Surname	Centre Number	Candidate Number
Other Names		2

GCE A LEVEL – NEW

A480U10-1

S19-A480U10-1

TUESDAY, 4 JUNE 2019 – AFTERNOON

GEOLOGY – A level component 1
Geological Investigations

2 hours 15 minutes

ADDITIONAL MATERIALS

In addition to this examination paper, you will need:

- the Resource Sheet
- **Specimens A, E** and **F**
- geological equipment for testing specimens
- the Mineral Data Sheet
- a calculator
- a protractor
- 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.

	For Examiner's use only		
	Question	**Maximum Mark**	**Mark Awarded**
Section A	**1.**	**16**	
	2.	**14**	
Section B	**3.**	**12**	
	4.	**9**	
	5.	**9**	
	6.	**9**	
	7.	**6**	
	8.	**9**	
	9.	**21**	
	Total	**105**	

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INFORMATION FOR CANDIDATES

This paper is in 2 sections, **A** and **B**.

Section **A**: 30 marks. Answer **both** questions. You are advised to spend about 35 minutes on this section.

Section **B**: 75 marks. Answer **all** questions. You are advised to spend about 1 hour 40 minutes on this section.

The geology is **not** designed to represent any particular area.

The Mineral Data Sheet and **Map 1** and **Photographs 1, 2, 3** and **4** are provided on separate resource sheets.

Strips of plain paper may be obtained from the supervisor on request.

Three specimens, **A, E** and **F,** are provided for use.

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 **5** and **7**.

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SECTION A

Answer **all** *questions.*

1. **Figure 1a** shows an example of the trilobite *Nobiliasaphus*.

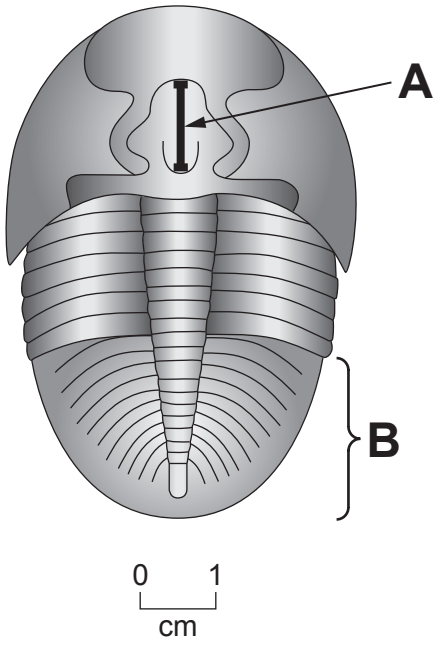

Figure 1a

Refer to **Figure 1a**.

(a) State the name of the features represented by **A** and **B**. [2]

A .....

B .....

(b) **Figure 1b** shows how the number of thoracic segments of two groups of trilobites have changed during geological time.

