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Total

X043/301

NATIONAL QUALIFICATIONS 2011

MONDAY, 16 MAY
1.00 PM – 3.30 PM

GEOLOGY
HIGHER

Fill in these boxes and read what is printed below.

Full name of centre

Town

Forename(s)

Surname

Date of birth
Day Month Year

Scottish candidate number

Number of seat

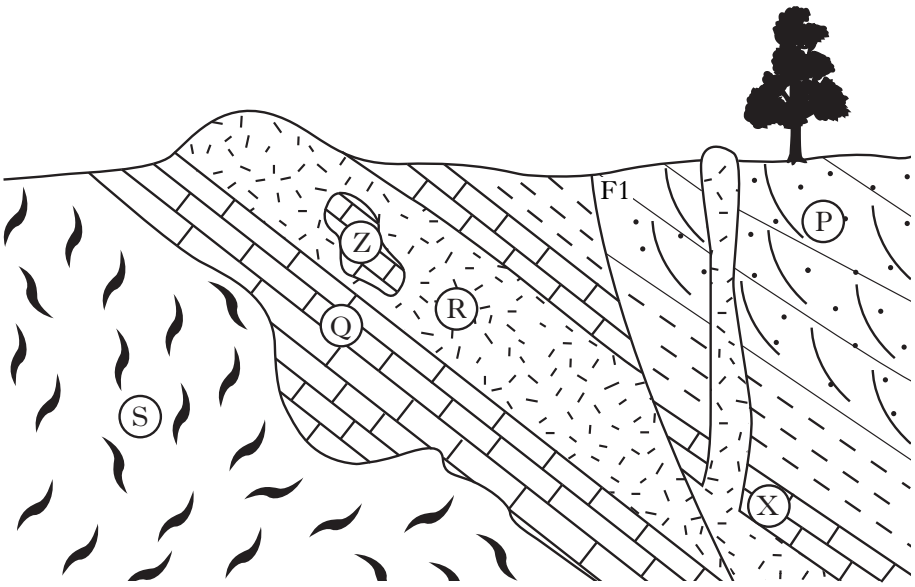
1. This paper consists of three sections A, B and C. You are advised to spend about 1 hour on Section A, half an hour on Section B and 1 hour on Section C.
2. You should attempt **all** of the questions in Sections A and C and only **one** question in Section B.
3. All answers should be written in the spaces provided in this answer book and should be written clearly and legibly in ink.
4. The marks allocated to each question or part of a question are shown at the end of each question or part of a question.
5. Additional space for answers or rough work will be found at the end of this book. If further space is required, supplementary sheets may be obtained from the Invigilator and should be inserted inside the **front** cover of this booklet. You should draw a line through anything which you do not wish the examiner to mark.
6. Before leaving the examination room you must give this book to the Invigilator. If you do not, you may lose all the marks for this paper.

Marks

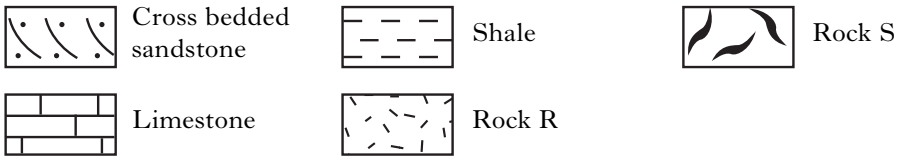
SECTION A

All questions in this section should be attempted. Forty marks are allocated to this section.

1. Examine the diagram below.



Key



(*a*) Which **one** of the following statements is correct?

A Igneous intrusion R is a dyke.
B Igneous intrusion R is a sill.
C Fault F1 is a reverse fault.
D Fault F1 is a thrust fault.

Give only the letter **1**

(*b*) Which **one** of the following statements is correct?

A Rock P formed in a lower energy depositional environment than Rock Q.
B Rock Z is a fault breccia.
C There is a conformable relationship between rocks S and Q.
D Rock R is the youngest rock on the diagram.

Give only the letter **1**

(*c*) What rock would you expect to find at X?

