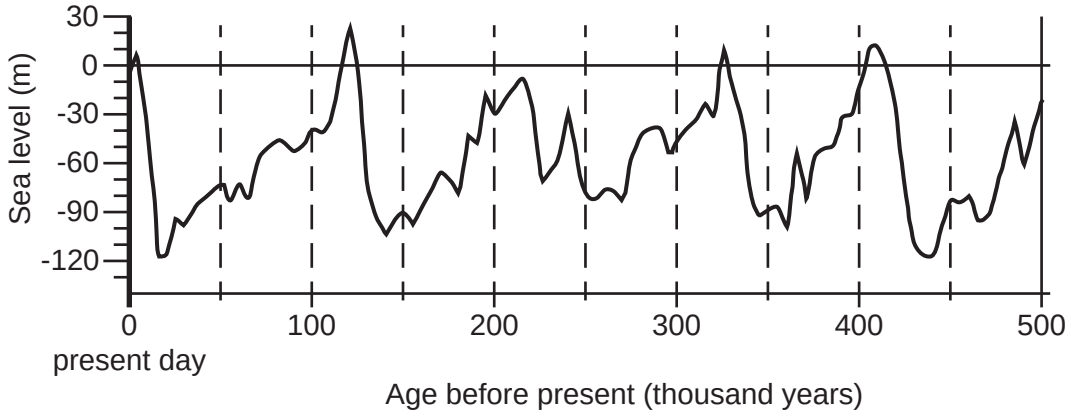

Figure 1

1. Which **two** of the following statements are **incorrect**? Tick (✓) only **two** boxes. [2]

at times sea level has been more than 100 m lower than at present ☐

compared to the present, past falls in sea level have been greater than rises in sea level ☐

250,000 years ago polar ice would have been more extensive than today ☐

250,000 years ago global temperatures would have been higher than today ☐

levels of carbon dioxide in the atmosphere would have been higher 150,000 years ago than 400,000 years ago ☐

the climate of the past 500,000 years was dominated by repeated glacial and interglacial cycles ☐

2. Explain how the absence of ice sheets can increase global warming. [2]

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Figure 2 is an aerial photograph of part of the south coast of Devon.

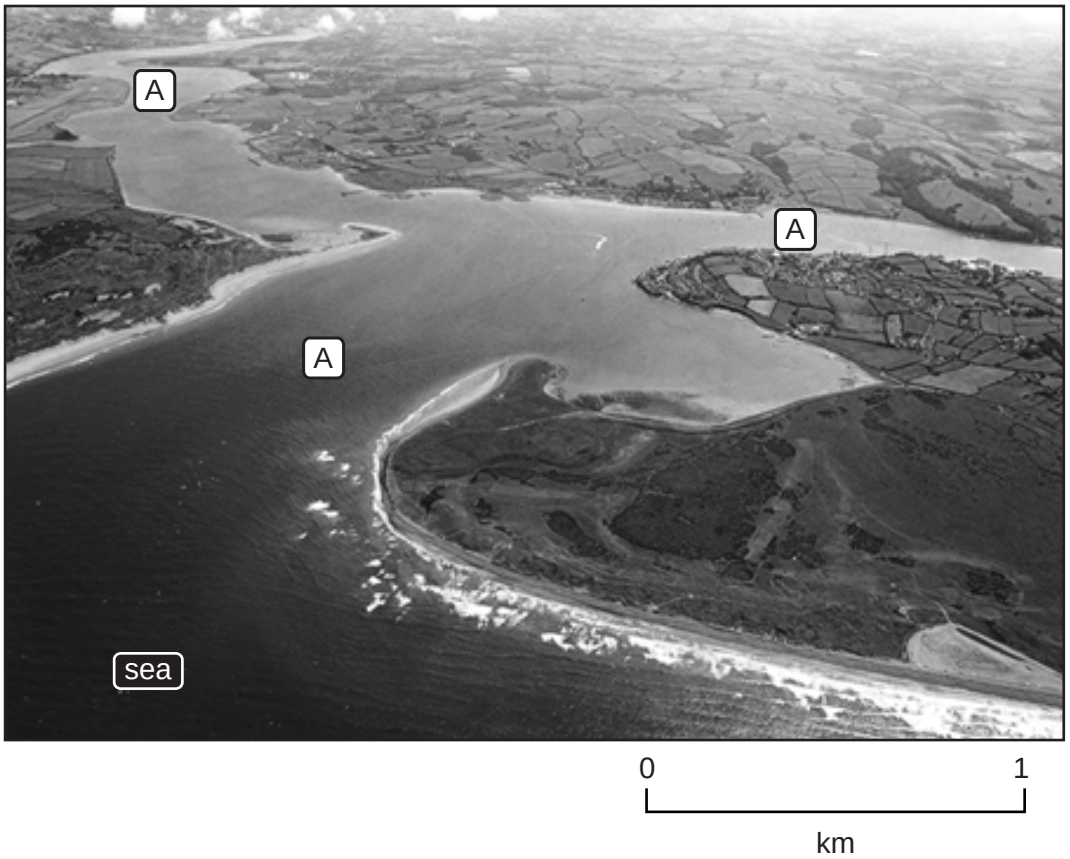

Figure 2

3. What is the name of feature **A** in **Figure 2**? Tick (✓) only **one** box. [1]

raised beach ☐

drowned river valley (ria) ☐

submerged forest ☐

U-shaped valley ☐

discordant drainage ☐

4. Explain how feature **A** in **Figure 2** provides evidence for a changing global sea level. [2]

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Section 2 – answer questions 1 – 7

Figure 3 shows two different styles of folding (**B** and **C**).

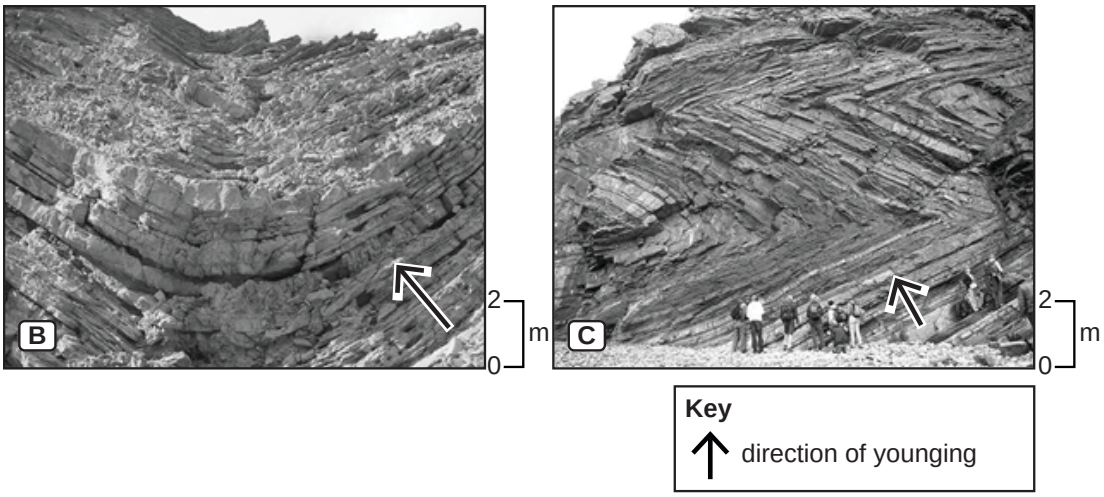

Figure 3

1. Which **two** of the following statements about the folding in **Figure 3** are **incorrect**? Tick (✓) only **two** boxes. [2]

fold **B** is a syncline ☐

in fold **B** the angle of dip on each limb is similar ☐

the folding in **C** has approximately vertical axial planes ☐

some of the fold limbs in **C** are upside down ☐

the fold hinges in **B** are rounded whereas the fold hinges in **C** are angular ☐

the folding in **C** has formed under greater tension than fold **B** ☐

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Figure 4 is a geological **map**. The land surface is flat.

