

SECTION B

Questions 5 - 8 relate to the **British Geological Survey 1:50 000 geological map extract of Settle**.

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

This section should take approximately 1 hour to complete.

5. (a) The **generalised geological column** shows that the **Worston Shales (WrSh)** are made up of a number of different rock types, some of which appear as wedge-shaped units.
- (i) State **one** additional rock type included within the **Worston Shales (WrSh)** by completing **Table 5**. [1]

Worston Shales (WrSh)	Rock type
	<i>shale</i>
	•
	<i>mudstone</i>

Table 5

- (ii) Explain why some of these beds appear as *wedge-shaped units* on the **generalised geological column**. [2]

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- (b) Using the **generalised geological column** only, calculate the total combined thickness of the **Worston Shales (WrSh)** and overlying **Lower Bowland Shales (LBS)**. Show your working. [2]

Thickness

- (c) The **generalised geological column** shows that the boundary between the **Worston Shales (WrSh)** and the **Thornton Limestone (ThtL)** is marked by a knoll-reef limestone (**K**). **Figure 5** is a photograph showing this boundary which crops out in **Box A** on the **geological map (grid reference 718532)**.

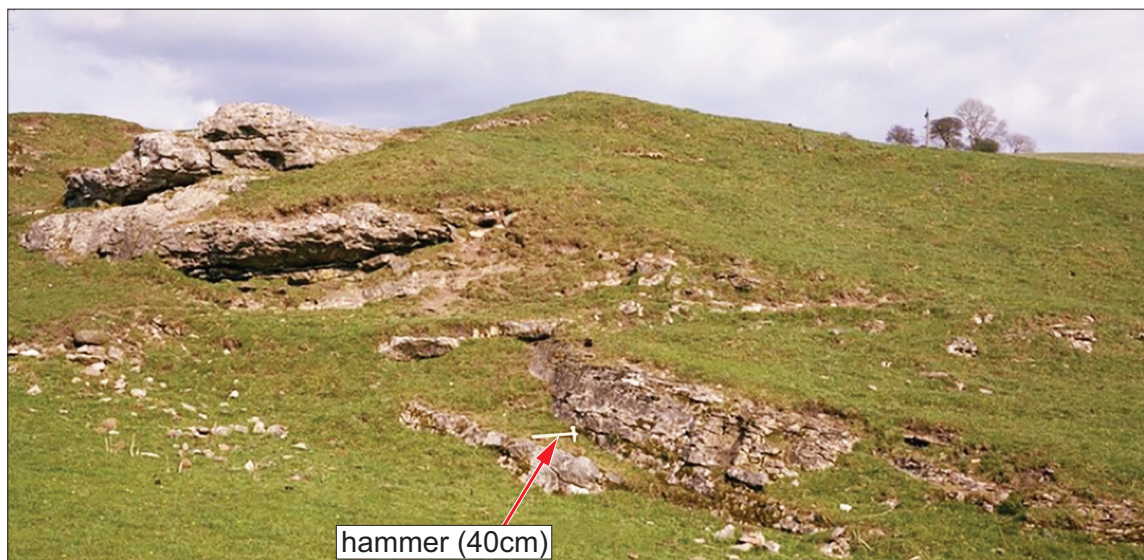


Figure 5

- (i) Refer to the **generalised geological column**.

State the type of boundary that locally marks the junction between the **Worston Shales (WrSh)** and the **Thornton Limestone (ThtL)**. [1]

- (ii) Refer to **Figure 5** and the **geological map**.

1. Label on **Figure 5**
 - the knoll-reef limestone (**K**→)
 - the Thornton Limestone (**ThtL**→)
2. Draw a line on **Figure 5** to indicate the position of the boundary between the knoll-reef limestone (**K**) and the **Thornton Limestone (ThtL)**.
3. State the direction in which the camera was pointing.

Camera direction

[3]

6. **Figure 6** is a simplified sketch of the structural features of the **geological map**.

