Surname	Centre Number	Candidate Number
Other Names		2

GCE A Level – LEGACY

1214/01

S19-1214-01

GEOLOGY – GL4
Interpreting the Geological Record

TUESDAY, 4 JUNE 2019 – AFTERNOON

2 hours

	For Examiner's use only		
	Question	**Maximum Mark**	**Mark Awarded**
Section A	**1.**	**15**	
	2.	**15**	
	3.	**14**	
	4.	**16**	
Section B	**5.**	**12**	
	6.	**17**	
	7.	**11**	
	Total	**100**	

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ADDITIONAL MATERIALS

- the Geological Map Extract (Bristol);
- a hand-lens or magnifier to study the map (optional);
- a calculator;
- a protractor.

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. If you run out of space, use the additional page 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.

Candidates are reminded that marking will take into account the quality of communication used in their answers.

Examiner only

SECTION A

Answer all questions in the spaces provided.
This section should take approximately 1 hour to complete.

1. **Figure 1a** shows data collected from a sill and adjacent rock exposed in a cliff. **Figure 1b** shows structures within the sill.

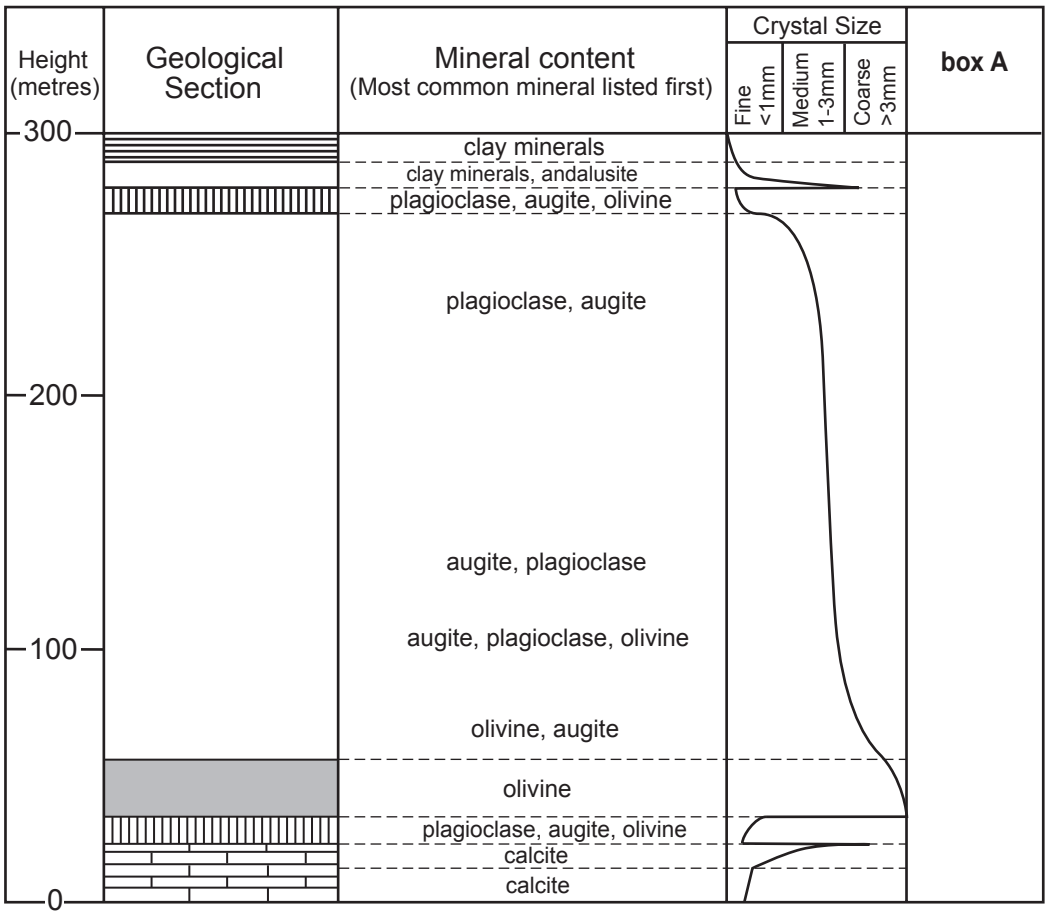

Figure 1a

Figure 1b

Examiner only

Refer to **Figure 1a**.

(a) In **box A** on **Figure 1a**, mark and label:

(i) the top and bottom margins of the sill; [2]

(ii) a possible location for the rock type hornfels.
Use a labelled arrow (◄— **H**). [1]

(b) (i) Describe and explain the variation in crystal size within the sill. [3]

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(ii) Explain the variation in mineral content within the sill. [4]

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(c) Refer to **Figure 1b**.

(i) Identify the structures within the sill and explain their origin. [3]

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(ii) Evaluate the use of these structures in confirming that the igneous body is a sill rather than a lava flow. [2]

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Turn over.