A Hornfels
B Marble
C Mylonite
D Migmatite

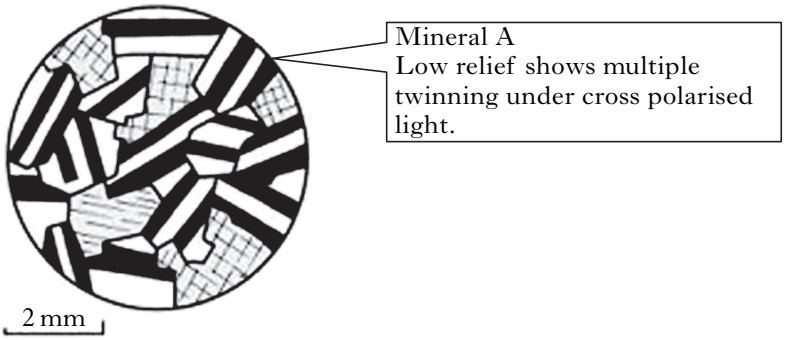
Give only the letter **1**

Marks

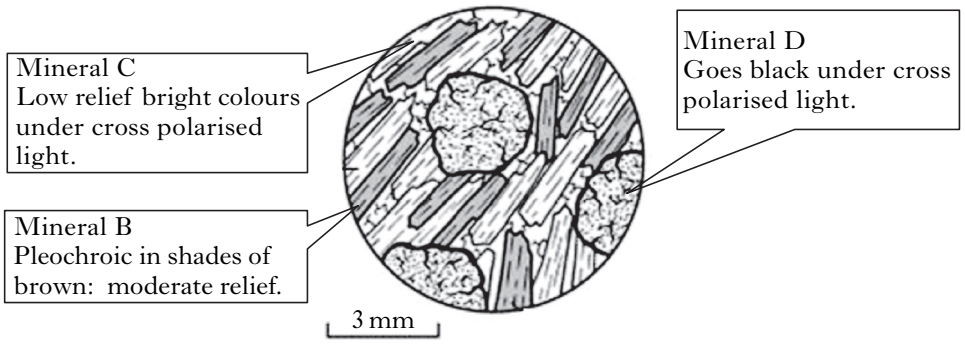
1. (continued)

(*d*) Samples of rocks R and S from the previous diagram are shown below in thin section.

Rock R



Rock S



Complete the table below by naming the minerals and the rocks.

Mineral or rock	*Name of mineral or rock*
Mineral A	
Mineral B	
Mineral C	
Mineral D	
Rock R	
Rock S	

3

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks

1. (continued)

(*e*) **Explain** the term "contact metamorphism".

.....

.....

.....