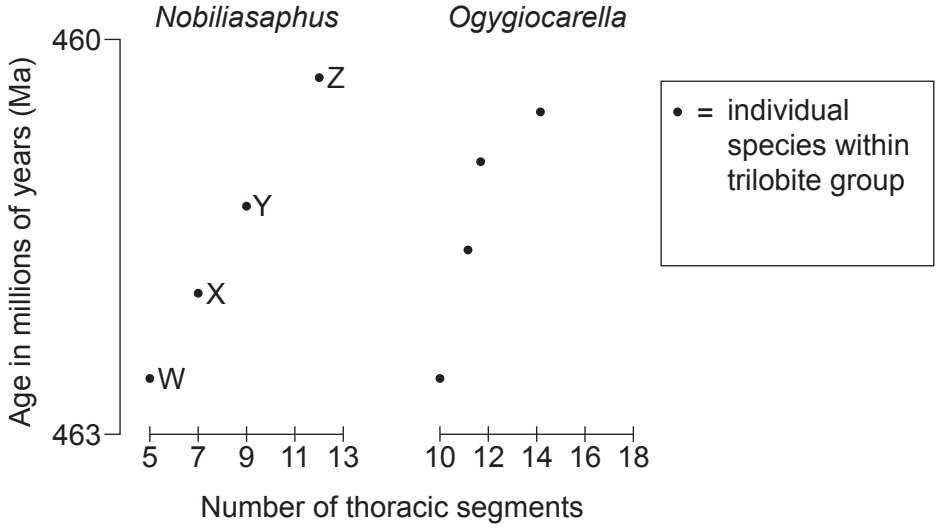

Figure 1b

Refer to **Figure 1b**.

(i) State the geological **period** shown in **Figure 1b**. **Tick (✓)** only **one** box. [1]

Precambrian	Jurassic	Quaternary	Ordovician
☐	☐	☐	☐

(ii) State the geological **era** in which the trilobites lived. [1]

Era .....

(c) Refer to **Figures 1a** and **1b**.

(i) Identify the letter on **Figure 1b (W, X, Y** or **Z)** which represents the trilobite species shown in **Figure 1a**. **Tick (✓)** only **one** box. [1]

W	X	Y	Z
☐	☐	☐	☐

(ii) The number of thoracic segments in the species within the trilobite groups *Nobiliasaphus* and *Ogygiocarella* changed over time. State **one** similarity and **one** difference in these changes for the two groups. [2]

Similarity .....

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Difference .....

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(iii) A student concluded that the trilobites shown in **Figure 1b** show gradual rather than punctuated evolution. Evaluate this conclusion with reference to the evidence shown in **Figure 1b**. [3]

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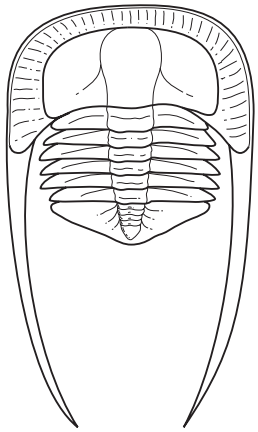
(d) **Figure 1c** shows an example of the trilobite *Trinucleus*.



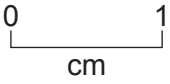


Figure 1c

(i) Suggest, with reference to its morphology, the likely mode of life of *Trinucleus*. [3]

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(ii) Explain why it is difficult to determine the modes of life of the fossils in **Figures 1a**, **1b** and **1c**. [3]

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2. **Figure 2a** shows a graphic log recorded from a coal-bearing sequence in Northern England.

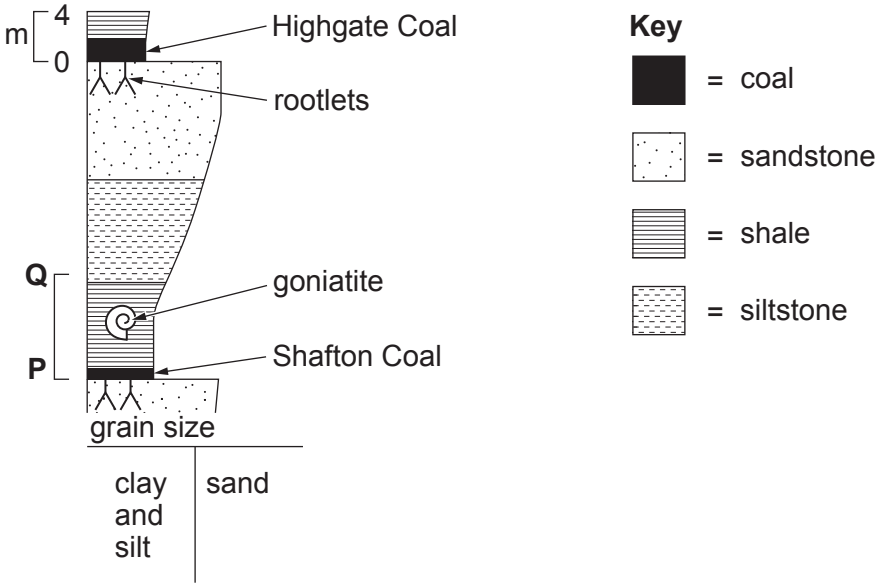

Figure 2a

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(a) Describe the changes in palaeoenvironment during deposition between **P** and **Q** on **Figure 2a**. [3]

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(b) **Figure 2b** contains information about the ranks of coal and their composition.