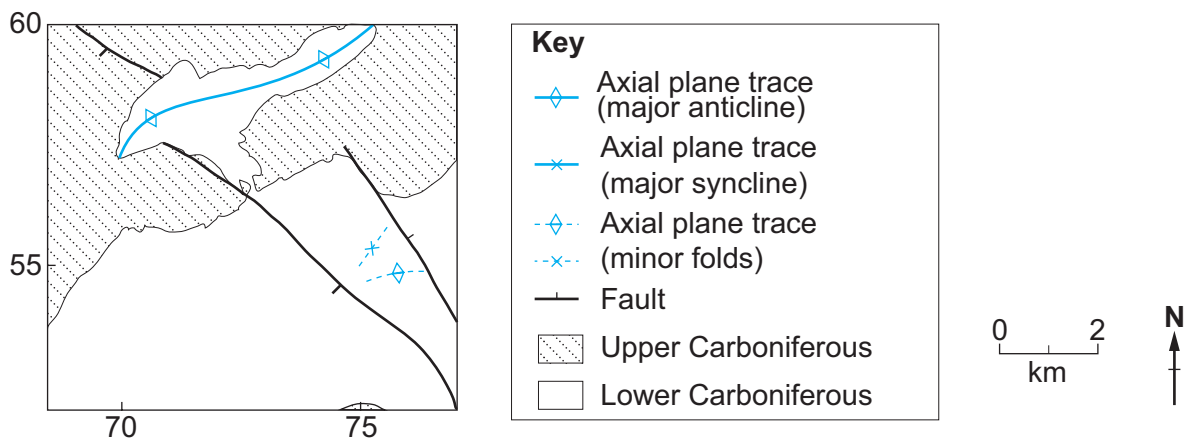


Figure 6

- (a) Complete **Table 6** by stating the **evidence** from the **geological map alone** for the fold descriptors of the **major anticline** indicated on **Figure 6**. [2]

Fold descriptors	Evidence
1. an antiform	•
2. an anticline	•

Table 6

- (b) On **Figure 6**, draw the axial plane traces of
1. **another** major anticline
 2. a major syncline.
- Use the symbols in the key to identify the folds. [2]

- (c) A student described **both** major **anticlines** as
"...plunging to the NE."
 Critically evaluate this statement. [3]

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7. Refer to the line of section **S-T** in **grid square 6952** on the **geological map** and the cross sections (**W**, **X**, **Y** and **Z**) in **Figure 7a**. Faults on the **geological map** are to be considered **normal** faults unless indicated, in the map key, as reversed (**RF**).

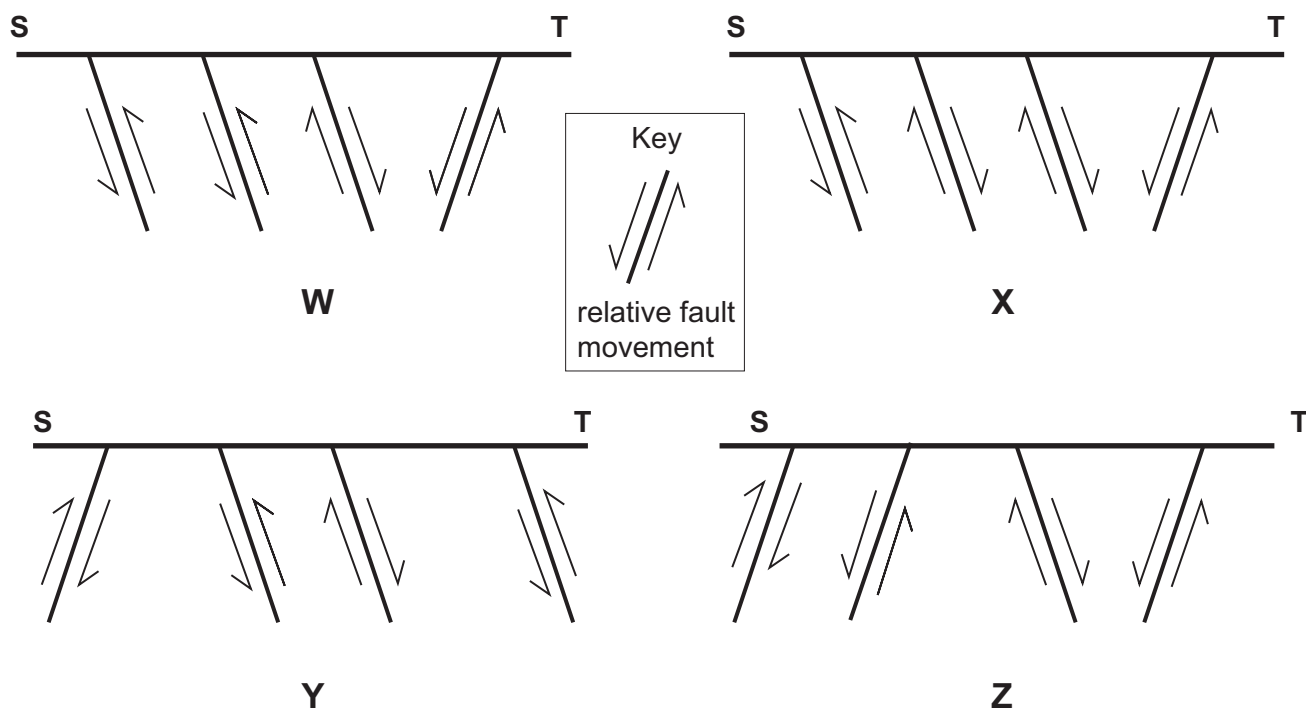


Figure 7a

- (a) State which of the sketch cross sections (**W**, **X**, **Y** or **Z**) is most likely to represent the geological structure along the line of section **S-T**. Explain the reasons for your choice. [3]