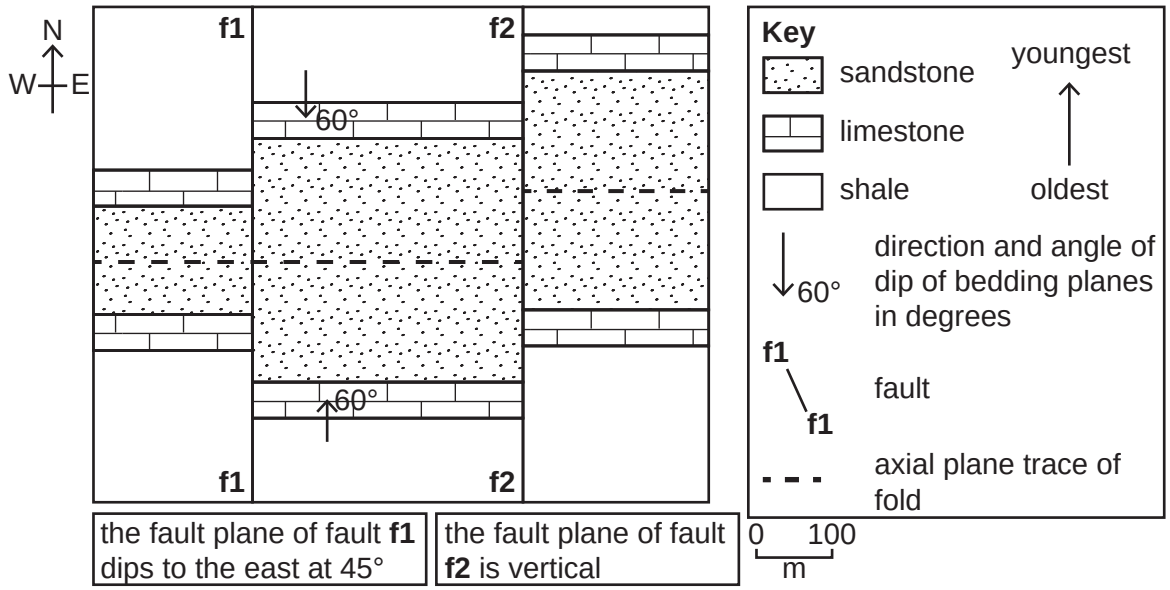

Figure 4

2. Which **three** of the following statements about the structures in **Figure 4** are **incorrect**? Tick (✓) only **three** boxes. [3]

the movement along fault **f1** is vertical	☐
fault **f1** is downthrown to the east	☐
fault **f1** is a reverse fault	☐
fault **f2** is a strike slip fault	☐
the movement along fault **f2** is horizontally to the right	☐
the fold is a syncline	☐
the fold is overturned	☐

3. Draw a line from each of the following types of stress to the correct type of fault. [3]

compression	normal fault
shear	strike slip fault
tension	thrust fault

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Figure 5 is a photograph showing mineralisation along one of the faults in **Figure 4**.

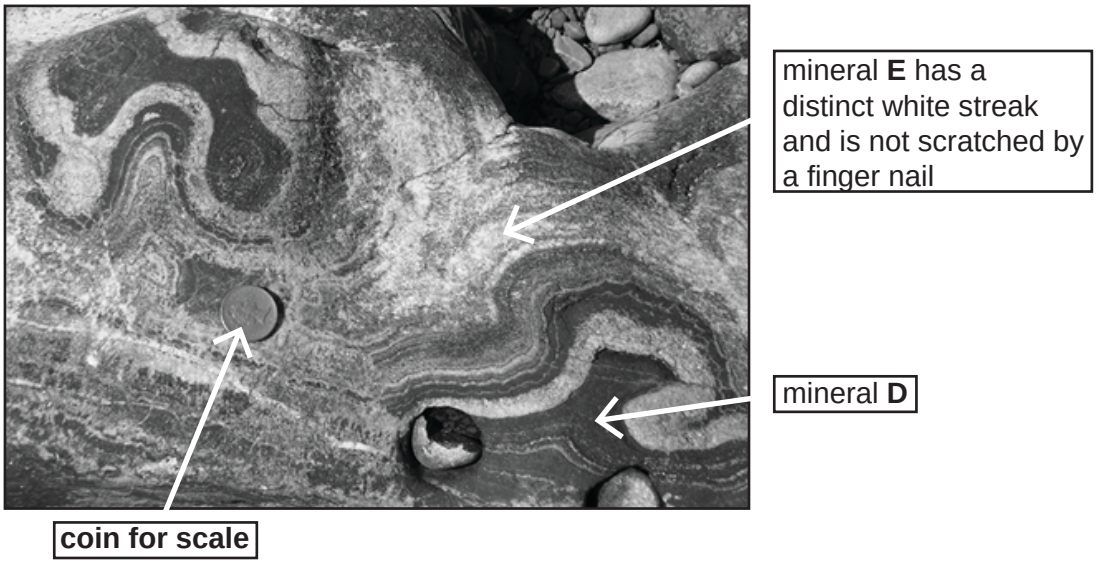

Figure 5

4. Mineral **D** has been mined for the metal iron. Which **one** of the following minerals is the ore of iron? Tick (✓) only **one** box. [1]

halite ☐

galena ☐

gold ☐

quartz (amethyst) ☐

haematite ☐

5. Using the **Data Sheet**, identify the white mineral **E** in **Figure 5**. Tick (✓) only **one** box. [1]

quartz ☐

feldspar ☐

mica ☐

calcite ☐

halite ☐

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6. Which **one** of the following techniques is **most suitable** for detecting ore minerals in the field such as mineral **D** in **Figure 5**? Tick (✓) only **one** box. [1]

geotechnical survey ☐

seismic survey ☐

geochemical analysis of river sediment ☐

changes in groundwater monitored in boreholes ☐

analysis of porosity and permeability of nearby rocks ☐

Successful carbon capture and storage depends upon suitable rock types and geological structures being available close to a coal-fired power station. **Figure 6** is a recent newspaper article and diagram of carbon capture and storage.

Carbon capture and storage

At the storage site the carbon dioxide (CO_2) is injected into the selected geological formation. After injection, the carbon dioxide moves up through the reservoir until it reaches the "cap rock". This mechanism of storage is the same one that has kept oil and natural gas under the ground for millions of years. In the UK, carbon dioxide will predominantly be stored in suitable geological structures, between 1 and 4 km below the seabed of the North Sea. Depleted oil and gas fields offer potential storage sites for carbon dioxide from power stations.

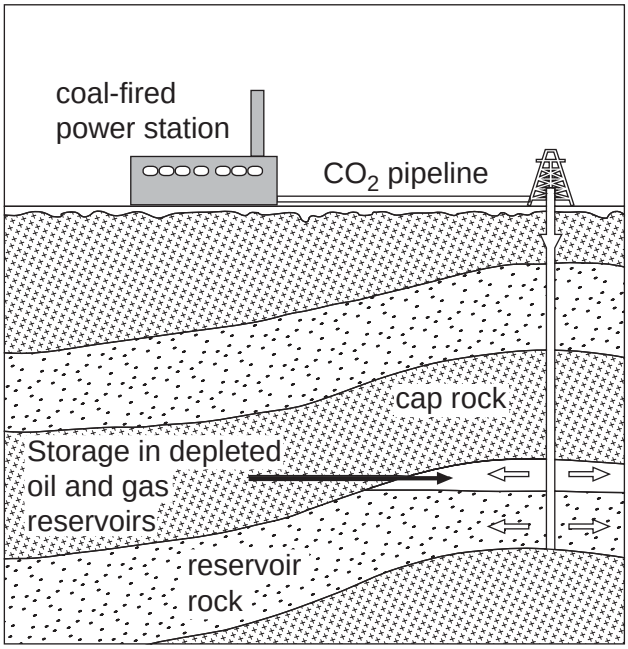

Figure 6

7. Explain why depleted oil and gas fields offer potential storage sites for carbon dioxide produced by coal-fired power stations. [4]

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Examiner only

Section 3 – answer questions 1 – 7

Figure 7 is a photograph of sedimentary rock in a quarry.

