

Surname	Centre Number	Candidate Number
Other Names		2



GCE AS/A level

1212/01



S16-1212-01

GEOLOGY – GL2a Investigative Geology

A.M. WEDNESDAY, 27 April 2016

1 hour 30 minutes

ADDITIONAL MATERIALS

In addition to this examination paper, you will need:

- the Resource Sheet;
- Specimens **A**, **E** and **H**;
- geological equipment for testing specimens;
- the Mineral Data Sheet.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Answer **all** questions.

Write your name, centre number and candidate number in the spaces at the top of this page.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

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

The Mineral Data Sheet and **Map 1** and **Photographs 1** to **6** are provided on separate resource sheets.

These are **not** required by the examiner.

Strips of plain paper may be obtained from the supervisor on request. The strips are **not** required by the examiner.

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

Specimens **A**, **E** and **H** may be tested with the equipment specified by the supervisor.

The number of marks is given in brackets at the end of each question or part-question.

Marking will take into account the quality of communication used in your answers.

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	8	
2.	7	
3.	9	
4.	4	
5.	4	
6.	6	
7.	5	
8.	12	
9.	5	
Total	60	

Answer all questions in the spaces provided.

Study **Map 1** on the Resource Sheet carefully before answering **Questions 1-9**.

1. Specimen E is representative of **Rock Unit E** on **Map 1**.

- (a) The list below contains statements about **Specimen E**. Select the **three** statements which best apply to **Specimen E**. [3]

Tick (✓) only
three boxes

- *It has a porphyritic texture*
- *It is well sorted*
- *It has a glassy texture*
- *It has a foliation*
- *It formed by cooling at a constant rate*
- *It is the product of contact metamorphism*
- *It crystallised from a magma*
- *It is the product of regional metamorphism*
- *It formed by slow cooling*

(b) **Photograph 1** on page 4 of the Resource Sheet shows an included fragment within **Rock Unit E** on **Map 1**. The included fragment is dominated by two minerals labelled **X** and **Y**. **Photograph 2** is a photomicrograph of part of the included fragment. You may wish to refer to the Mineral Data Sheet.

(i) Giving **two** reasons, state the name of mineral **X** in **Photographs 1** and **2**. [3]

Reason 1

.....

Reason 2

.....

Name of mineral X

(ii) State the name of mineral **Y** in **Photograph 1**. [1]

Name of mineral Y

(iii) Select the most likely name of the rock forming the included fragment shown in **Photograph 1**. [1]

gabbro

peridotite

granite

gneiss

Tick (✓) only **one** box

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010003

8

2. (a) **Map 1** shows several outcrops of **Rock Unit B**. With reference to the evidence in **Map 1 only**, indicate the **two** most likely types of igneous body represented by **Rock Unit B**. Give a reason for your answer. [2]

lava flow

dyke

sill

pluton

Tick (✓) only
two boxes

Reason

.....

- (b) **Photograph 3** on page 4 of the Resource Sheet shows an outcrop of **Rock Unit B** at **Locality I** on **Map 1**. The photograph is taken looking towards the east.

- (i) State the name of the igneous structures shown in **Photograph 3**. [1]

.....

- (ii) Explain how the igneous structures shown in **Photograph 3** formed. You may use an annotated diagram if you wish. [2]

.....

.....

.....

- (c) **Figure 2** is a student's field sketch of the geology at **Locality I** on **Map 1**. It includes the area shown in **Photograph 3**. The student has suggested that **Rock Unit B** is a lava flow.