Examiner only

2. **Figure 2a** shows two fossil trilobites (**A** and **B**) interpreted as having different modes of life based on their morphology.

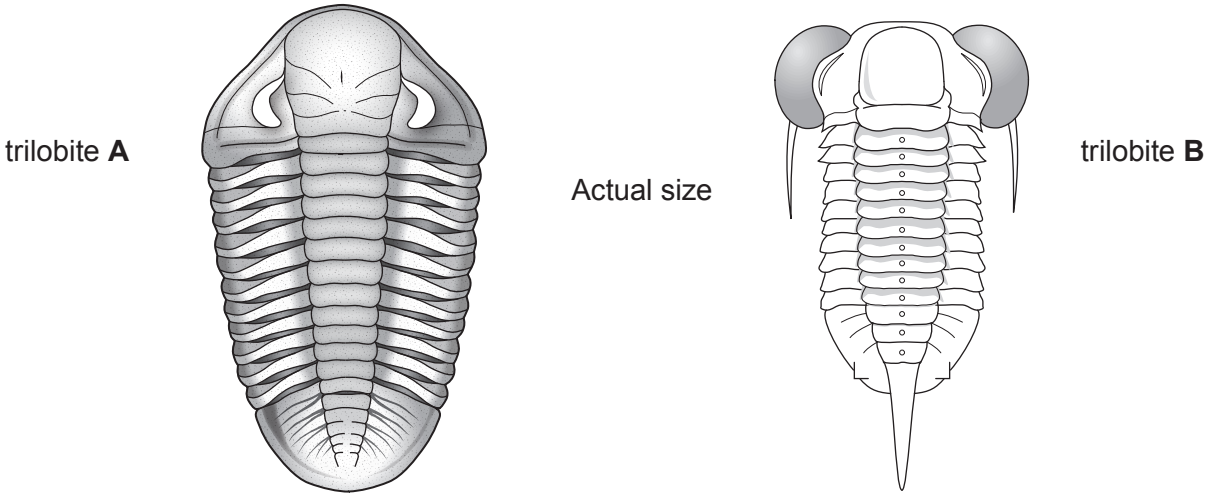

Figure 2a

Refer to **Figure 2a**.

(a) (i) Evaluate the following student's description of trilobite **A**.

*"Trilobite **A** has a semi-circular cephalon, kidney-shaped eyes and rounded genal spines. The thorax contains 11 segments and the pygidium is larger than the cephalon."* [2]

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(ii) State **two** differences between the segments of the thorax and the pygidium of trilobite **A**. [2]

1. .....

2. .....

(b) Suggest a possible former mode of life for trilobite **B** using **two** pieces of evidence from the morphology of the fossil. [3]

Mode of life .....

Evidence 1 .....

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Evidence 2 .....

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(c) **Figure 2b** is a scattergraph showing the variation in size of the pygidium for an assemblage of trilobite **A** obtained from the same bedding surface.

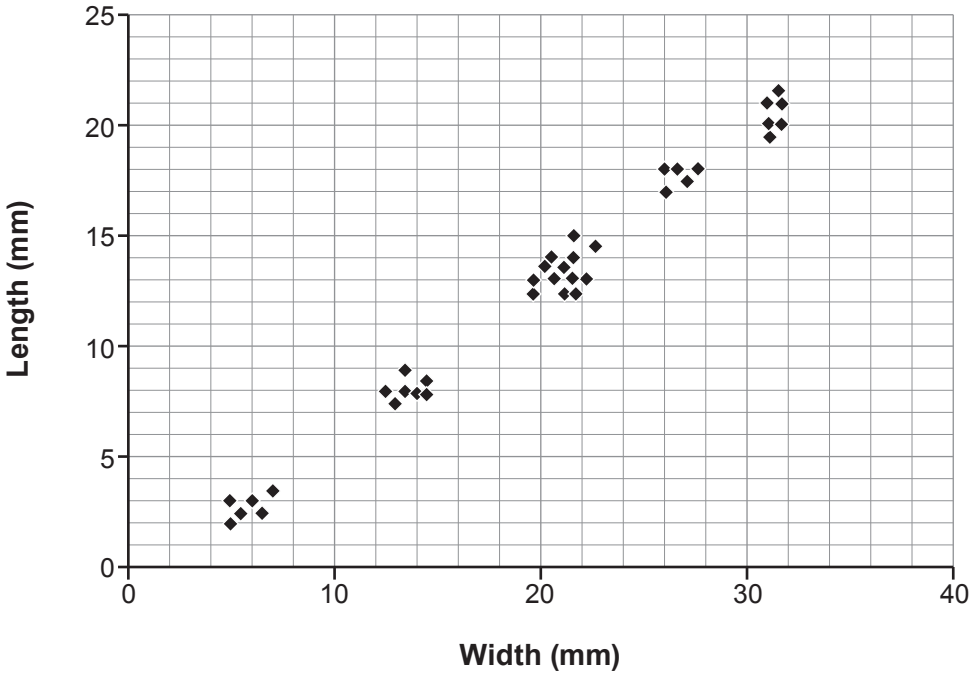

Figure 2b

Refer to **Figure 2b**.