Figure 7

1. Which **one** of the following statements about the sedimentary structure in **Figure 7** is **correct**? Tick (✓) only **one** box. [1]

the structure is graded bedding ☐

the beds are upside down ☐

the structure is large-scale cross bedding ☐

the structure is desiccation cracks ☐

the structure is typically found in a river environment ☐

Examiner only

Figure 8 shows a microscope view of the grains of the sedimentary rock collected from the quarry in **Figure 7**. The graph shows the grain size distribution of the same grains from the sedimentary rock.

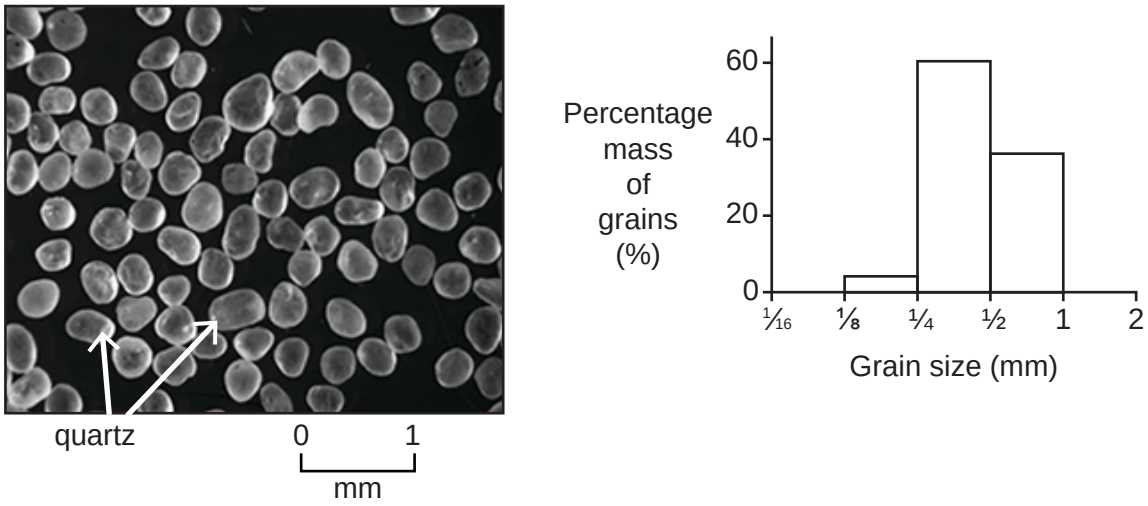

Figure 8

2. Which **two** of the following statements about the grains in **Figure 8** are **correct**? Tick (✓) only **two** boxes. [2]

well sorted	☐
poorly sorted	☐
the grain size is typical of a conglomerate	☐
fine-grained	☐
crystalline texture	☐
the grain size is typical of a sandstone	☐

3. Explain **one** erosional process which has resulted in the quartz grains becoming well rounded. [2]

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4. Explain how the evidence from **Figures 7** and **8** can be used to determine the environment of deposition, climate and latitude of Britain at the time of deposition. [3]

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5. Which **two** of the following properties are **most likely** to result in a rock being a suitable aquifer? Tick (✓) only **two** boxes. [2]

highly compacted	☐
well cemented	☐
interconnected pore spaces	☐
spherical grains	☐
a large percentage of fine grains	☐
angular grains	☐

Examiner only

Figure 9 is a geological cross-section where the rock shown in **Figure 7** forms an aquifer.

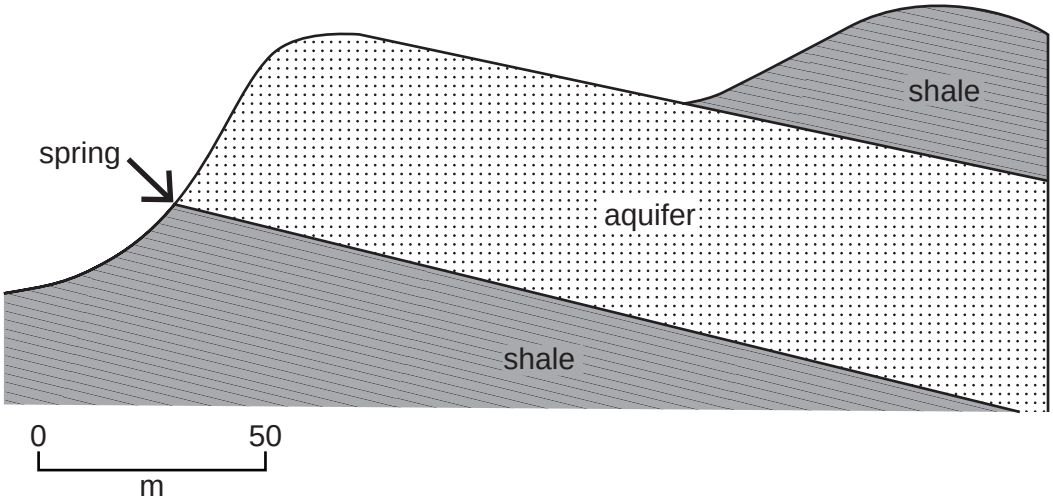

Figure 9

6. Explain why a spring occurs at the location shown on **Figure 9**.
Use information from **Figures 7** and **8**. [2]

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Figure 10 shows how **sediment** is converted into a **sedimentary rock** during the rock cycle.

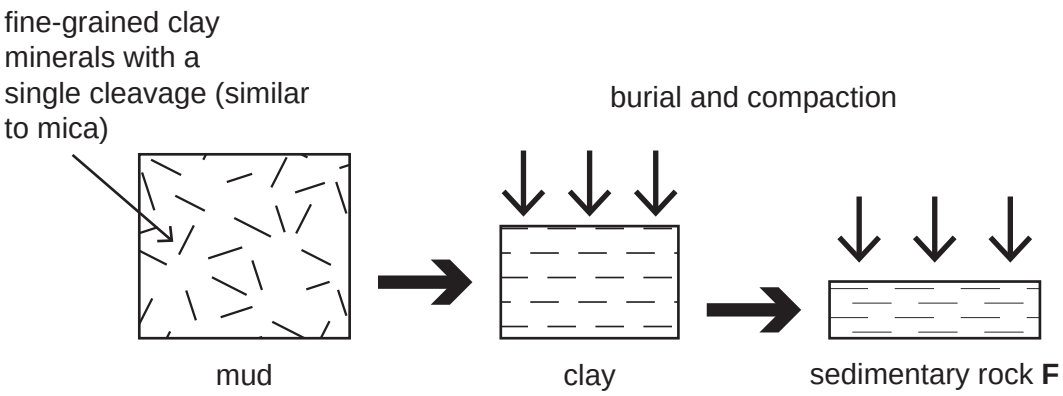

Figure 10

7. Which **three** of the following statements are **correct**? Tick (✓) only **three** boxes. [3]

physical weathering of granite produces clay ☐

water is lost from the mud and clay during compaction ☐

rock **F** is sandstone ☐

conversion of the mud to a sedimentary rock is called metamorphism ☐

the clay becomes more permeable during this process ☐

the porosity of the clay decreases during this process ☐

rock **F** is shale ☐

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Section 4 – answer questions 1 – 8

Figure 11 is a map of the Caribbean plate showing three different types of plate boundary and the location of the island of Montserrat (**M**).