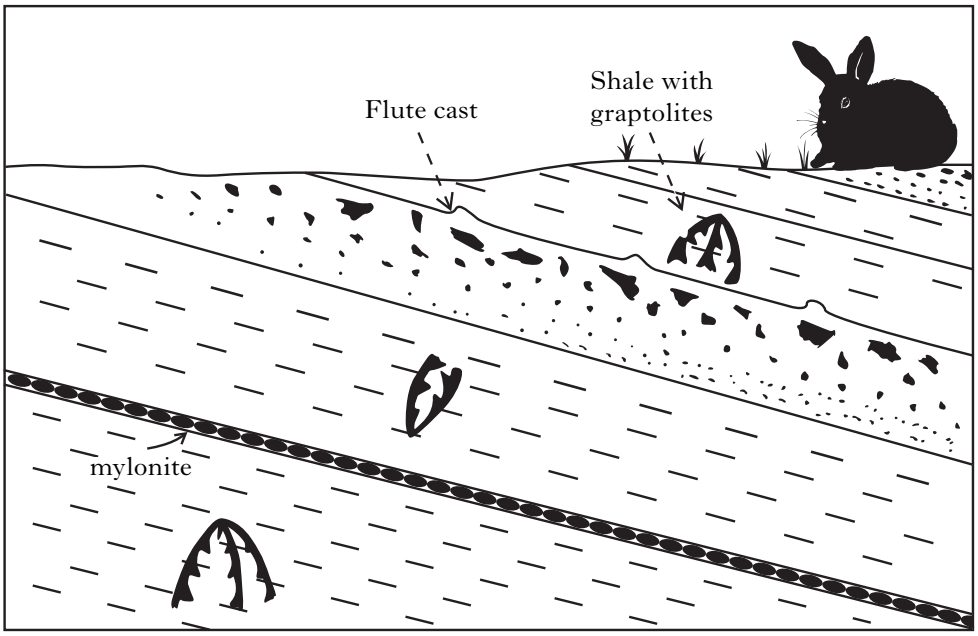
..... **1**

[Turn over for Question 2 on *Page six*

DO NOT WRITE IN THIS MARGIN

Marks

2. Study the diagram of the rock quarry face below.



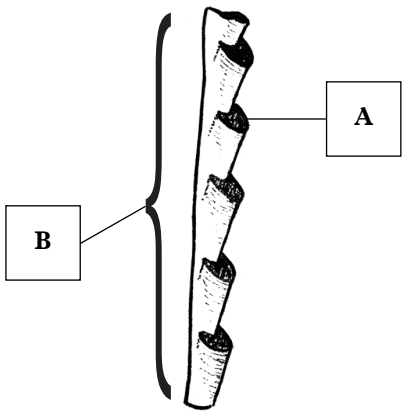
(*a*) What **three** pieces of evidence suggest that the rocks are upside down?

(i) .....

(ii) .....

(iii) **3**

(*b*) Study the diagram of a graptolite below and identify features A and B.



A .....

B **2**

DO NOT WRITE IN THIS MARGIN

Marks

2. (continued)

(*c*) Which **one** of the following statements is correct?

A Graptolites are used to zone late Palaeozoic and Mesozoic rocks.
B Graptolites are usually found in a life assemblage.
C Graptolites are planktonic freshwater organisms.
D Graptolites are used to zone lower Palaeozoic rocks.

Give only the letter **1**

(*d*) Which **one** of the following statements is correct?

A Turbidite and greywacke are different terms for the same rock type.
B Greywackes are well sorted sandstones containing only rounded quartz grains.
C Turbidity currents flow rapidly down the continental slope or submarine canyons.
D Turbidity currents flow slowly along the continental shelf.