Annotate **Figure 2** to show **two** pieces of evidence you would look for in the field which would prove that **Rock Unit B** is a lava flow. [2]

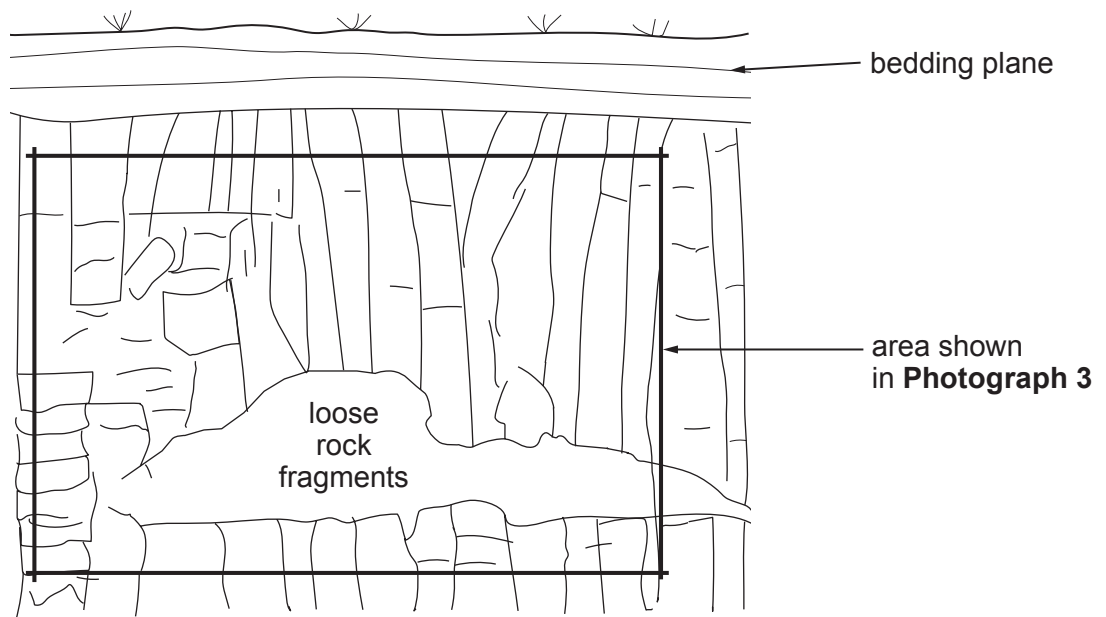


Figure 2

3. **Photograph 4** on page 4 of the Resource Sheet shows a fossil within **Rock Unit C**, collected from **Locality II** on **Map 1**.

Photograph 5 on page 4 of the Resource Sheet shows an outcrop of **Rock Unit D** on **Map 1**.

(a) **Figure 3a** is a student's drawing of the fossil shown in **Photograph 4**.

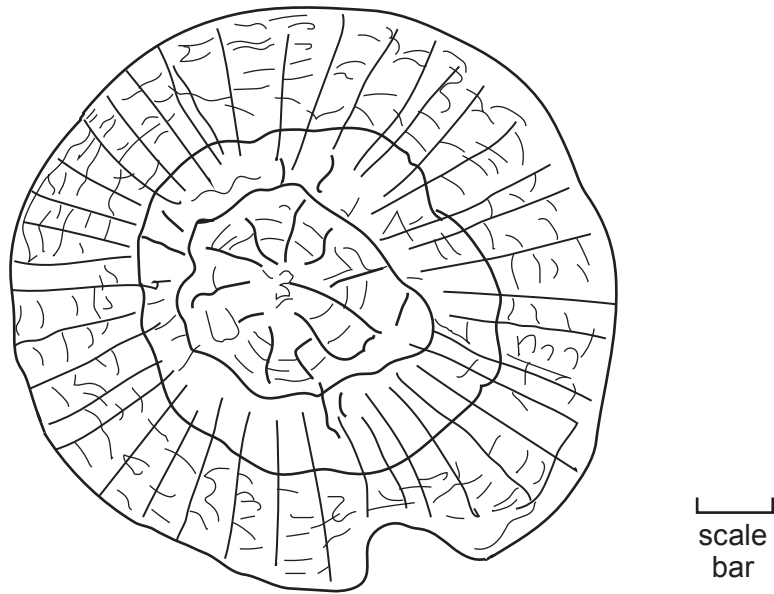


Figure 3a

(i) Place a tick (✓) in **one** of the boxes below to indicate the length represented by the scale bar in **Figure 3a**, so that the drawing accurately represents the size of the fossil shown in **Photograph 4**. [1]