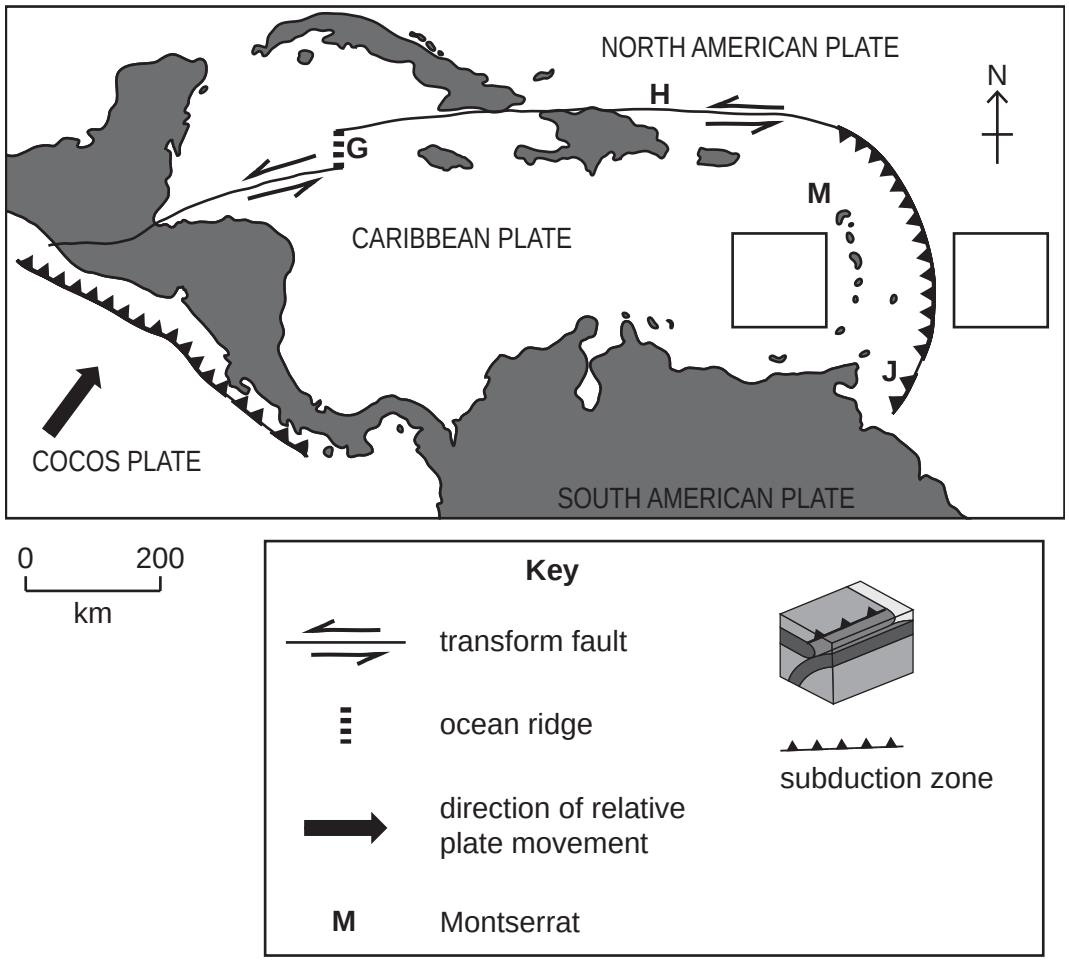

Figure 11

1. Which type of plate boundary is present at each of the locations **G**, **H** and **J** in **Figure 11**? Select your answers from the list below. [3]

conservative
convergent (destructive) oceanic-oceanic
convergent (destructive) oceanic-continental
convergent (destructive) continental-continental
divergent (constructive)

G .....

H .....

J .....

Examiner only

2. Selecting from the choices below, draw an arrow in both of the empty boxes in **Figure 11** to show the directions of relative plate movement at those locations. [1]

3. Which **one** of the following occurs at a conservative plate boundary? Tick (✓) only **one** box. [1]

shallow, medium and deep focus earthquakes ☐

volcanic activity and deep focus earthquakes ☐

volcanic activity without seismic activity ☐

shallow focus earthquakes only ☐

mountain belts and thrust faults ☐

4. Select the **most likely** rock associated with each of the following situations. Select your answers from the list below. [4]

slate marble granite basalt andesite limestone turbidite

recrystallisation of shale in the Caledonian orogenic belt ☐

island arc volcanic eruption such as Montserrat (**Figure 11**) ☐

ocean trench sediment in the Lower Palaeozoic of Britain ☐

divergent plate boundary in the Cenozoic of NW Britain ☐

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Figure 12 shows the thickness of volcanic ash around the Soufrière Hills volcano on the Caribbean island of Montserrat (**M** on **Figure 11**). The ash was produced during eruptions between 1995 and 1999.