(i) Measure the dimensions (maximum width and length) of the pygidium of trilobite **A** in **Figure 2a** and plot them on the **Figure 2b**. [1]

(ii) Describe the distribution of data on **Figure 2b**. [2]

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(iii) Suggest, giving reasons, which **one** of the conclusions in **Table 2** (**X, Y** or **Z**) is the **most likely** explanation for the distribution of data on **Figure 2b**. [3]

	Conclusion
X	Death assemblage formed by the transport and deposition of broken fragments of trilobite shell.
Y	Life assemblage with trilobites moulting between stages of growth.
Z	Gradual evolution of the trilobite genus from small to larger forms.

Table 2

Conclusion letter (**X, Y** or **Z**) .....

Reasons .....

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(d) Explain why there are fewer problems in accurately relating morphology to mode of life in fossil bivalves and brachiopods than in trilobites. [2]

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3. **Figure 3** is a partly completed block diagram of a plunging fold cut by a dip-slip fault and a dyke.

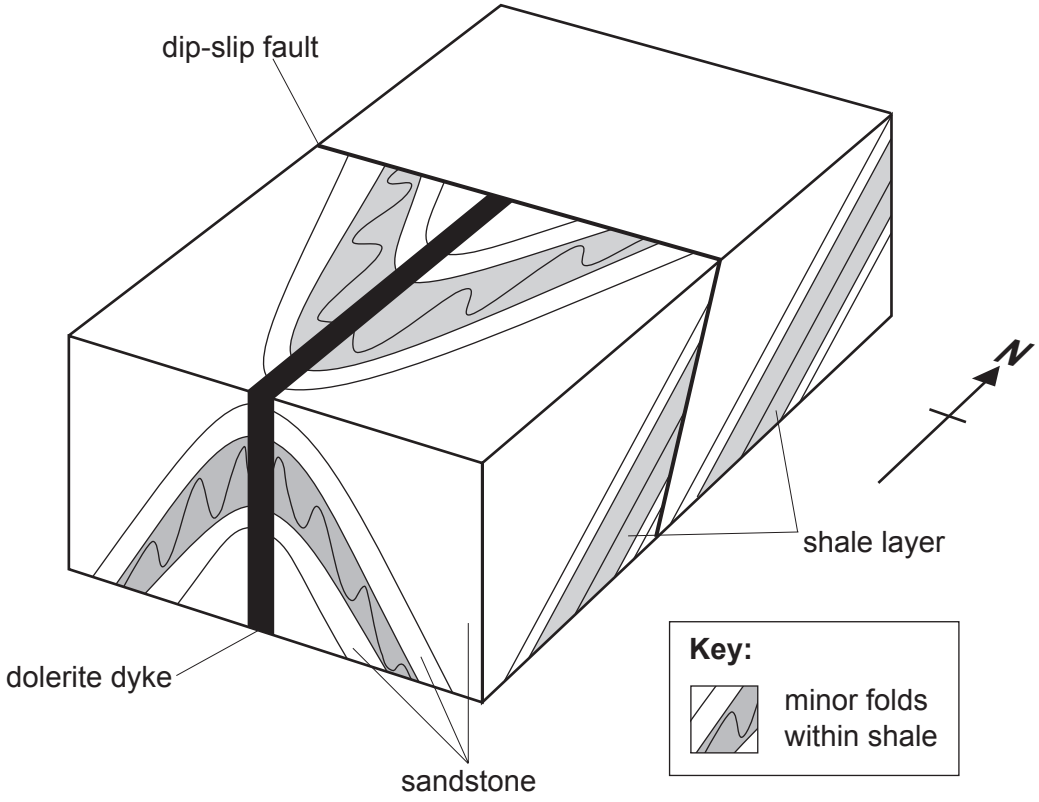

Figure 3a

Refer to **Figure 3a**.

(a) (i) Complete **Table 3** to describe the fold elements of the major fold. [2]

Fold element	Description
Fold type	•
Symmetry	Symmetrical – limbs of same length
Orientation (strike) of the axial plane trace	•
Direction of plunge of fold axis	South

Table 3

Examiner only

(ii) Describe how the following **two** characteristics of the minor folds within the shale differ from the fold in the sandstone. [2]

Wavelength .....

Symmetry .....

(iii) Explain the difference in the way the shale and sandstone have responded to stress during folding. [3]

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(b) Complete **Figure 3a**, to the north of the fault outcrop, by sketching, on the top surface;

(i) the outcrop of the dyke [1]

(ii) the probable outcrop of the shale [2]

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(c) **Figure 3b** is a photograph of an exposed vertical face of the fault plane.