2.5 mm

5 mm

20 mm

40 mm

Tick (✓) only
one box

(ii) Name the fossil group represented in **Figure 3a**. [1]

Fossil group

(b) Draw in **Figure 3b** the texture of **Rock Unit D**, in **Photograph 5**, to the scale provided. [3]

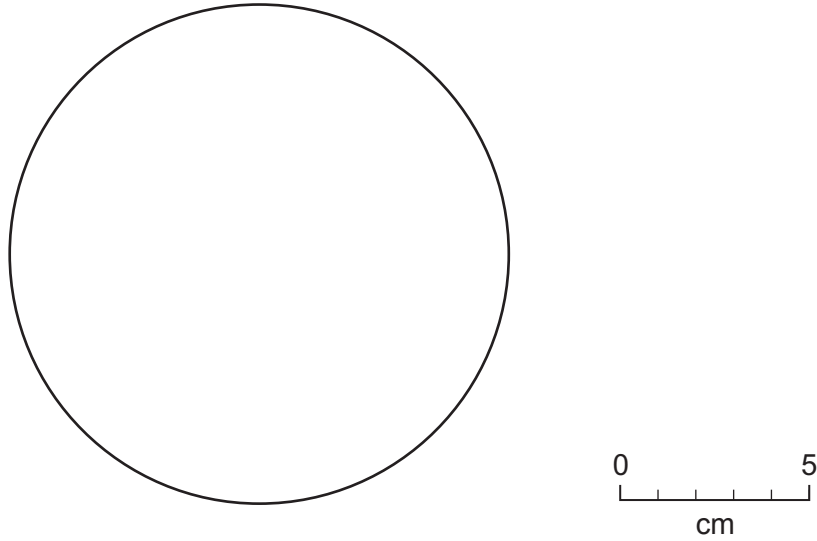


Figure 3b

(c) **Rock Unit D** in **Photograph 5** is dominated by coarse clasts all composed of the same mineral.
 A student suggested that “*the mineral forming the coarse clasts in **Rock Unit D** came from **Rock Unit C***”.

Evaluate this statement with reference to

- the age relationship of **Rock Units C** and **D**
- the mineral content of **Rock Units C** and **D**.

You should refer to

- **Map 1**
- **Photograph 4**
- **Photograph 5**
- the Mineral Data Sheet.

[4]

.....

.....

.....

.....

.....

.....

4. (a) **Fault F1** on **Map 1** is a fault which shows dip-slip rather than strike-slip movement. State **two** pieces of evidence from **Map 1** which indicate that **Fault F1** shows dip-slip movement. [2]

Evidence 1

Evidence 2

- (b) **Fault F2** dips steeply towards the south-west.

Complete the description of **Fault F2** by ticking (✓) **one** box for each statement shown. [2]

- The footwall is to the

north-west of the fault

south-west of the fault

north-east of the fault

Tick (✓) only
one box

- The fault can be classified as

normal

reverse

thrust

Tick (✓) only
one box

4

5. Specimen H contains a metallic mineral associated with **Fault F2** on **Map 1**.

A student has stated that *“the metallic mineral in Specimen H is pyrite”*.

Complete **Table 5**.

- State the results of the two diagnostic tests on the metallic mineral in **Specimen H**.
- Evaluate the student’s statement with reference to each test result by ticking (✓) **one** box for each evaluation.
- Give a reason for each evaluation.

You may wish to use the equipment provided by the supervisor and to refer to the Mineral Data Sheet. [4]

Diagnostic Test	Result of diagnostic test	Evaluation and reason
colour	•	Evaluation of statement <i>“the metallic mineral in Specimen H is pyrite”</i> True <input type="checkbox"/> False <input type="checkbox"/> Tick (✓) only one box <i>Reason</i>
hardness	•	Evaluation of statement <i>“the metallic mineral in Specimen H is pyrite”</i> True <input type="checkbox"/> False <input type="checkbox"/> Tick (✓) only one box <i>Reason</i>

Table 5

6. (a) **Specimen A** is representative of **Rock Unit A** on **Map 1**.