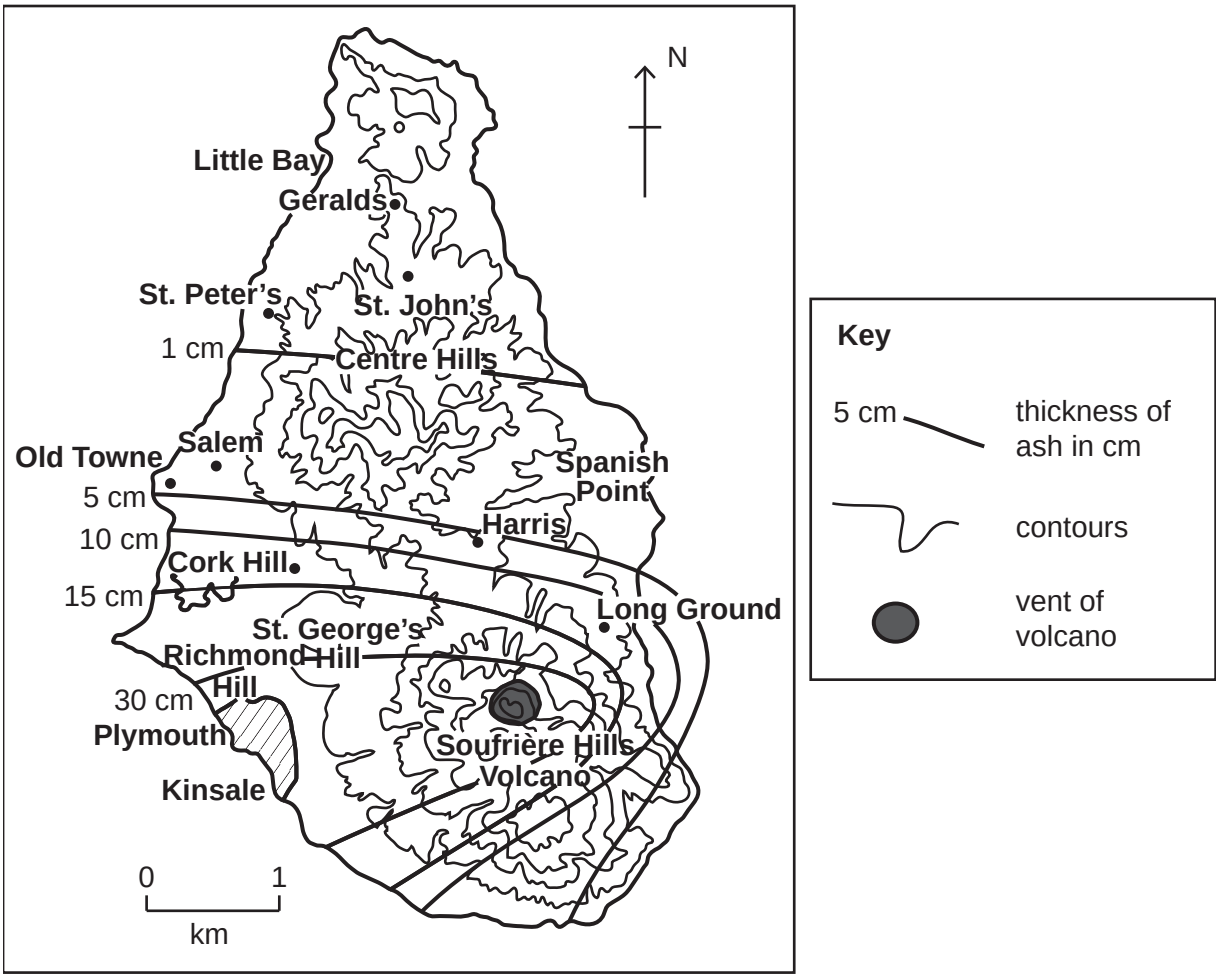

Figure 12

5. Which **two** of the following **correctly** describe or explain the pattern of volcanic ash around Soufrière Hills after the eruptions? Tick (✓) only **two** boxes. [2]

Cork Hill and Long Ground were covered by different thicknesses of ash ☐

the town of Plymouth was buried under more than 30 m of ash ☐

Little Bay suffered only a light covering of ash ☐

the wind at the time of the eruptions was blowing from an approximately easterly direction ☐

the wind at the time of the eruptions was blowing from an approximately westerly direction ☐

the ash was confined to river valleys ☐

all the ash fell on the island ☐

Examiner only

Figure 13 is a photograph taken near the abandoned town of Plymouth on Montserrat in 2010.

Figure 13

6. Identify the volcanic hazard in **Figure 13**. Tick (✓) only **one** box. [1]

lava flow ☐

pyroclastic flow ☐

mudflow ☐

ash fall ☐

landslide ☐

Examiner only

7. The Soufrière Hills volcano is being regularly monitored by the Montserrat volcano observatory. Explain how **ground deformation** and **gas emissions** are used to help predict volcanic activity. [4 QWC]

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8. Give **two** reasons why the level of risk from natural hazards is reduced in areas of higher economic development. [2]

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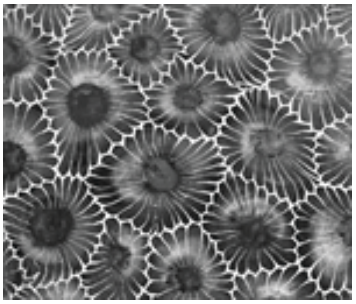
Section 5 – answer questions 1 – 6

Table 1 shows three different fossils.

Fossil			
Feature			

scale for each fossil 0 1 cm

Table 1

1. Match each of the fossils in **Table 1** to one of their features from the list below. Write your answers in the blank boxes in **Table 1**. [3]

thecae three lobes radial septa

2. Which **one** of the following statements is **correct**? Tick (✓) only **one** box. [1]

graptolites are used to date Mesozoic marine sediments ☐

trilobites are extinct so the environment in which they lived is unknown ☐

graptolites are used to date Upper Palaeozoic continental sediments ☐

trilobites are found in sedimentary rocks with other marine fossils so were marine ☐

corals indicate a reef environment in temperate latitudes ☐

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Figure 14 shows three sedimentary logs from widely separated locations and the position of fossils (**N**, **P**, **Q** and **R**) found within them.

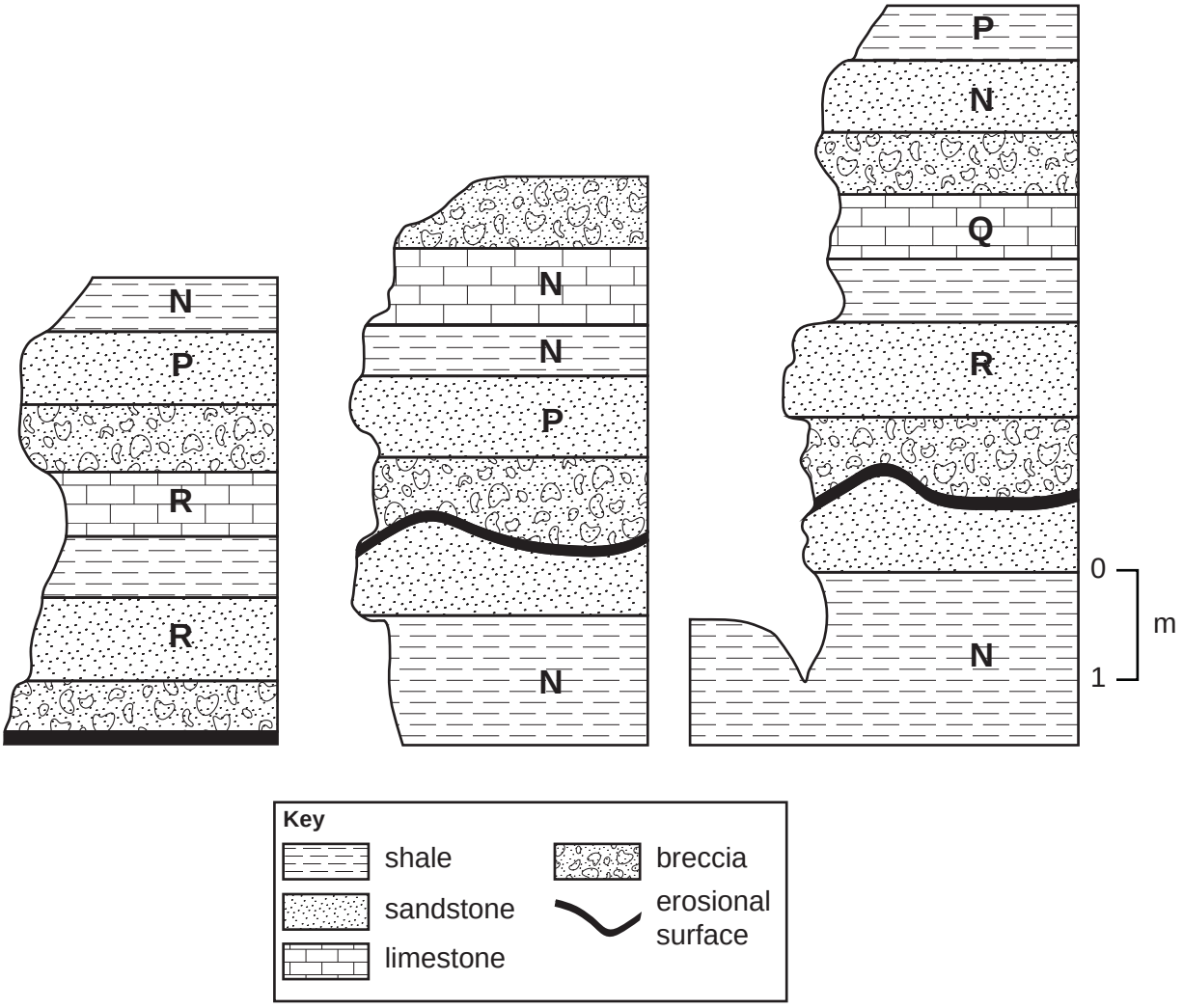

Figure 14

3. Which fossil (**N**, **P**, **Q** or **R**) in **Figure 14** is the **most suitable** for relative dating and correlation? Give **two** reasons for your answer. [3]

Fossil

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Decay of radioactive isotopes in minerals provides a method of calculating the absolute ages of rocks. **Figure 15** shows the rate of decay of a radioactive parent isotope into a daughter isotope.