Give only the letter **1**

[Turn over

3. The table below shows distance across an oceanic destructive plate margin and the associated gravity anomalies.

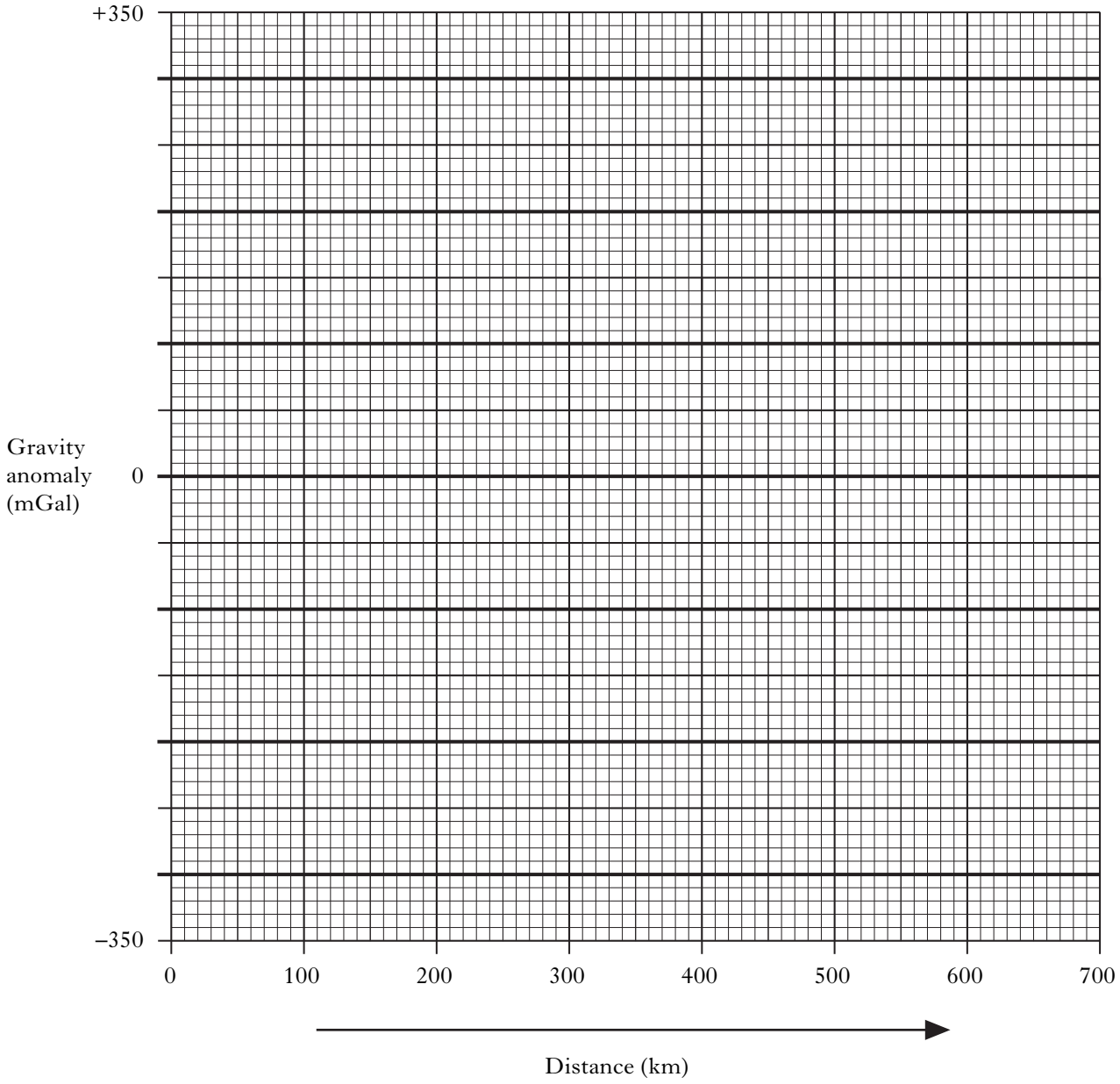
Distance (km)	*Gravity anomaly* (mGal)
50	–20
100	–10
150	10
200	20
250	0
300	–200
350	–330
400	–200
450	50
500	150
550	–20
600	–100
650	–30
700	0

DO NOT WRITE IN THIS MARGIN

Marks

3. (continued)

(*a*) On the graph paper below, plot gravity anomaly against distance.



2

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks

3. (continued)

(*b*) (i) Label the largest positive gravity anomaly on the graph. **1**

(ii) **Explain** the presence of the major negative anomaly and major positive anomaly.

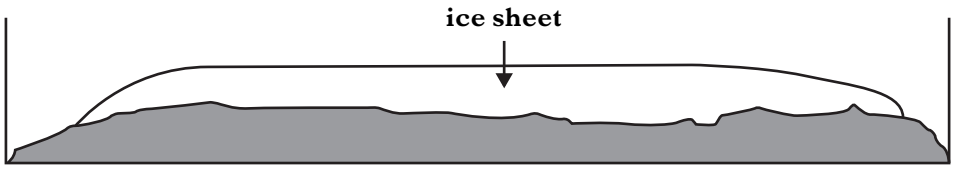
.....

.....

.....

..... **2**

(*c*) Using the diagram, **explain** why a positive gravity anomaly exists over the continent shown.



Explanation

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.....