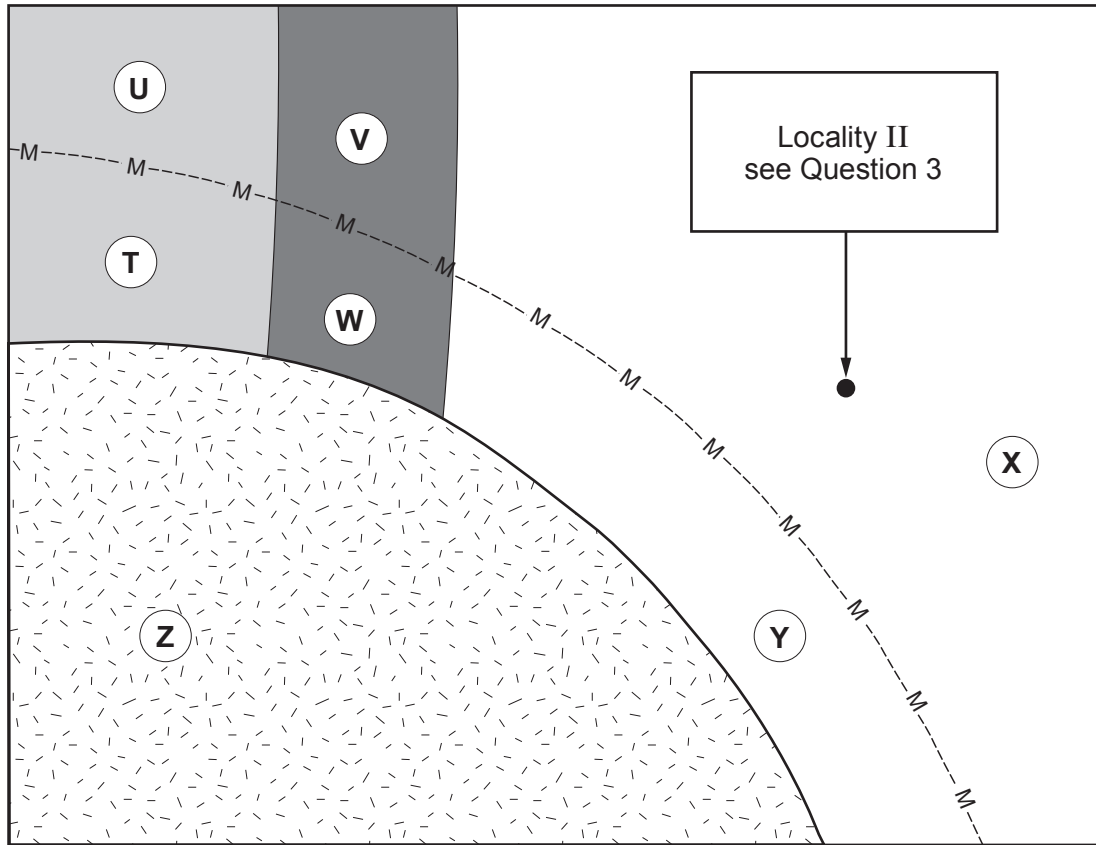
The list below contains statements about **Specimen A**. Select the **three** statements which best apply to the rock shown in **Specimen A**. [3]

Tick (✓) only
three boxes

- *It formed under water*
- *It is well sorted*
- *It formed by rapid cooling*
- *It is a lava*
- *It has a slaty cleavage*
- *It formed under low energy conditions*
- *It has a crystalline texture*
- *It is the product of regional metamorphism*
- *It formed under high energy conditions*

(b) **Map 2** below shows the geology in **box A** on **Map 1**. The key for the rock units is the same as for **Map 1**.