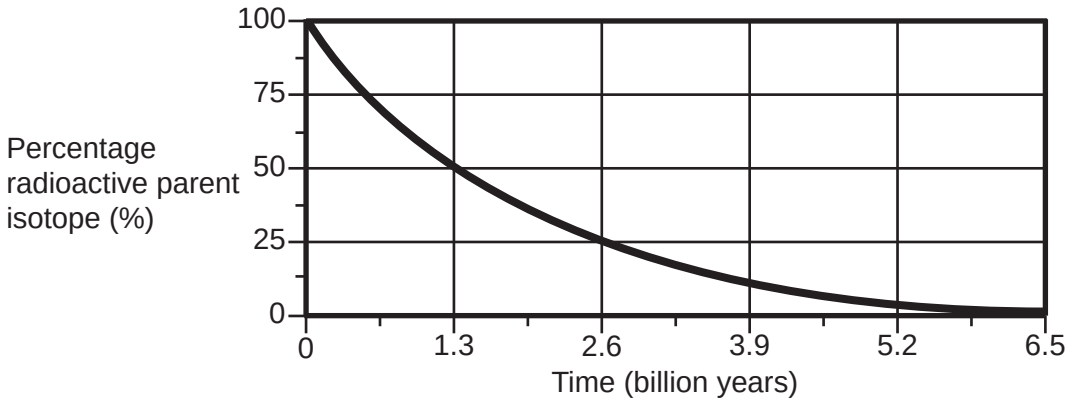

Figure 15

4. Which **two** of the following statements are **correct**? Tick (✓) only **two** boxes. [2]

a mineral in granite containing 12.5 % of the parent isotope is 3.9 billion years old ☐

the half-life of the isotope is 2,600 million years ☐

50 % of the daughter element is formed after one half-life ☐

the time taken for decay gets longer with each half-life ☐

25 % of the parent isotope is left after four half-lives ☐

a mineral in basalt with 75 % of the daughter element present is 3.9 billion years old ☐

5. Explain **two** reasons why radiometric dating is a suitable method of absolute dating for some rocks and minerals but not others. [4 QWC]

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6. Draw a line from each of the following geological events to the correct geological age. [4]

life originated in the oceans	4,600 Ma
the K/T mass extinction	3 Ma
appearance of early hominids such as Lucy	65 Ma
the Earth was formed	3,500 Ma

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Section 6 – answer questions 1 – 8

Figure 16 is a geological map showing two igneous bodies (**S** and **T**).

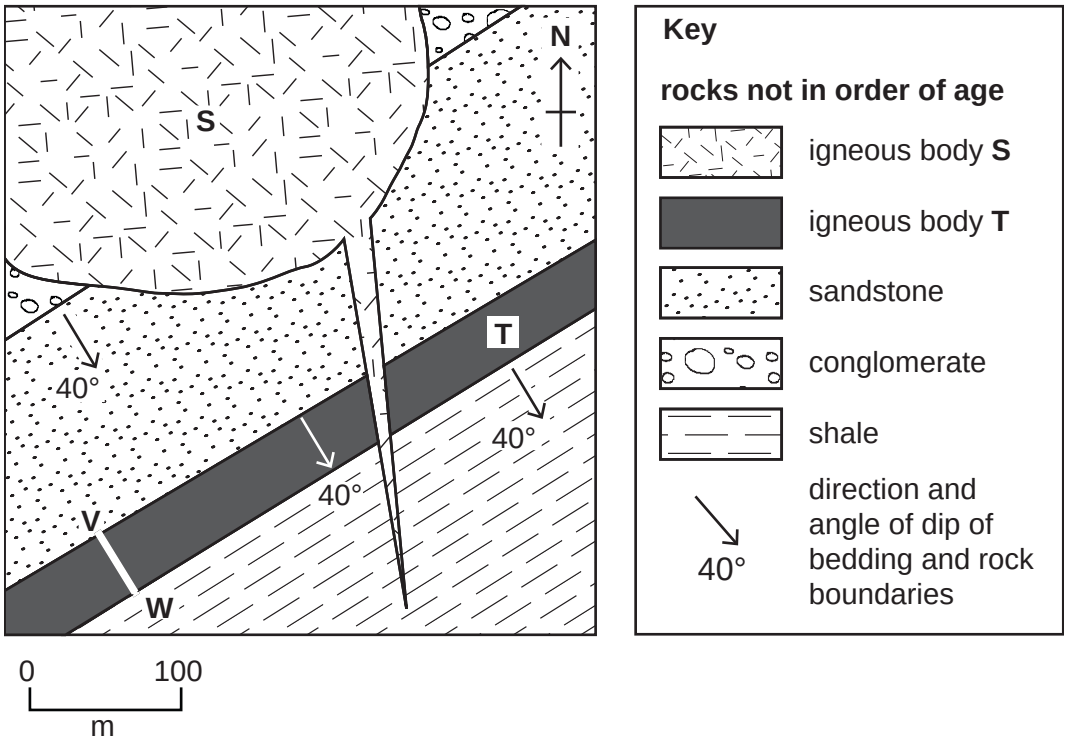

Figure 16

1. Which **two** of the following **correctly** describe the igneous body **S** and its contact with the sedimentary rocks in **Figure 16**? Tick (✓) only **two** boxes. [2]

cuts across the strike of the bedding ☐

extrusive ☐

intrusive ☐

parallel to the strike of the bedding ☐

unconformity ☐

outer edge of a metamorphic aureole ☐

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Figure 17 is a microscope view of a rock collected from the centre of igneous body **S** in **Figure 16**.

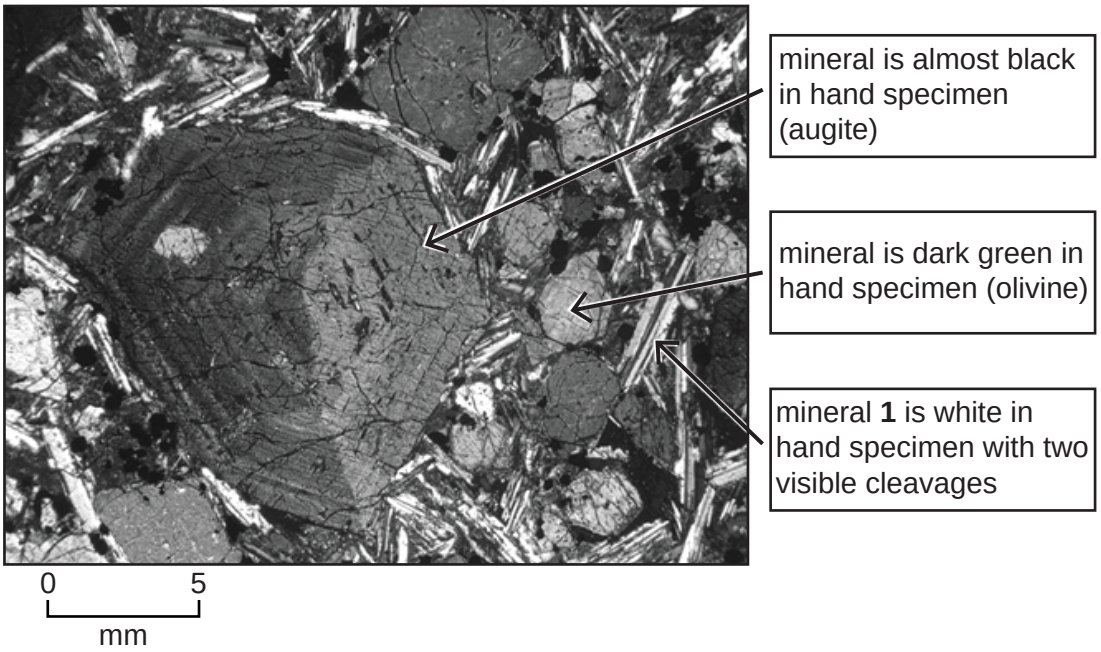

Figure 17

2. Which **two** of the following statements about the rock in **Figure 17** are **correct**?
Tick (✓) only **two** boxes. [2]

the rock is granite	☐
crystals are arranged randomly	☐
the texture is poorly sorted	☐
crystals show alignment	☐
the texture is fragmental	☐
mineral **1** is feldspar	☐