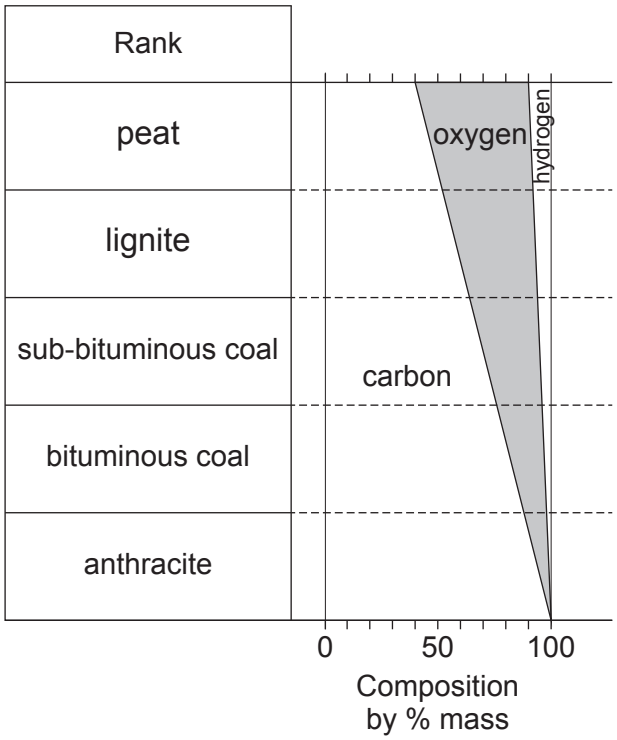

Figure 2b

(i) Describe the appearance of **anthracite** in hand specimen. [2]

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(ii) Analysis of the Highgate Coal revealed that it has 4% hydrogen and 13% oxygen by mass:

- calculate the % carbon by mass in the Highgate Coal.
- determine the rank of the Highgate Coal using **Figure 2b**. [2]

% Carbon .....

Rank .....

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(c) **Figure 2c** shows some 19th century workings that have been discovered in the Highgate Coal during modern extraction of the area by opencast mining. The 19th century mining used the pillar and stall method. **Figure 2d** is a plan of an area within these workings.

Figure 2c

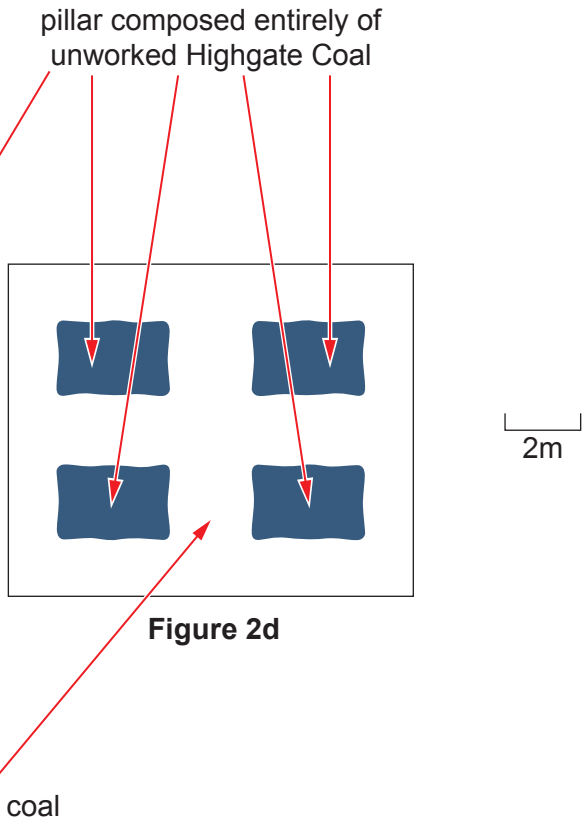

Figure 2d

Using the information shown in **Figures 2a** and **2d** calculate the volume of coal left in the pillars within the area of **Figure 2d**. Show your working. [3]

Volume of coal .....