A rock sample collected from the solid geology within the area shown on **Map 2** contains randomly orientated crystals of chialstolite.



Map 2

Indicate by inserting the correct letter (**T, U, V, W, X, Y** or **Z**) into the blank box below, the most likely location on **Map 2**, from which the rock sample containing chialstolite crystals was collected. Give reasons for your answer. [3]

Location

Reasons

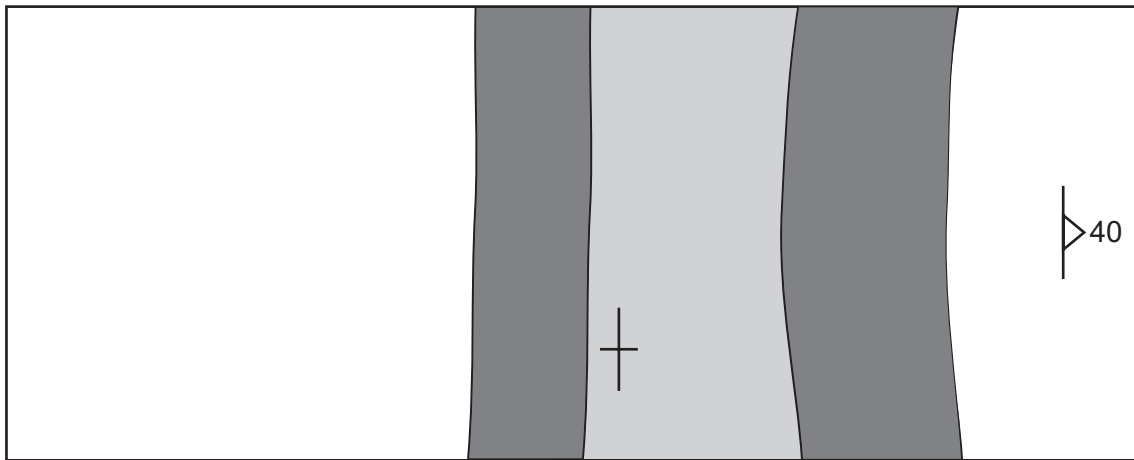
.....

.....

.....

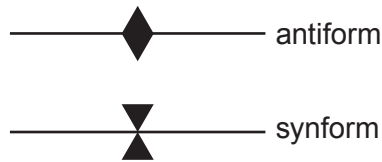
.....

7. **Map 3** shows the geology in **box B** on **Map 1**. The key is the same as that for **Map 1**.



Map 3

(a) Refer to **Map 1** and **Map 3**. Clearly draw and label on **Map 3** the axial plane traces (APT) of an **antiform** and a **synform**. Label them as appropriate with the following symbols. [2]



- (b) The list below contains statements about the folding within the area shown on **Map 1**. Select the **three** statements which best apply to the folding shown in **Map 1**. [3]