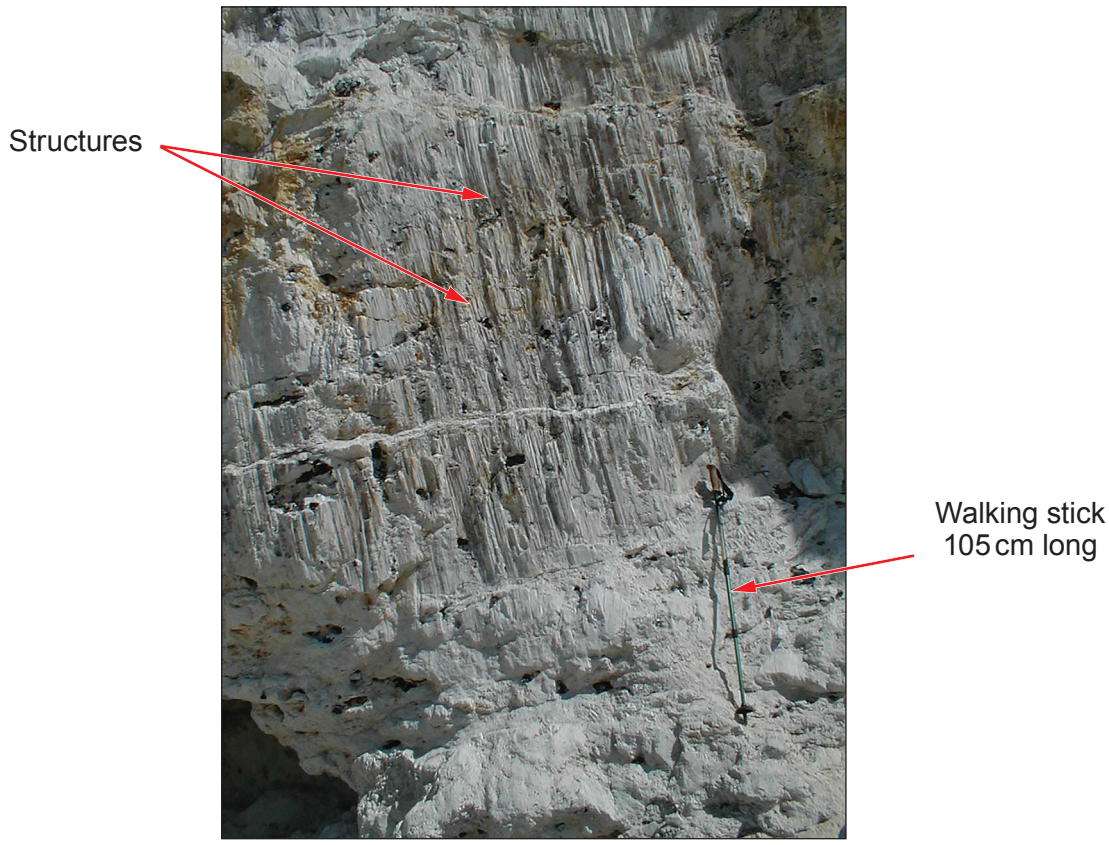

Figure 3b

Refer to **Figure 3b**.

(i) Name the structures exposed on the fault plane. [1]

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(ii) Critically assess the **use** of these structures in determining the fault movement in the field. You may wish to annotate **Figure 3b**. [3]

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4. **Figure 4a** shows the changes in diversity of fauna (Sepkoski graph) during the Phanerozoic.