(d) A mining company is planning to investigate whether to extract coal from the surrounding area in the future by conducting a systematic borehole survey. Evaluate the suitability of this technique. [4]

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SECTION B

Answer **all** *questions.*

3. Study **Map 1** on the resource sheet.

(a) **Rock Unit J** is a granite containing:

- randomly orientated euhedral feldspar phenocrysts with a modal length of 2 cm
- a subhedral groundmass with a modal crystal size of 5 mm.

Complete **Figure 3** to show this texture. [4]

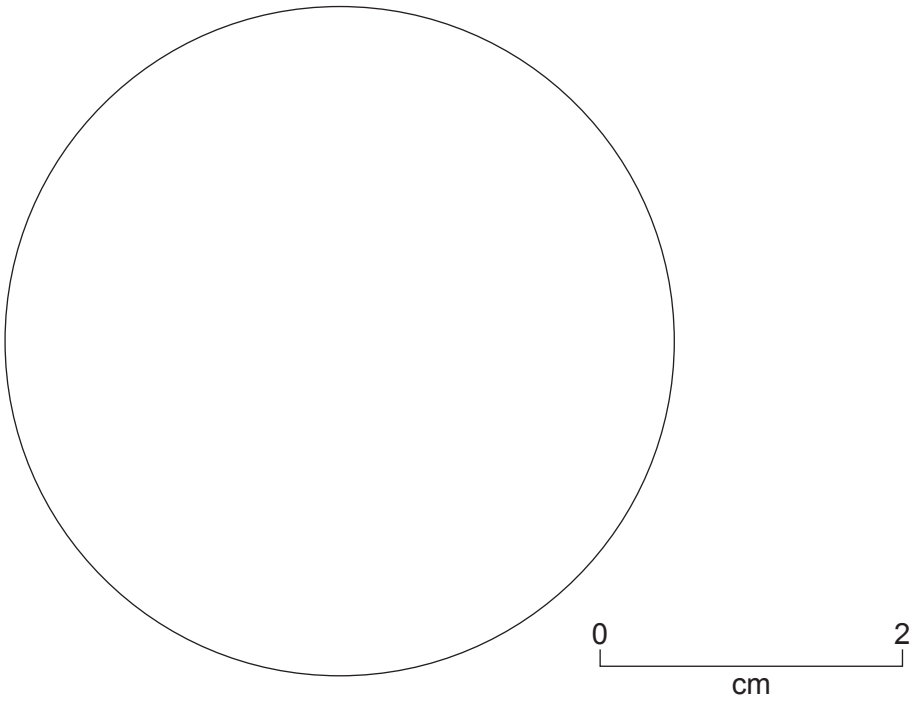

Figure 3

(b) Describe **one** diagnostic test or observation that could be carried out to confirm that the phenocrysts are feldspar crystals.
State the result of the test/observation. You may wish to refer to the Mineral Data Sheet. [2]

Description

.....

.....

Result

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.....