Tick (✓) only
three boxes

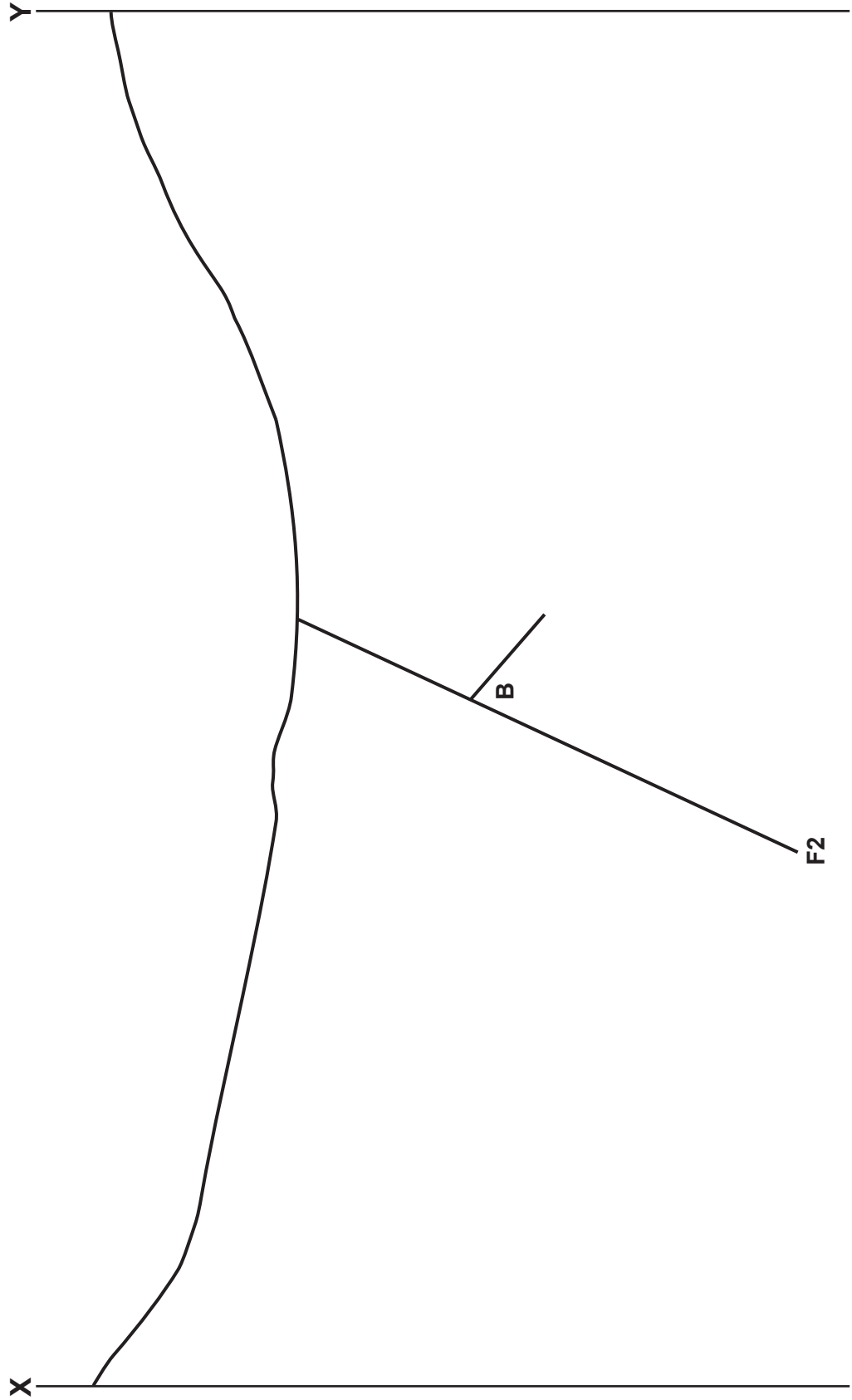
- *Folding of **Rock Unit B** happened more recently than the folding of **Rock Unit A***
- *Folding was caused by compression from the north and south*
- *Folding of **Rock Units A-C** happened before the faulting of **Rock Units A-C***
- *The axial planes in **Rock Units A-C** dip to the east*
- *Folding was caused by compression from the east and west*
- *Folding of **Rock Unit D** happened before the folding of **Rock Units A-C***
- *Folding of **Rock Units A-C** was caused by the intrusion of **Rock Unit E***
- *The axial planes in **Rock Units A-C** dip to the west*
- *Folding was caused by tension from the east and west*

5

8. The topographic profile below was taken along the line X–Y on Map 1. Fault F2 and part of a boundary of Rock Unit B have been inserted.

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

- Draw the rock units. Use similar ornament, or letters, for these as on Map 1.
- Draw and label any **fold axes**.
- Draw arrows alongside fault F2 to show movement.
- Project the rock units and structures above the ground surface to illustrate any cross-cutting relationships. [12]



9. An unconformity provides evidence of a significant time gap in the geological record. Using an annotated diagram(s) explain how an unconformity provides this evidence.