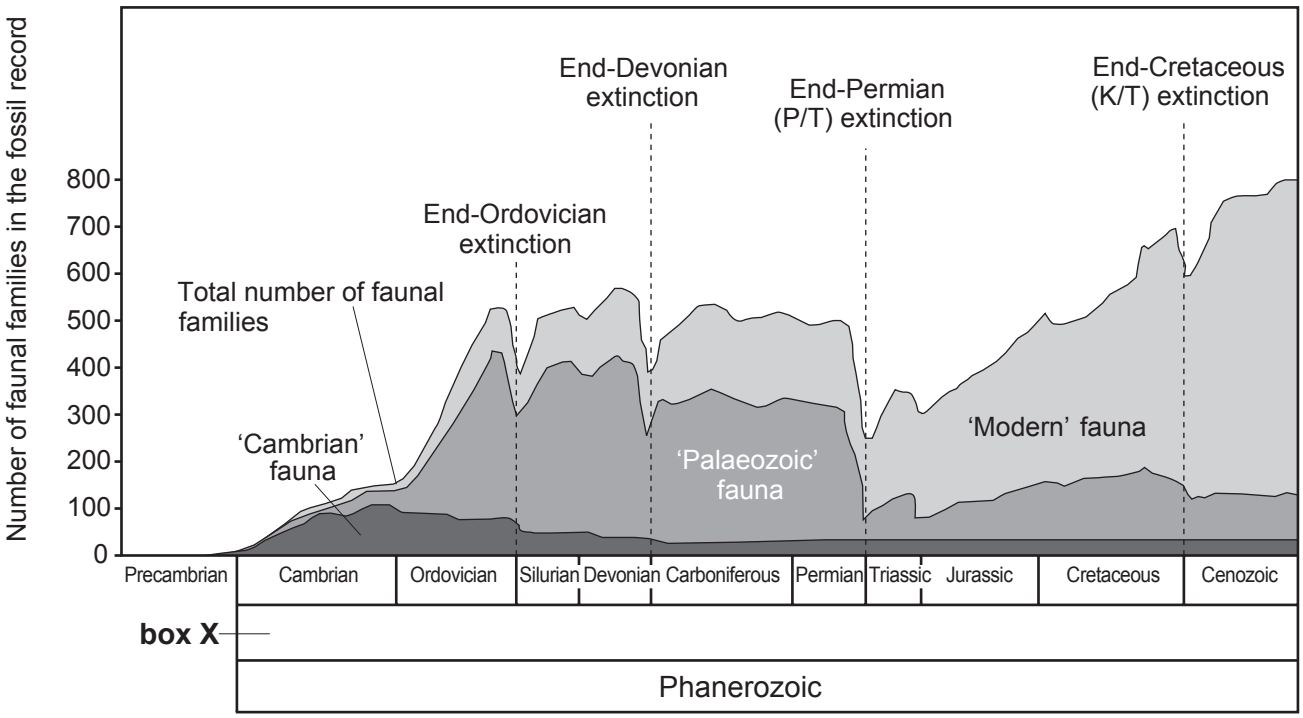

Figure 4a

Refer to **Figure 4a**.

(a) (i) In **box X** on **Figure 4a** mark and label the extent of the Palaeozoic era. [1]

(ii) State the most abundant Phanerozoic fauna (*Cambrian, Palaeozoic or Modern fauna*) that existed during the Silurian. [1]

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(iii) Describe the changes in relative abundance of Phanerozoic faunas between the end-Ordovician and end-Cretaceous (K/T) mass extinction events. [3]

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Examiner only

(b) (i) Using **Figure 4a**, calculate the percentage of faunal families that became extinct during the end-Cretaceous mass extinction (K/T).
Show your working. [2]

Percentage of families extinct.....%

(ii) From your knowledge, state **two** examples of faunal groups that became extinct at the K/T boundary. [2]

1. .....

2. .....

(c) From your knowledge, describe **two** contrasting hypotheses that have been put forward to account for the mass extinctions in **Figure 4a**. [4]

1. .....

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2. .....

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(d) Explain the limitations of using the Sepkoski graph for drawing meaningful conclusions about the diversity of life in the geological record. [3]

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Turn over.

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SECTION B

*Questions **5 – 7** relate to the **British Geological Survey 1:50 000 geological map** extract of **Bristol***

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

This section should take approximately 1 hour to complete.

5. *(a)* Using the key on the **geological map**, identify the feature represented by the symbol at the following grid references (**GR**). [2]

Grid Reference **(GR)**	Feature
498649	•
494644	•

(b) **Figure 5** shows a typical boundary between the base of the Triassic Dolomitic Conglomerate (**MMMF** within the Triassic Mercia Mudstone Group) and the underlying strata in this area.

Figure 5

Examiner only

Draw and annotate a sketch of **Figure 5** in the space below to explain the formation and significance of this boundary. [5]

(c) (i) With reference to the **geological map**, describe the outcrop pattern of the Dolomitic Conglomerate (**MMMF**) [2]

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(ii) *"The Dolomitic Conglomerate (**MMMF**) was deposited by high-energy streams flowing in valleys from an upland area formed before the Triassic."*

Explain the evidence for this statement from the **geological map** and **Figure 5**. [3]

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Turn over.

Examiner only

6. A student recorded dip directions for the main outcrop of Carboniferous Limestone shown on the **geological map** as part of an investigation into the major fold structure. **Table 6a** is a partly completed tally, and **Figure 6** a partly completed rose diagram, of these dip directions from the **geological map**.

Direction	N	NE	E	SE	S	SW	W	NW
Tally	𝍸 𝍸 //	𝍸 ///	/	𝍸	𝍸 𝍸 /	///	𝍸	𝍸 //
Total number of dips in each direction	•	•	•	5	11	3	5	7

Table 6a

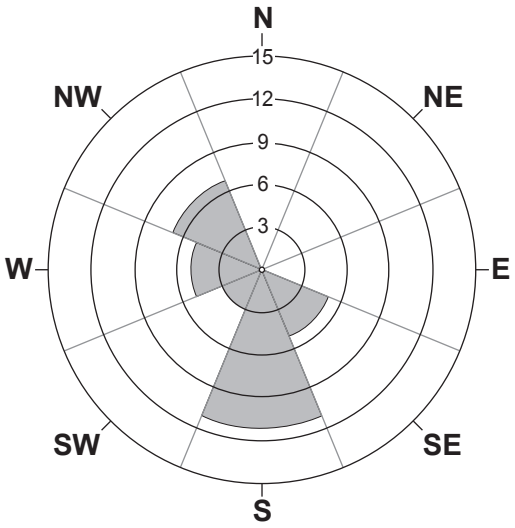

Figure 6

(a) (i) The tally in **Table 6a** does not include the directions of the **three** dip arrows in **box Z** on the **geological map**. Add these to the tally and complete the totals for the data set. [2]

