

**SECTION B**

Questions 5 - 7 relate to the **British Geological Survey 1:50 000 geological map extract of Kirkcaldy (Sheet 40E)**

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

This section should take approximately 1 hour to complete.

5. (a) With reference to the **cross-section**, state the

- maximum thickness
- maximum depth

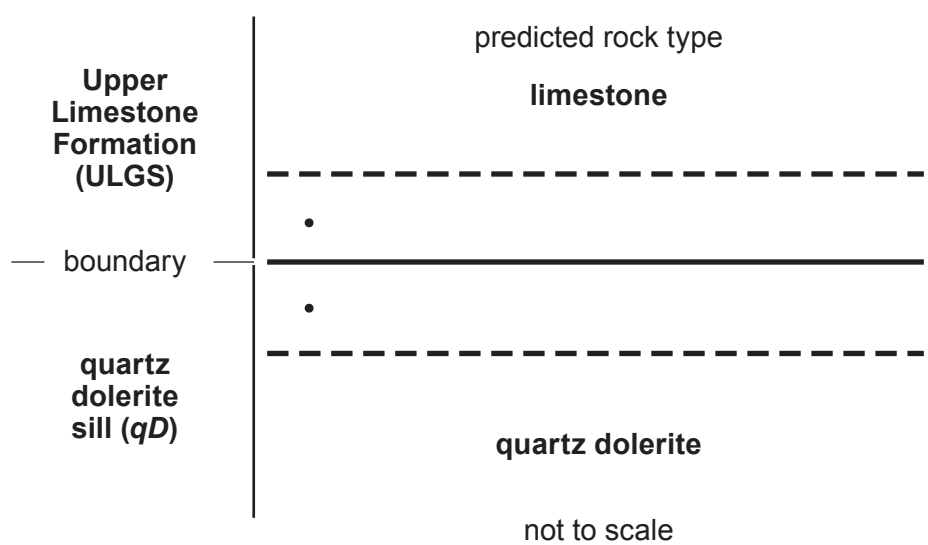
of the quartz dolerite (**qD**) beneath sea-level (OD) on the axis of the Leven Syncline.

Maximum thickness on the Leven Syncline	•	m
Maximum depth on the Leven Syncline	•	m

[2]

(b) The quartz dolerite (**qD**) that crops out in **Box A** on the **geological map** is interpreted as the surface outcrop of a sill.

(i) Complete **Figure 5** by stating the **two** rock types you might predict to find **in the field** at the upper boundary of the sill in **Box A**. [2]



**Figure 5**

- (ii) From your **knowledge**, explain why an igneous body made of quartz dolerite (**qD**) is more likely to be associated with an intrusion than a lava flow. [2]

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- (iii) Critically evaluate the evidence from the **geological map** and **cross-section** that suggests the quartz dolerite (**qD**) forms a sill rather than a dyke. [3]

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- (c) *“The quartz dolerite (**qD**) sill was partly intruded along faults.”*

Critically evaluate the **evidence** from the **cross-section** for this statement. [2]

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6. Figure 6 is a copy of the geological map.