Credit will only be awarded for answers which relate to **one** of the following. Tick (✓) only **one** box to indicate your choice.

Tick (✓) only
one box

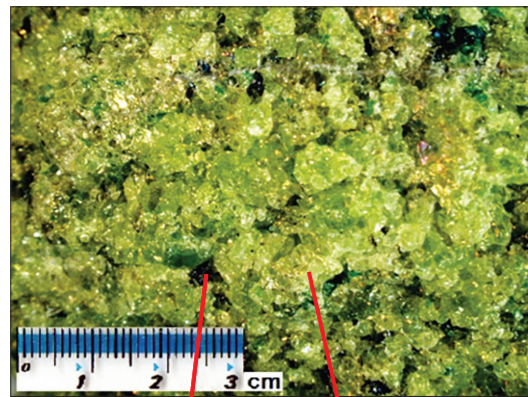
- Your fieldwork observations of **one** rock exposure
- **Map 1**
- **Photograph 6** (on page 4 of the Resource Sheet) taken looking towards the north at **Locality III** on **Map 1**

An annotated diagram(s) must be used in your answer.

[5]

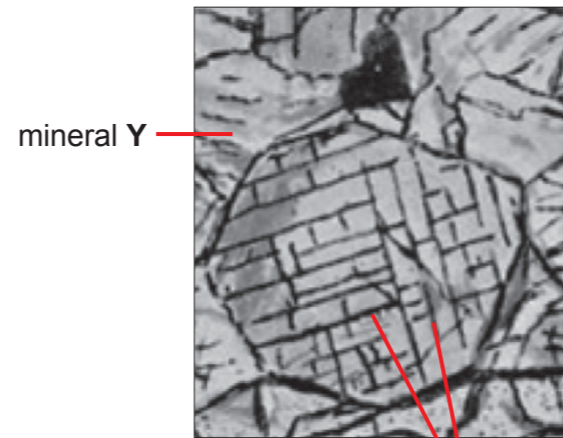
	5

Photograph 1 For use in Question 1



mineral X
mineral Y has no cleavage

Photograph 2 For use in Question 1



0 1 mm
cleavage planes in mineral X



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Resource Sheet

Photograph 3 For use in Question 2



0 1 m

Photograph 4 For use in Question 3



Rock Unit C reacts with 0.5M hydrochloric acid

Photograph 5 For use in Question 3



0 4 cm
clasts composed of a milky white mineral harder than feldspar

Photograph 6 For use in Question 9

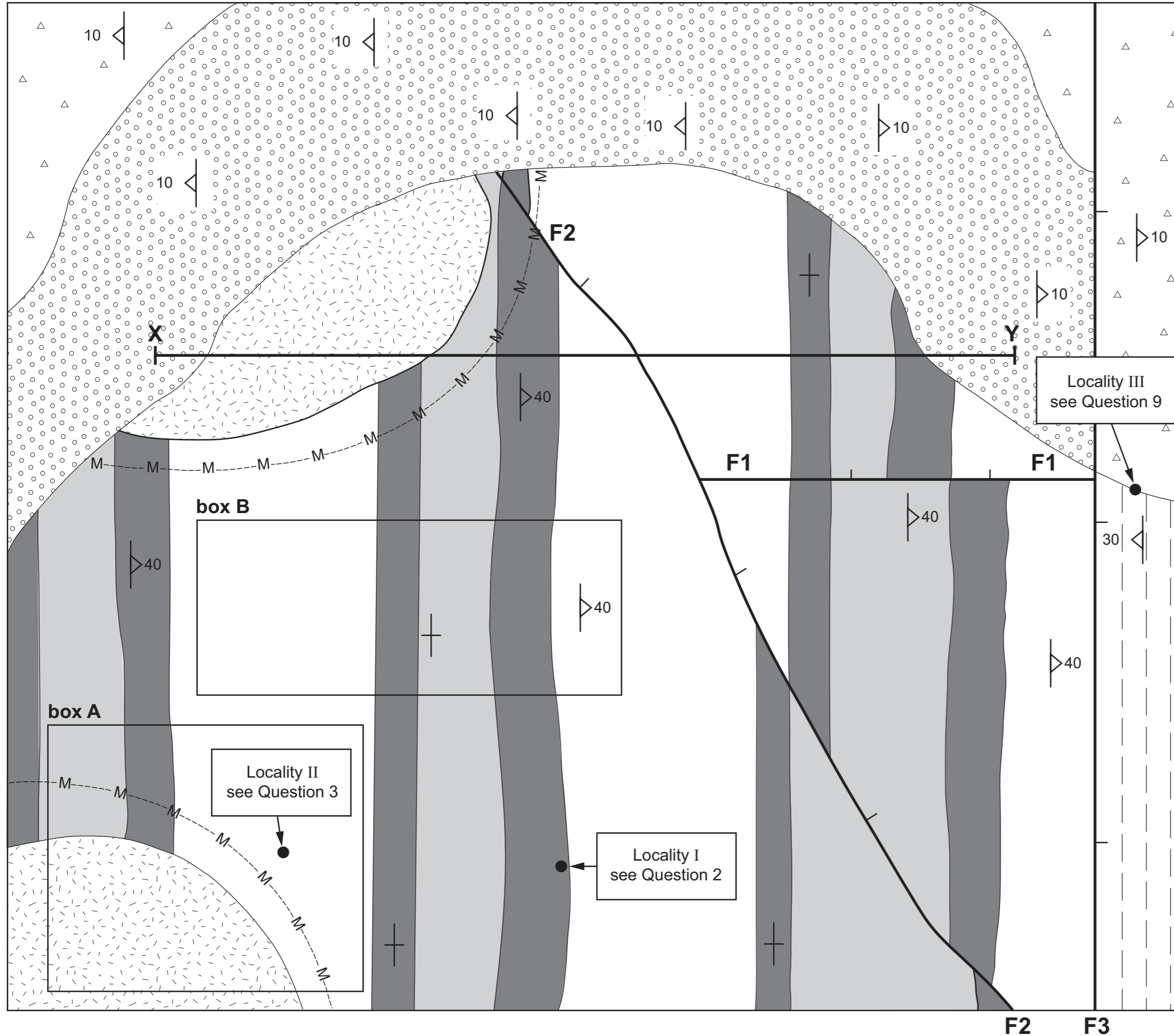


0 1 m



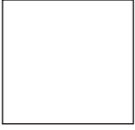