(ii) Complete **Figure 6** to show the total number of dip directions for the completed data set in **Table 6a**. [2]

Examiner only

(b) In analysing the data the student concluded that the main outcrop of Carboniferous Limestone forms *"an elongated, dome-shaped fold which plunges to the west and east".*

(i) Evaluate this statement with reference to the **evidence** from the **geological map** and **Figure 6**. [4]

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(ii) State **two** limitations of the use of rose diagrams of dip directions to show the structure of folds. [2]

1. .....

2. .....

(c) (i) Using the **geological map** and **cross-section**, describe the general characteristics of the Wrington Hill Fault that crops out at **GR 478642** by completing **Table 6b** below. [4]

Fault characteristic	
Average dip angle	•
Strike direction	approximately E – W
Throw (as measured by vertical displacement of Portishead Formation (**PoB**) (metres)	• (m)
Downthrow side	South
Hanging wall side	•
Type of fault	•

Table 6b

(ii) The student further concluded that *"the major faults affecting the Carboniferous Limestone are largely compatible with the principal stress directions that formed the major fold structure."*
Evaluate this statement. [3]

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Turn over.

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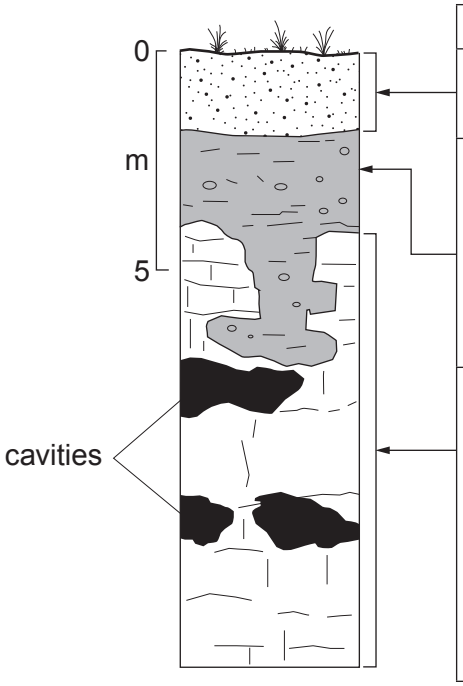
7. Bristol Airport is situated in **grid square 5065**. **Figure 7** is a summary of typical ground conditions at Bristol Airport. Five disused landfill sites and a number of disused lead mines are located on or close to the site.



Deposit	Thickness/Depth	Comment
Made ground	<1 m - 2 m thick	Tarmac, limestone gravel, sand and clay.
Superficial deposits (drift)	2 m - 5 m thick but up to 8 m infilling solution hollows.	Red-brown clay with limestone fragments and cobbles.
Black Rock Limestone	Typically 2 m - 4 m to rockhead – but locally up to 8 m	Grey, crystalline, shelly limestone. Regular steeply inclined joints and fractures with gently dipping bedding surfaces showing solution cavities and hollows.

The Carboniferous Limestone is classified by the Environment Agency as "a major aquifer... able to support large water abstraction for public supply and other purposes from boreholes surrounding Broadfield Down. The regional groundwater flow from Broadfield Down follows the dip."

Figure 7

(a) With reference to **Figure 7**, explain why cavities and hollows typically form in limestone. [3]

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(b) The borehole at **GR 532641** is used to abstract groundwater from the Carboniferous Limestone aquifer for public supply. State **two geological** advantages of this location. [2]

1. .....

2. .....

Examiner only

(c) With reference to **Figure 7**, the **geological map**, **cross-section** and **previous data**, identify the possible **geological** implications associated with the further development of this site as an airport.

You may consider why the engineering activities associated with this development (building of runways, taxiways, car parks, airport buildings, aviation fuel depot etc) need to take account of any of the following:

- interference with the hydrological system
- surface/groundwater pollution
- ground stability
- geological hazards from past human activity. [6]

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END OF PAPER

Acknowledgements

Figure 1b: P. Loader
Figure 3b: P. Loader
Figure 4a: Fossils at a glance – Milsom & Rigby (2009)
Figure 5: https://somersetwriters.files.wordpress.com/2016/09/

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For continuation only.