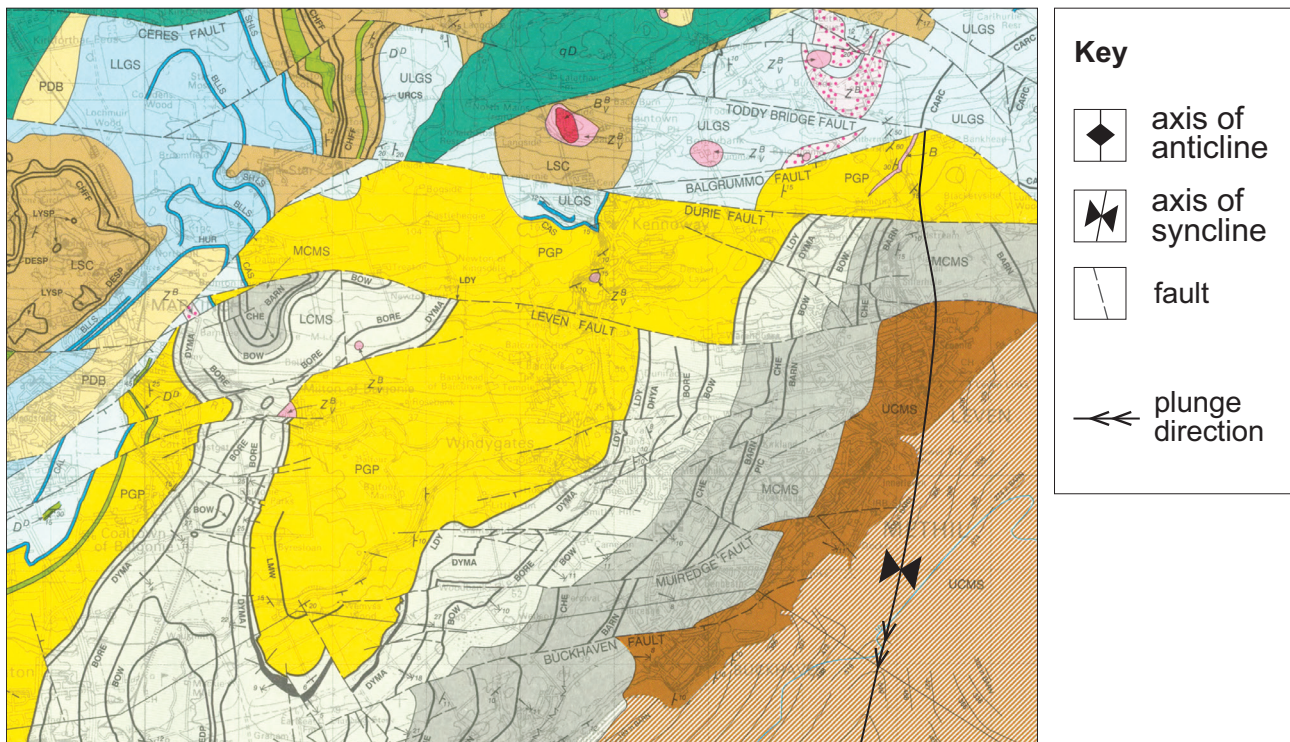


Figure 6

Refer to the **geological map**, **generalised geological column** and **Figure 6**.

- (a) (i) On **Figure 6**, draw in the axial plane trace of a *plunging anticline*. Use the symbol in the key to indicate the direction of plunge of this fold. [2]
- (ii) Describe the **evidence** that enables identification of the following fold characteristics. [2]
- Anticline .....
  - Direction of plunge .....
- (b) A student incorrectly concluded that the Durie Fault (**GS 3602**) showed strike slip movement to the right (dextral). Give **two** pieces of map evidence that show this interpretation to be **incorrect**. [2]
- .....
  - .....

- (c) Using the **geological map** and **cross-section**, describe the general characteristics of the Buckhaven Fault that crops out in **grid square 3698** by completing **Table 6** below. [4]

Buckhaven Fault characteristics	
Dip angle	varies with depth
Strike direction	•
Downthrow side	•
Hanging wall	•
Fault type	•

Table 6

- (d) The **cross-section** shows the base of the Upper Coal Measures (**UCMS**) to the east of the Buckhaven Fault is approximately aligned with the Chemiss coal (**CHE**) of the Middle Coal Measures (**MCMS**) to the west.
- (i) Using the **generalised geological column only**, calculate the throw (vertical displacement) of the Buckhaven Fault. Show your working. [2]

Throw = ..... m

- (ii) Describe how displacement on the Buckhaven Fault varies with depth. [2]

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- (e) Coal mining of the Middle and Lower Coal Measures (**MCMS** and **LCMS**) occurred within the Leven Syncline on land and beneath the Firth of Forth Estuary. Using the **cross-section** and **generalised geological column** suggest the **geological** problems that might have been encountered during mining. [3]

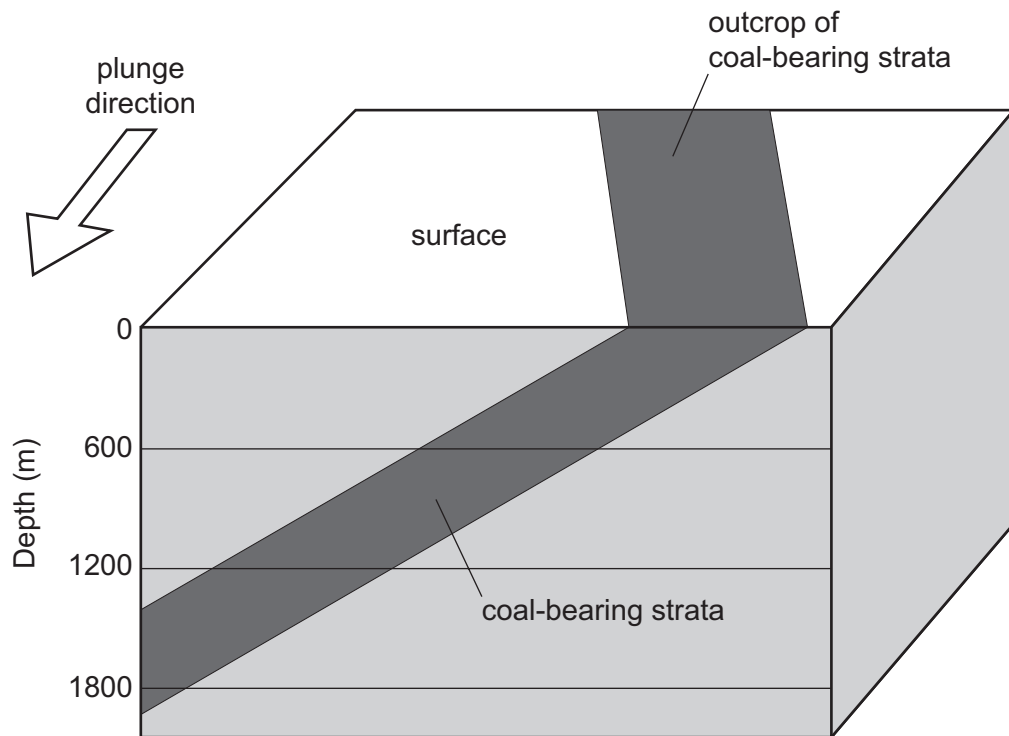
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7. **Figure 7a** is a model showing coal-bearing strata on the limb of a plunging fold. **Table 7** gives details of the conditions needed to dispose of carbon dioxide (sequestration) in coal-bearing strata.