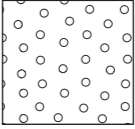
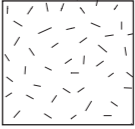
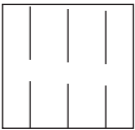
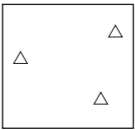
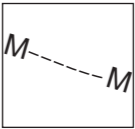
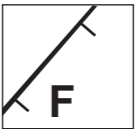
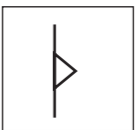
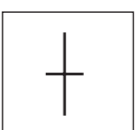
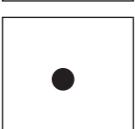
Acknowledgements:

- Photograph 1: <http://pixshark.com>
- Photograph 2: <http://historicfalls.com>
- Photograph 3: <http://marlimillerphoto.com>
- Photograph 4: <http://www.thefossilforum.com>
- Photograph 5: <http://www.cedd.gov.hk>
- Photograph 6: <http://geotripperimages.com>

MAP 1



The rock units are not in order of age.
Their ornament is not necessarily representative of rock type.

-  Rock Unit A (Specimen A)
-  Rock Unit B (Photograph 3)
-  Rock Unit C (Photograph 4)
-  Rock Unit D (Photograph 5)
-  Rock Unit E (Photograph 1 and 2, Specimen E)
-  Rock Unit F (Photograph 6)
-  Rock Unit G (Photograph 6)
-  Limit of metamorphism
-  Fault
-  Direction of dip of bed
-  Vertical bed
-  Locality numbers