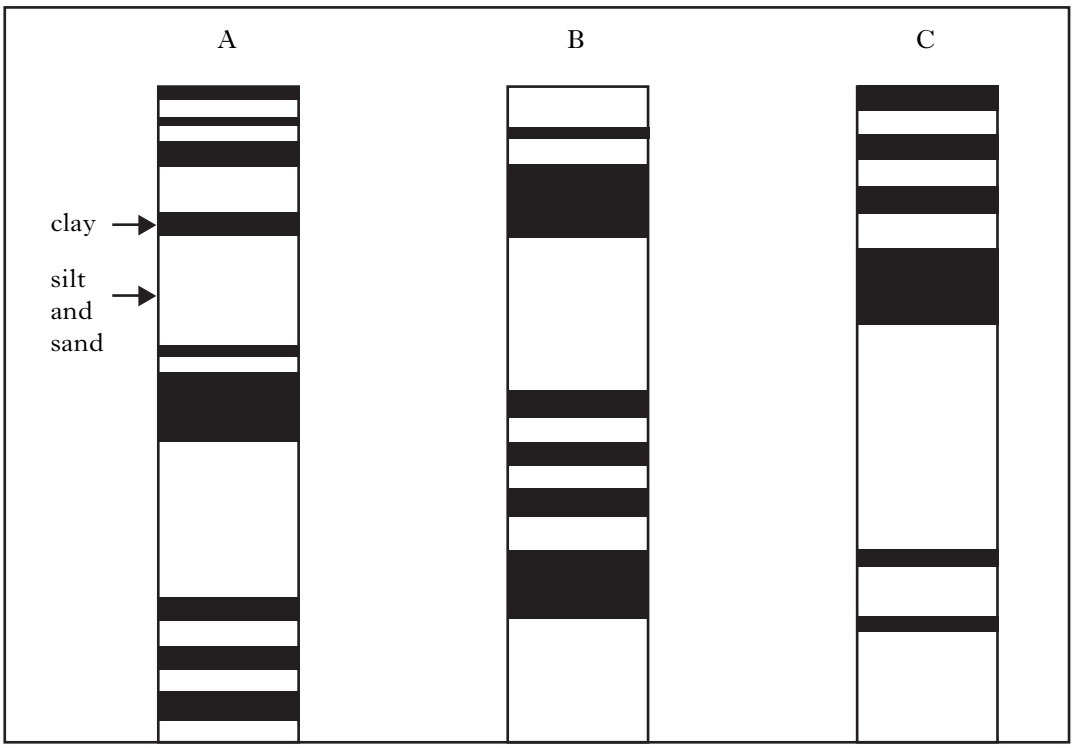
.....

..... **2**

DO NOT WRITE IN THIS MARGIN

Marks

4. The boreholes below show varves from three lake beds in Sweden.



(*a*) (i) Draw lines on the diagram above to match up the sequences in the different lakes. **1**

(ii) **Explain** the term "varve".

.....

..... **1**

(iii) How many years of deposition are represented by the sediments in the boreholes?

..... **1**

(*b*) Which **one** of the following statements about stratigraphy is correct?

A Correlation is the matching up of sequences in different areas on the basis of lithology only.

B Diachronous beds can only contain fossils from one zone.

C Time marker horizons are often locally distributed and are capable of being traced over a small geographical area.

D Overlap is a type of unconformable relationship.

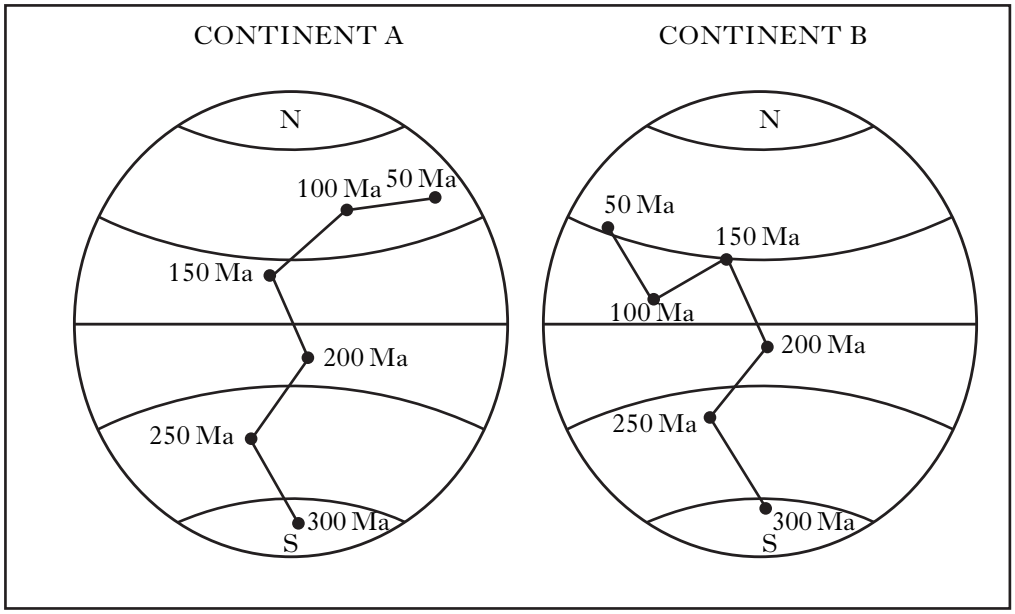
Give only the letter **1**

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks

5. Study the diagram showing the apparent polar wandering curves for continents A and B.



(*a*) Describe how the continents have moved over the last 300 million years in relation to each other.