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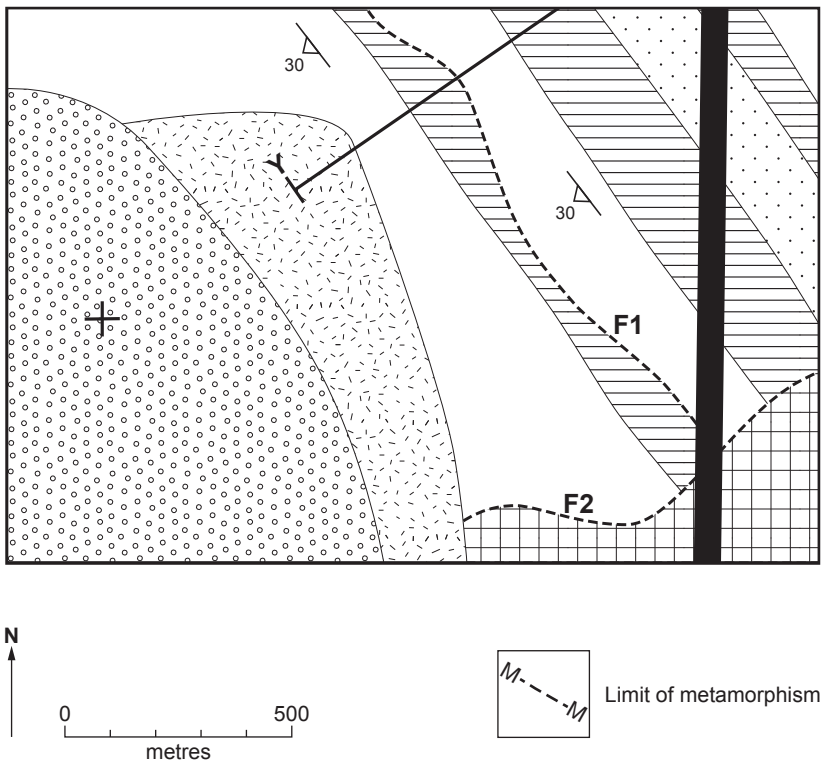
(c) **Map 2** shows the south-western corner of **Map 1**. The key for the rock units is the same as for **Map 1**.
Rock Unit J has been correctly interpreted as a pluton and has produced a metamorphic aureole which is 50 m in width. Draw the outer edge of this metamorphic aureole on to **Map 2** below. [2]



Map 2

(d) State and explain **two** factors that determine the width of a metamorphic aureole. [4]

1 .....

.....

.....

2 .....

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4. **Specimen F** was collected from **Rock Unit F** on **Map 1**.

(a) (i) Describe the outcrop pattern of **Rock Unit F** on **Map 1**. [2]

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(ii) Describe the texture and composition of **Specimen F**. [3]

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(iii) State the name of **Specimen F**. [1]

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(b) With reference to **Specimen F** and the outcrop pattern of **Rock Unit F** on **Map 1**, state the type of igneous body formed by **Rock Unit F**.

Give **one** piece of supporting evidence from each of:

- **Map 1**
- **Specimen F** [3]

Type of igneous body .....

Evidence from **Map 1**

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.....

Evidence from **Specimen F**

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9

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5. **Photograph 1** on the resource sheet is a photograph showing **Rock Units C**, **G** and **K** around **Locality I** on **Map 1** with the camera facing towards the north.

State and give reasons for the observations you would make in a field investigation to determine the past geological processes that have happened in the area shown in **Photograph 1**, and the order in which they occurred.

You may wish to use an annotated diagram(s) in your answer. [9 QER]

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6. **Specimen E** is a plaster cast of a fossil found in **Rock Unit E** on **Map 1**.

(a) (i) Draw a diagram of **Specimen E** in **Figure 6a** using the scale provided. [3]