Examiner only

3. The igneous rock in **Figure 17** has both coarse and medium-sized crystals. Which **two** of the following statements **correctly** explain how this texture formed? Tick (✓) only **two** boxes. [2]

the augite was formed by recrystallisation	☐
the augite crystallised slowly at depth	☐
mineral **1** was formed as a cement from pore waters	☐
mineral **1** crystallised nearer the surface than the augite	☐
the augite was formed from hydrothermal fluids	☐
mineral **1** formed before the augite	☐

Figure 18 is a graph showing the variation in crystal size between points **V** and **W** in igneous body **T** in **Figure 16**.

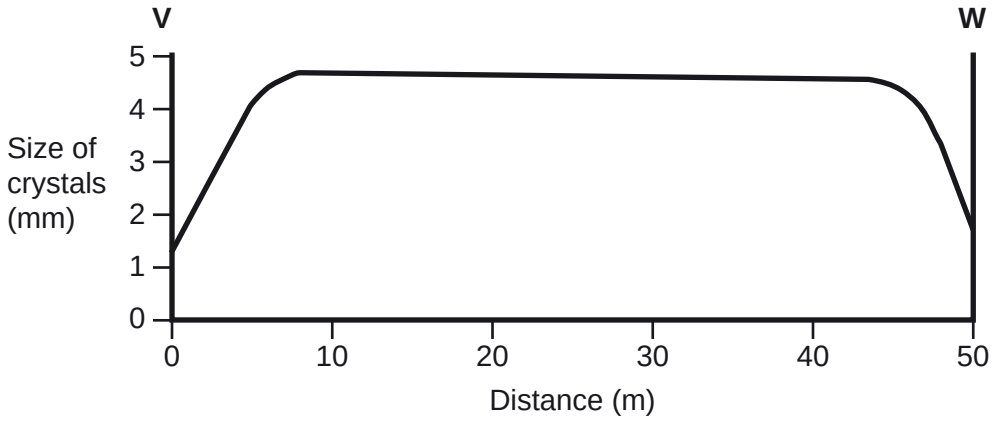

Figure 18

4. Describe and explain the variation in crystal size. [3]

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Examiner only

5. Which **two** of the following **correctly** describe igneous body **T** in **Figures 16** and **18**? Tick (✓) only **two** boxes. [2]

cuts across the strike of the bedding	☐
dyke	☐
sill	☐
parallel to the strike of the bedding	☐
lava flow	☐
pluton	☐

6. List the following geological features from **Figure 16** in order of relative age in **Table 2**.

igneous body **S**, igneous body **T**, sandstone, shale, conglomerate [3]

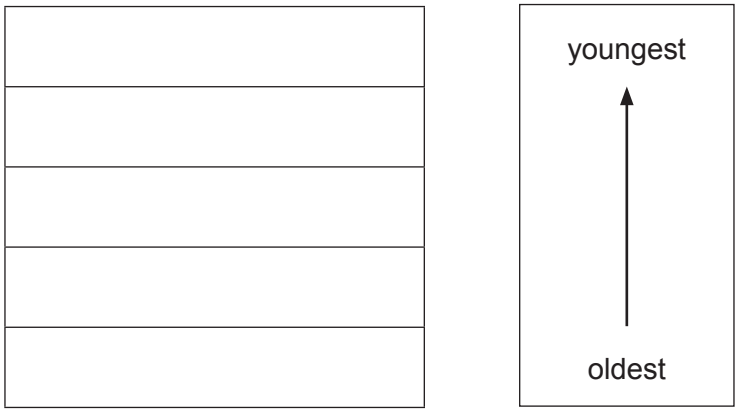

Table 2

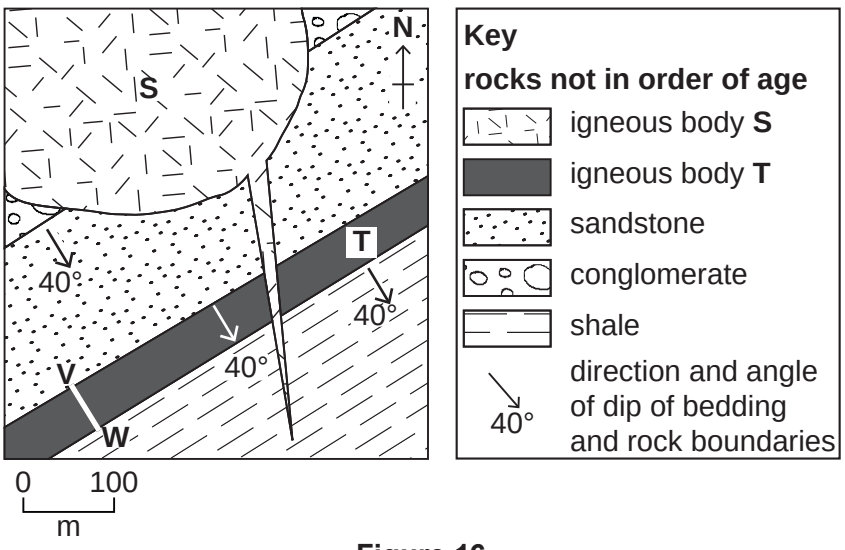

Figure 16

Examiner only

Some of the rock fragments in the conglomerate in **Figure 16** are of metamorphic rocks. **Figure 19** is a microscope view of one of the metamorphic rocks.

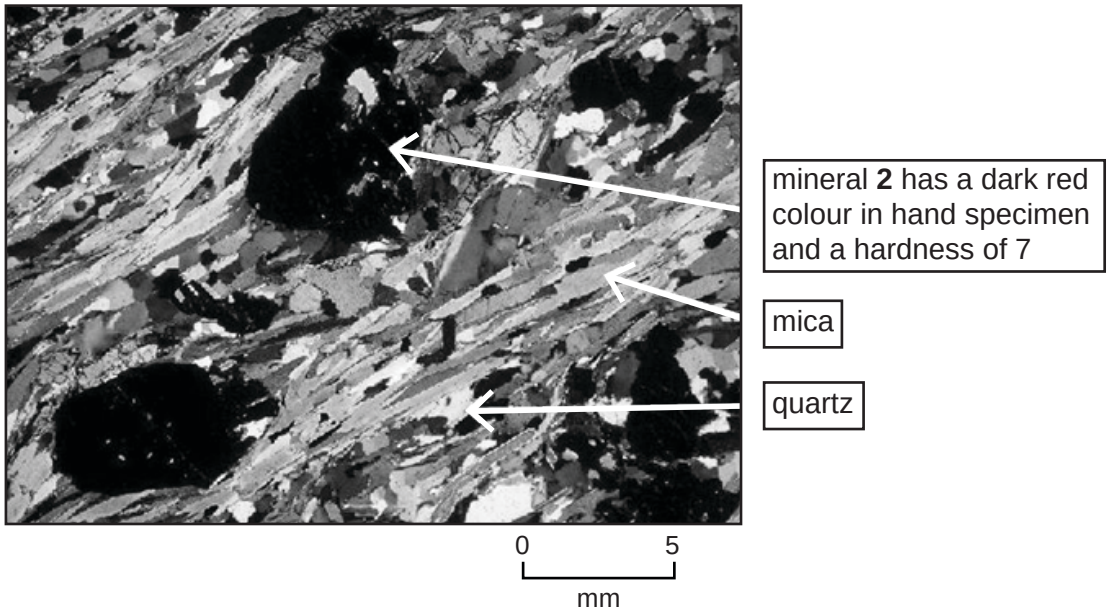

Figure 19

7. Which **one** of the following statements about the rock in **Figure 19** is **correct**?
Tick (✓) only **one** box. [1]

the rock has a schistosity	☐
the rock has a slaty cleavage	☐
mineral **2** is haematite	☐
the rock is non-foliated	☐
the rock is marble	☐