.....

.....

.....

.....

..... **2**

Polar wandering curves provide evidence for the relative movement of continents.

(*b*) Give **three** other pieces of evidence for continental drift.

(i) .....

(ii) .....

(iii) **3**

DO NOT WRITE IN THIS MARGIN

Marks

5. (continued)

(*c*) (i) 65 million years ago India lay 30 degrees south of the equator. Today it is 20 degrees north.

One degree of latitude is 110 km. Calculate the minimum drift rate of India over the last 65 million years.

Space for working

Answer ..... mm/year **2**

(ii) Why might the drift rate be greater than that calculated above?

.....

.....

.....

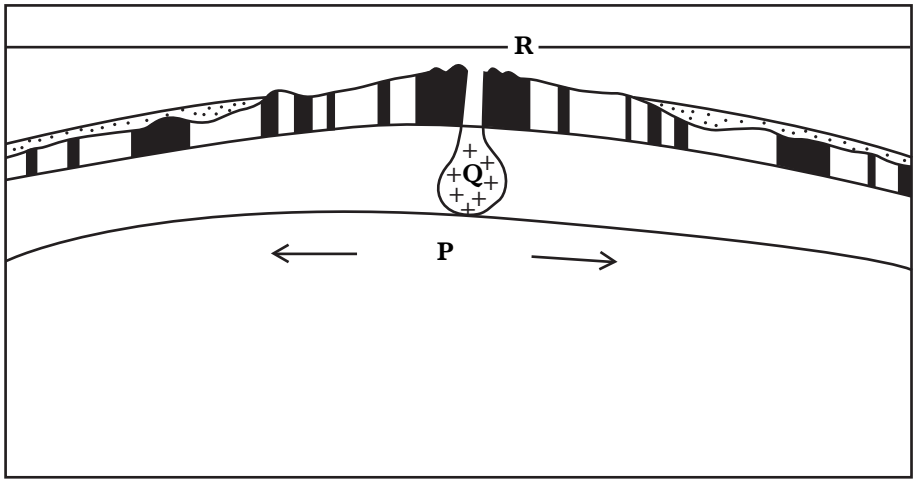
..... **1**

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks

6. Study the diagram of a plate boundary below.



(*a*) Which **one** of the following statements is correct?

A The Earth's magnetic field is axial and dipolar.
B The Earth's magnetic field is biaxial and polar.
C The Earth's magnetic field is produced by electrical currents flowing in the inner core.
D The Earth's magnetic field reverses every 5 million years.

Give only the letter **1**

(*b*) Which **one** of the following statements is correct?

A Sea floor spreading occurs at ocean trenches.
B Reverse faulting occurs at mid ocean ridges.
C Oceanic crust contains the Earth's oldest rocks.
D Basaltic volcanism occurs at constructive plate boundaries.

Give only the letter **1**

(*c*) Which **one** of the following statements is correct?