GCE A Level – LEGACY

1214/01-A

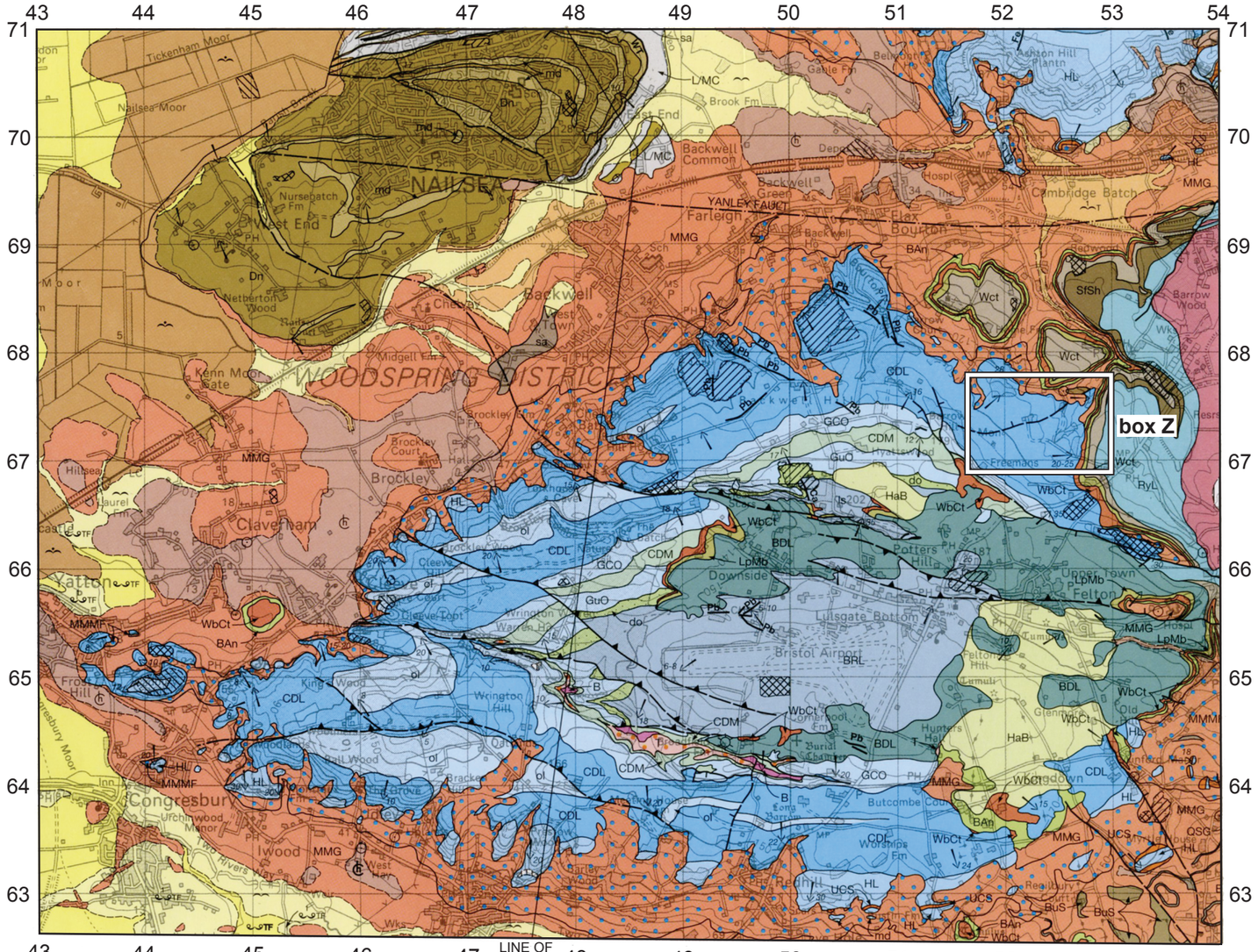
S19-1214-01A

GEOLOGY – GL4
Interpreting the Geological Record

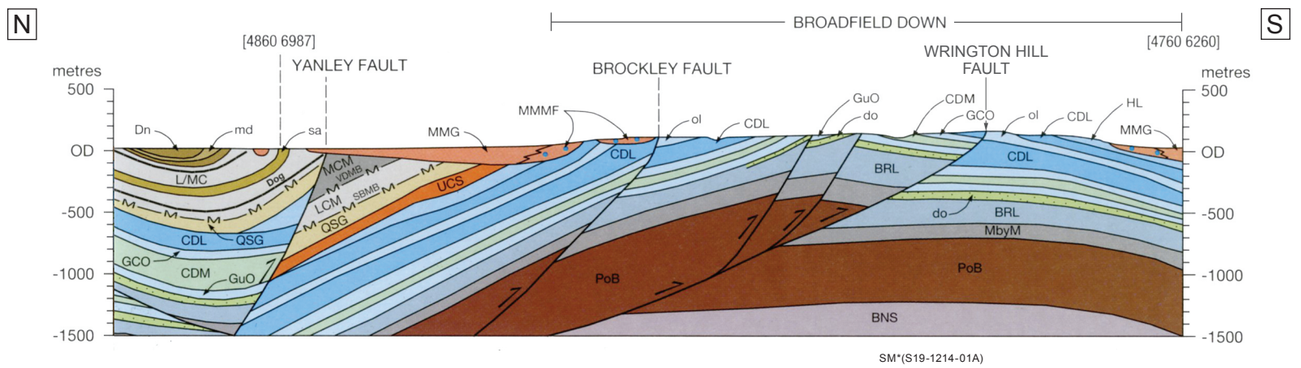
TUESDAY, 4 JUNE 2019 – AFTERNOON

MAP EXTRACT

WJEC 1214/01-A ADVANCED GEOLOGY GL4 JUNE 2019
Extract from Bristol Sheet 264 (Solid and Drift) 1:50 000 (1 cm to 500 m)