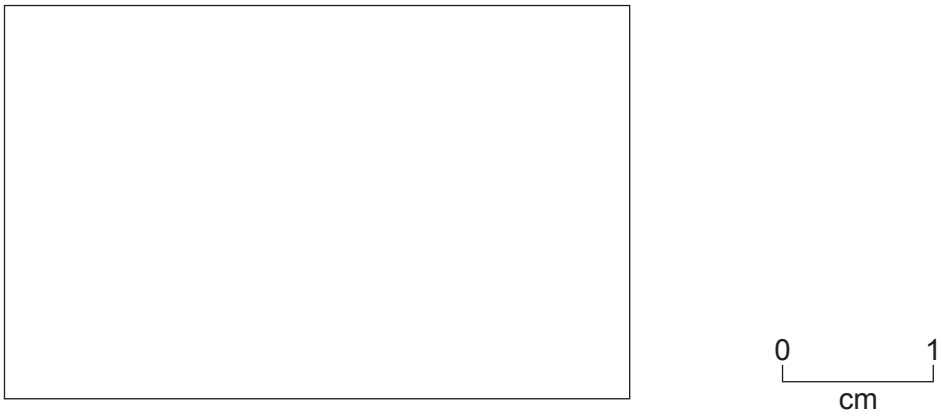

Figure 6a

(ii) State the name of the fossil group represented by **Specimen E**. [1]

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(b) **Figure 6b** shows fossil **X**. The figure shows a vertical section in a cliff face within **Rock Unit E** at **Locality II** on **Map 1**.

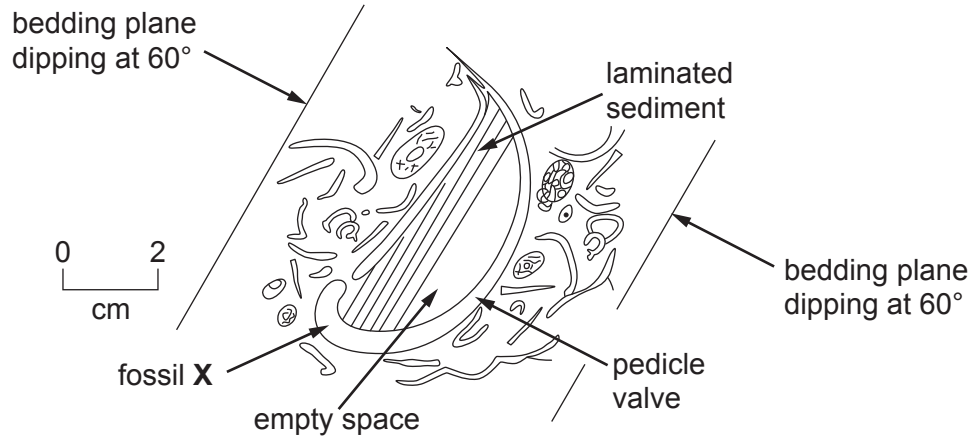

Figure 6b

State the name of the fossil group represented by fossil **X**. [1]

.....

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(c) **Photograph 2** shows a sedimentary structure found in **Rock Unit B** at **Locality III** on **Map 1**.
Rock Units B and **E** have been overturned at **Localities II** and **III**. Describe the evidence to support this statement from: [4]

- **Photograph 2 (Locality III)**
- **Figure 6b (Locality II)**

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7. **Photograph 3** shows the parent rock of **Rock Units A** and **H**.
Specimen A is representative of **Rock Unit A**.
Photograph 4 shows **Rock Unit H**.

With reference to **Specimen A** and **Photographs 3** and **4**:

- describe the processes which have resulted in the formation of **Rock Units A** and **H**.
- explain how these processes have produced the textures and mineralogies observed in **Specimen A** and **Photograph 4**. [6 QER]

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8. *(a)* **Map 1** shows two faults, **F1** and **F2**.