Choice of section (**W**, **X**, **Y** or **Z**)

Reasons

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- (b) A student recorded the strike orientation of the major faults on the **geological map** as part of an investigation into stress patterns. **Table 7** is a partly completed chart, and **Figure 7b** a partly completed rose diagram of these data.

Direction	N-S	NE-SW	E-W	NW-SE
Tally	////	### ///	///	### ### ### ### ### //
Total number of orientations	•	•	3	

Table 7

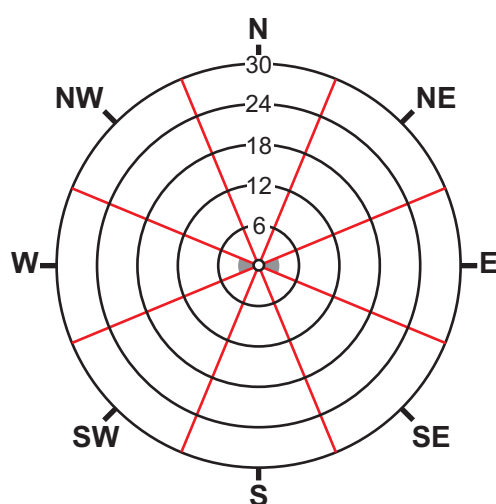


Figure 7b

- (i) The tally in **Table 7** does not include the 4 faults in **grid square 6952** and the 3 faults in **grid square 7555**. Add these to the tallies and complete the totals for the data set. [2]
- (ii) Complete the rose diagram (**Figure 7b**) to show the distribution of fault orientation totals for the completed data set in **Table 7**. [2]
- (c) (i) **Fault F** on the **geological map** dips to the **NE**. A student concluded that **Fault F** and the major folds both formed
- by compression
 - at the same time
- Critically evaluate this statement. [3]

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- (ii) **Figure 7b** shows a significant anomaly to the general fault orientation. Explain the evidence to suggest how some of these anomalous faults might have been formed at the same time as the formation of the major fold structures. [3]

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8. **Figure 8** is a typical exposure of the Worston Shales that underlies Stocks Reservoir (shaded white in **Box B** on the **geological map**). The photograph was taken looking North.



Figure 8

Refer to **Figure 8** and the **geological map**.

- (a) (i) State the angle of dip of the beds as seen in **Figure 8**. [1]

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- (ii) Explain why the dip measurements on the **geological map** in **Box B** might be significantly higher than can be determined in **Figure 8**. [2]

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- (b) Describe the **field** observations that might have been obtained at the location shown in **Figure 8** during planning of Stocks Reservoir. [4]

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- (c) Explain the geological advantages and disadvantages of developing this site as a reservoir. [4]

Examiner
only

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END OF PAPER

Acknowledgements

- Figure 1a** <http://hq-images.com/granite>
Figure 1b Glazner, F. A. and Johnson, B. R. 2013. Late crystallisation of K-feldspar and the paradox of megacrystic granites. *Contributions to Mineralogy and Petrology*, 166, 777-799.
Figure 2a <https://en.wikipedia.org/wiki/Stegosaurus>
Figure 2b <http://www.3ders.org/articles/20150220-museum-scientist-uses-3d-scanning-to-discover-secrets-of-rare-stegosaurus.html>
Figure 2c D. D. Gillette and M. G. Lockley (eds). *Dinosaur Tracks and Traces*, Cambridge University Press, 1991
Figure 4a <http://www.blackwellpublishing.com/paleobiology/figure.asp?chap=04&fig=Fig4-23&img=c04f023>
Figure 4b <http://www.slideshare.net/yuriammosov/earth-paleomaps-history-of-continental-drift>
Figure 4c https://upload.wikimedia.org/wikipedia/commons/thumb/0/08/Lycopsid_joggins_mcr1.JPG/1280px-Lycopsid_joggins_mcr1.JPG
Figure 5 British Geological Survey (P005661)
Figure 6 adapted from Figure 26 *Geology of the country around Settle* (BGS)
Figure 8 British Geological Survey (P005732)