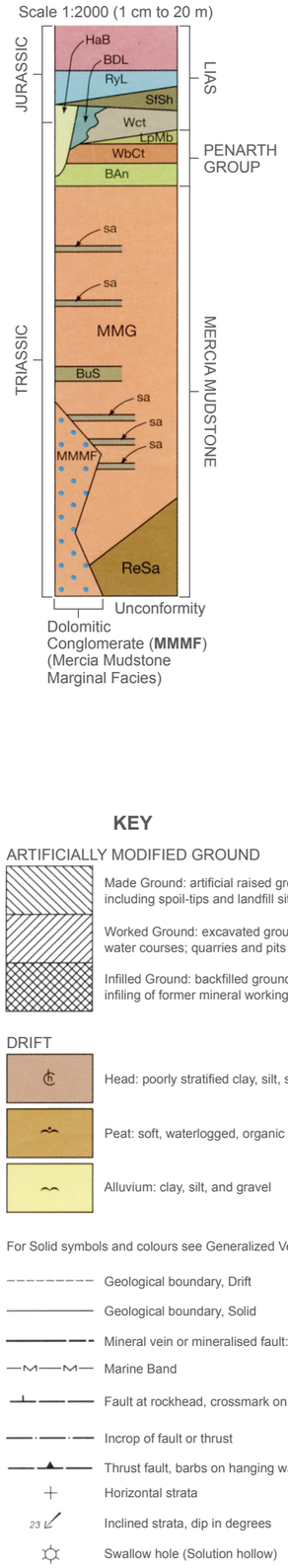


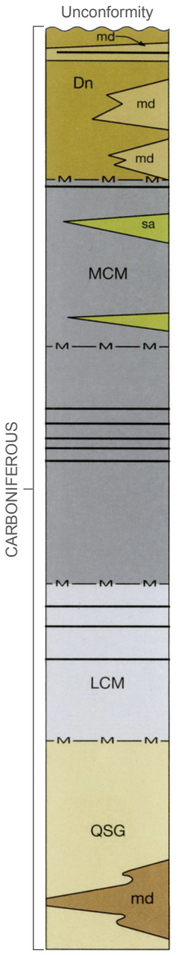
CROSS-SECTION SHOWING THE GENERAL RELATIONS OF ROCKS ALONG THE LINE of SECTION
Horizontal and Vertical Scale 1: 50 000

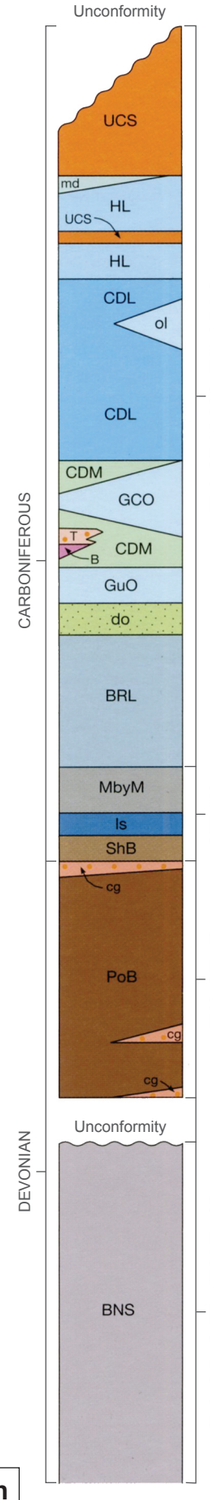


SM*(S19-1214-01A)

GENERALISED VERTICAL SECTIONS
Scale 1:6 000 (1 cm to 60 m) - unless stated







KEY

ARTIFICIALLY MODIFIED GROUND

- Made Ground: artificial raised ground, including spoil-tips and landfill sites
- Worked Ground: excavated ground for water courses; quarries and pits
- Infilled Ground: backfilled ground, including infiling of former mineral workings

DRIFT

- Head: poorly stratified clay, silt, sand and gravel
- Peat: soft, waterlogged, organic deposits
- Alluvium: clay, silt, and gravel

For Solid symbols and colours see Generalized Vertical Section

- Geological boundary, Drift
- Geological boundary, Solid
- Mineral vein or mineralised fault: - **Pb** lead (galena)
- Marine Band
- Fault at rockhead, crossmark on downthrow side
- Incrop of fault or thrust
- Thrust fault, barbs on hanging wall
- Horizontal strata
- 23 Inclined strata, dip in degrees
- Swallow hole (Solution hollow)
- Borehole