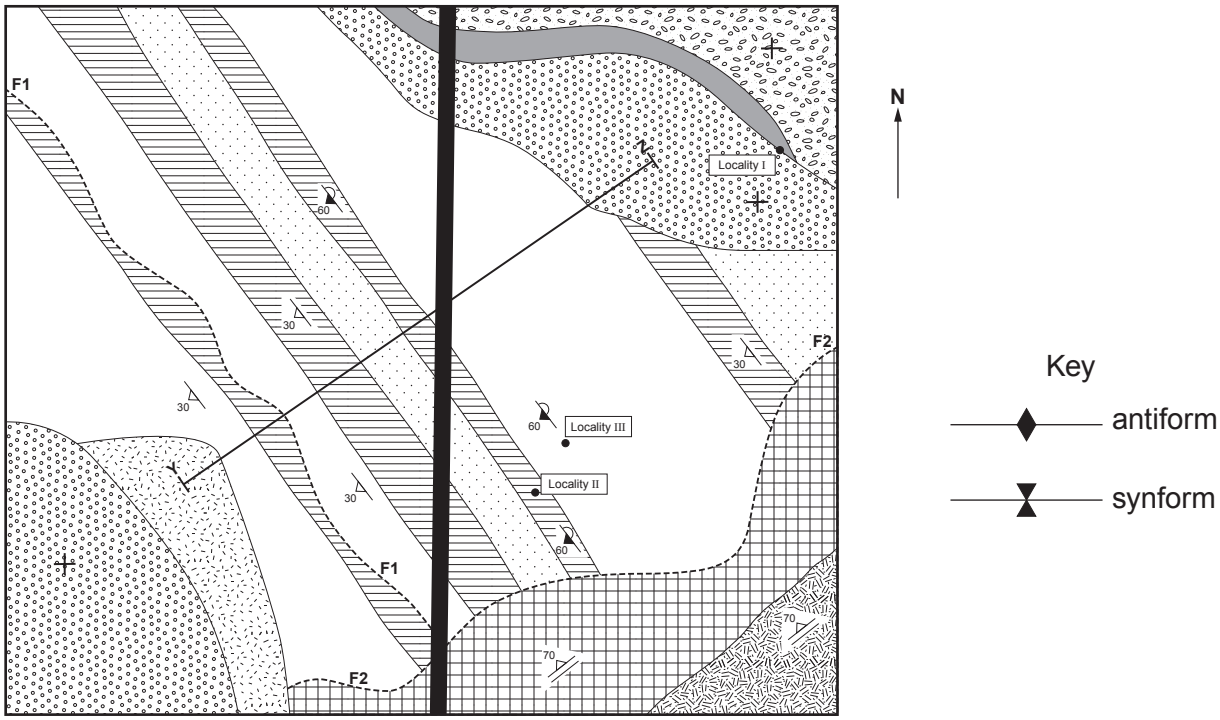
Complete **Table 1** to describe the features of faults **F1** and **F2** on **Map 1**. [6]

Feature of the fault	**Fault F1**	**Fault F2**
Angle of dip of the fault plane	80°	25°
Direction of dip of the fault plane	north-east	•
Hanging wall found on	•	south-east
Younger rock found on	•	•
Type of fault (Normal, Reverse, Thrust or Strike-Slip)	•	•

Table 1

(b) **Map 3** is a reduction of **Map 1**. The key for the rock units is the same as for **Map 1**. On **Map 3** clearly mark and label the position of:

- an unconformity in the **south-west** of the map
- **two** fold axial plane traces (using symbols in the key). [3]