**Figure 7a**

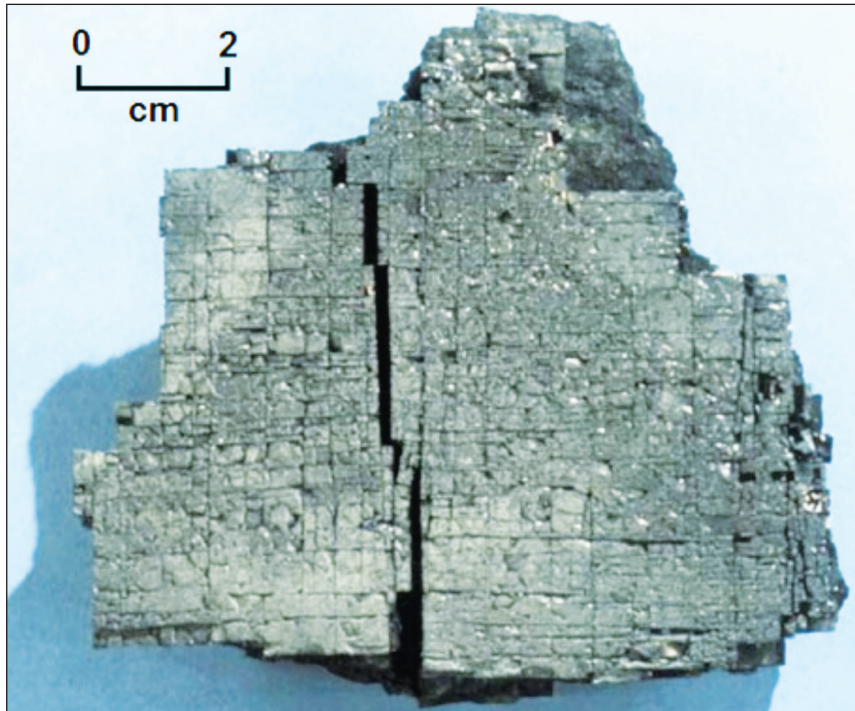
### **CO<sub>2</sub> sequestration**

The long-term disposal of carbon dioxide (CO<sub>2</sub>) by pumping liquefied gas into deeply buried coal seams (over 1200m deep) is an option for reducing atmospheric CO<sub>2</sub> levels. CO<sub>2</sub> binds strongly to the surfaces within coal where it is stored.

**Table 7**

- (a) Shade and label the **top surface** of **Figure 7a** to show the area below which there is potential for CO<sub>2</sub> sequestration. [2]

- (b) **Figure 7b** is a photo of a typical specimen of Carboniferous coal.



**Figure 7b**

Refer to **Figure 7b**.

- (i) Describe the structures within the specimen of coal. [2]

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- (ii) Explain why the structure of coal might be suitable as a host rock for CO<sub>2</sub> sequestration. [2]

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- (c) *“The Carboniferous strata of the Leven Syncline provide potential for CO<sub>2</sub> sequestration.”*

Use the data in the **generalised geological column**, the **cross-section** and **Table 7** to evaluate this statement. [6]

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**END OF PAPER**

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**Acknowledgements**

- Figure 1b**     <http://www.cneas.tohoku.ac.jp/labs/geo/ishiwata/SendaiSympo3.htm>
- Figure 2a**     Rock **A**: <https://cdn-assets.answersingenesis.org/img/articles/arj/v3/uluru-fig5.jpg>  
Rock **B**: <http://wserv3.esc.cam.ac.uk/1acollections/items/show/176>
- Figure 3**     adapted from Structural Geology – Twiss & Moores – W.H. Freeman 1992
- Figure 4**     Benton & Harper; Introduction to Paleobiology and the Fossil Record
- Figure 7b**     BGS: UK Coal Resource for New Exploitation Technologies, Final Report