8. Explain how the alignment of the micas can develop in a metamorphic rock such as the rock in **Figure 19**. [3]

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Section 7 – answer questions 1 – 5

Figure 20 shows the main sources for electricity generation in the UK between 1950 and 2014.

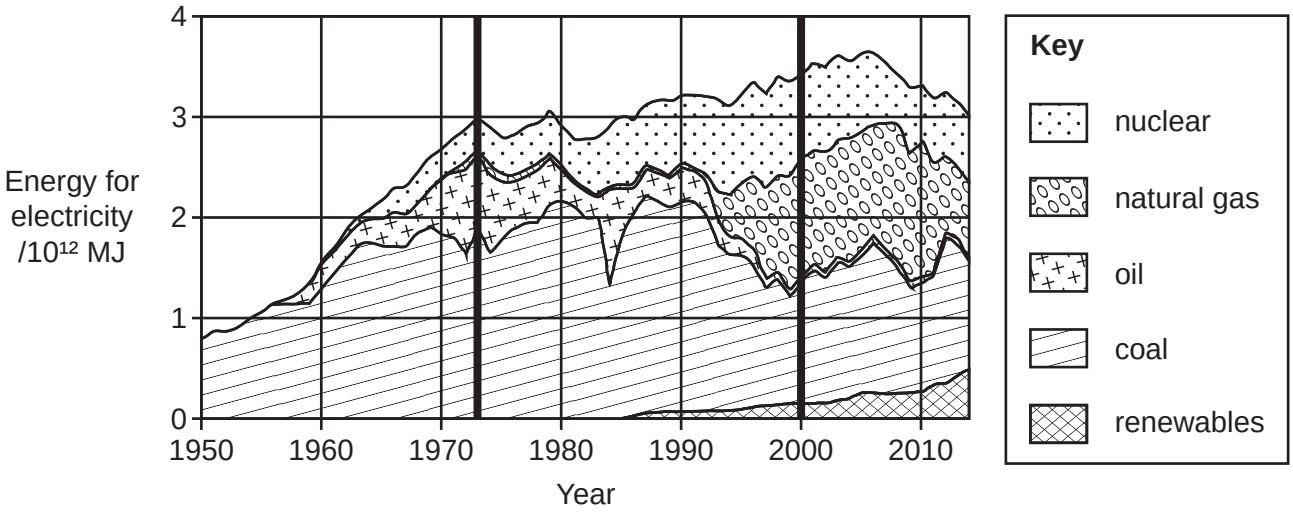

Figure 20

1. Which **two** of the following statements are **incorrect**? Tick (✓) only **two** boxes. [2]

electricity generation in the UK has increased between 2010 and 2014 ☐

between 1950 and 1973 coal was the main source ☐

between 1973 and 2000 oil reached its maximum contribution and then declined ☐

the contribution from nuclear energy was broadly the same between 2000 and 2014 ☐

between 1973 and 2000 natural gas made an increasing contribution ☐

renewables made their first significant contribution before 1973 ☐

since its maximum contribution between 1973 and 2000 coal as a source is in decline ☐

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Figure 21 shows the average annual wind speeds in and around the UK and the location of offshore wind farms in 2011.

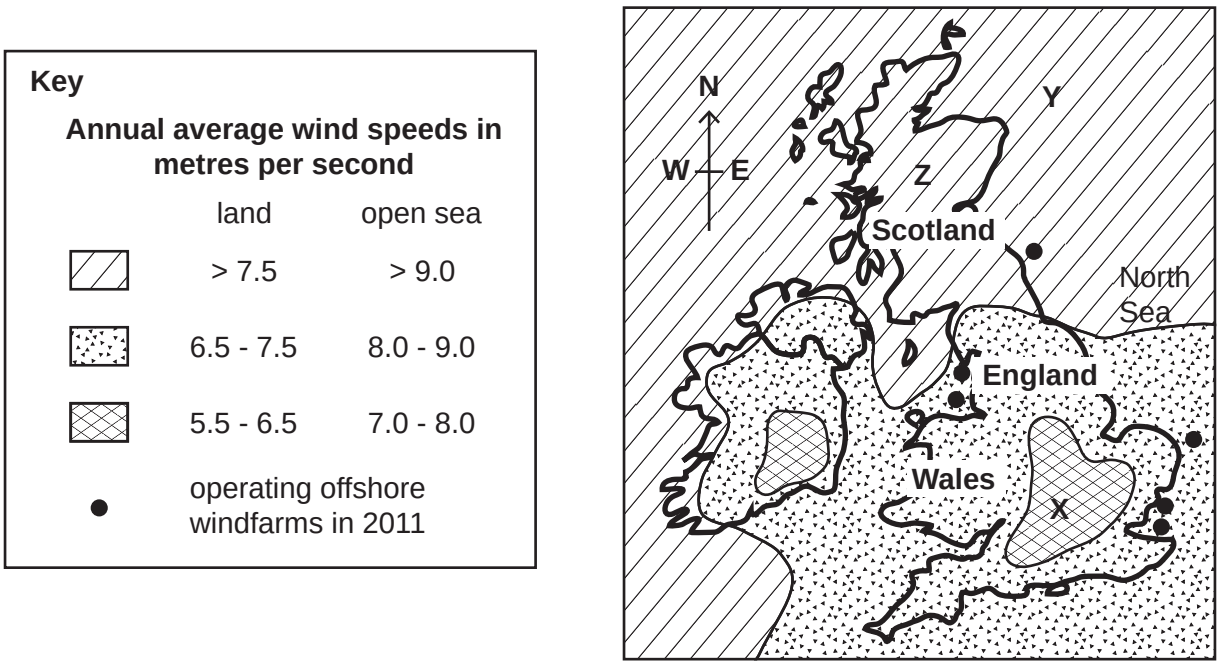

Figure 21

2. Write the **correct** average wind speed at each of the locations (**X**, **Y** and **Z**) in **Figure 21** in the correct empty boxes in **Table 3**. Select your answers from the list below. [2]

5.5-6.5 8.0-9.0 >7.5 >9.0 6.5-7.5 7.0-8.0

X	Y	Z

Table 3

3. Which **one** of the following statements is **incorrect**? [1]

winds are equally as strong off the west coast of Scotland as the northern North Sea ☐

winds are less strong in location **X** than in the southern North Sea ☐

the southern North Sea is a suitable area for wind farms ☐

offshore windfarms in the UK are all located in the areas with the strongest winds ☐

Examiner only

4. Explain **two** reasons why renewable energy resources are becoming more important. [2]

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5. Nuclear waste is one environmental problem caused by the generation of electricity from nuclear power.
Describe the environmental problem associated with nuclear waste. Explain a geological solution to this problem. [3]

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END OF PAPER