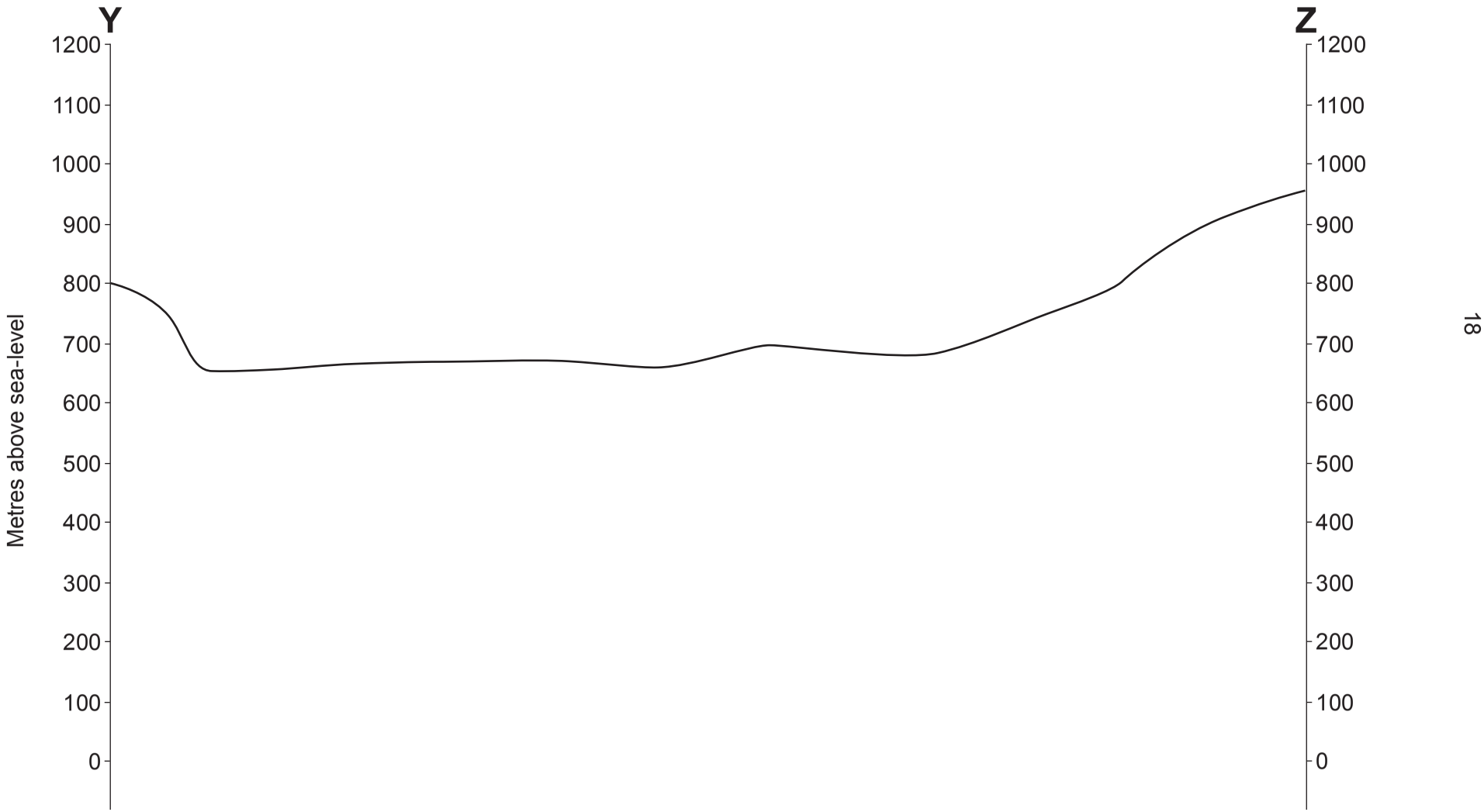


Map 3

9. *(a)* The topographic profile below was taken along the line **Y-Z** on **Map 1**.

Complete the geological cross-section along this line using **Map 1**.

- Draw the rock units. Use similar ornament or letters for those as used on **Map 1**
- Draw and label any **fold axes**
- Draw arrows alongside any **faults** to show movement
- Project the rock units and structures above the ground surface to illustrate any cross-cutting relationships. [13]



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(b) In the spaces below complete the sequence of geological events represented on **Map 1**, in order of age, *oldest at the base*. **Do not** include **Rock Units A**, **C** and **H**.

Your sequence should list, in the boxes provided, all the rock units except for;

- **Rock Units A**, **C** and **H**

Identify each Rock Unit by their letter given in the key to **Map 1**.

Clearly mark and label the position of:

- **Fault F1**
- **Fault F2**
- an episode of **folding** [8]

Youngest

Oldest

21

END OF PAPER

Acknowledgement:

Figure 2c https://www.aditnow.co.uk/Photo/28Th-March-2007_84806/