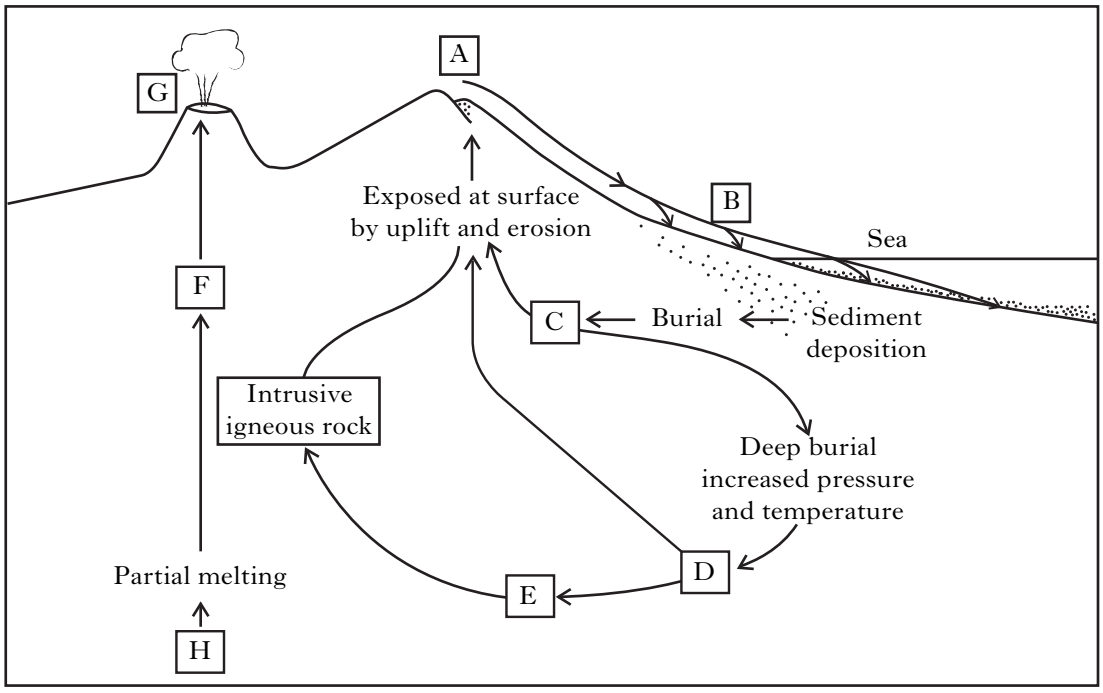
A Basaltic magma is formed by the partial melting of peridotite at P.
B Q is depleted in silica and enriched in ferromagnesian minerals relative to P.
C Pillow lavas found at R have coarsely crystalline skins.
D Partial melting of Q creates P.

Give only the letter **1**

DO NOT WRITE IN THIS MARGIN

Marks

7. Study the diagram of the rock cycle below.



Glaciofluvial, extrusive rocks, mantle, pegmatite, weathering and erosion, biochemical precipitation, melting, transportation, magma, cone sheet, metamorphic rock, sedimentary rock.

Match the letters on the diagram with the correct term from the wordbox.

A .....

B .....

C .....

D .....

E .....

F .....

G .....

H **4**

Section A: Total (40) marks

DO NOT WRITE IN THIS MARGIN

Marks

SECTION B

This section consists of three questions. Only ONE question should be attempted. Fifteen marks are allocated to this section.

Candidates should write their answer on pages 17, 18, 19 and 20.

Additional space for answers may be found at the end of this book.

8. Write an essay on ores.

Credit will be given for the use of diagrams.

Give details as follows.

(*a*) The formation of ores by internal processes, eg magmatic, hydrothermal and contact metasomatic processes **6**

(*b*) The formation of ores by surface processes, eg placer deposits, secondary enrichment **6**

(*c*) Methods of exploration to find and extract ore deposits **3**

(15)

9. Write an essay on sedimentary rocks.

Credit will be given for the use of diagrams.

Give details as follows.

(*a*) The formation of rocks from sediments **3**

(*b*) The use of sedimentary structures in determining way upness and environments of deposition **6**

(*c*) The classification of sedimentary rocks **6**

(15)

10. Write an essay on earthquakes and the internal structure of the Earth.

Credit will be given for the use of diagrams.

Give details as follows.

(*a*) Causes of earthquakes and types of earthquake waves **6**

(*b*) How the study of earthquakes is used to determine the internal structure of the Earth **6**

(*c*) The evidence used to determine the composition and structures of the mantle and core **3**

(15)

Section B: Total (15) marks

NOW GO TO SECTION C ON PAGE TWENTY-ONE

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SPACE FOR ANSWERS

DO NOT WRITE IN THIS MARGIN

SPACE FOR ANSWERS

DO NOT WRITE IN THIS MARGIN

SPACE FOR ANSWERS

DO NOT WRITE IN THIS MARGIN

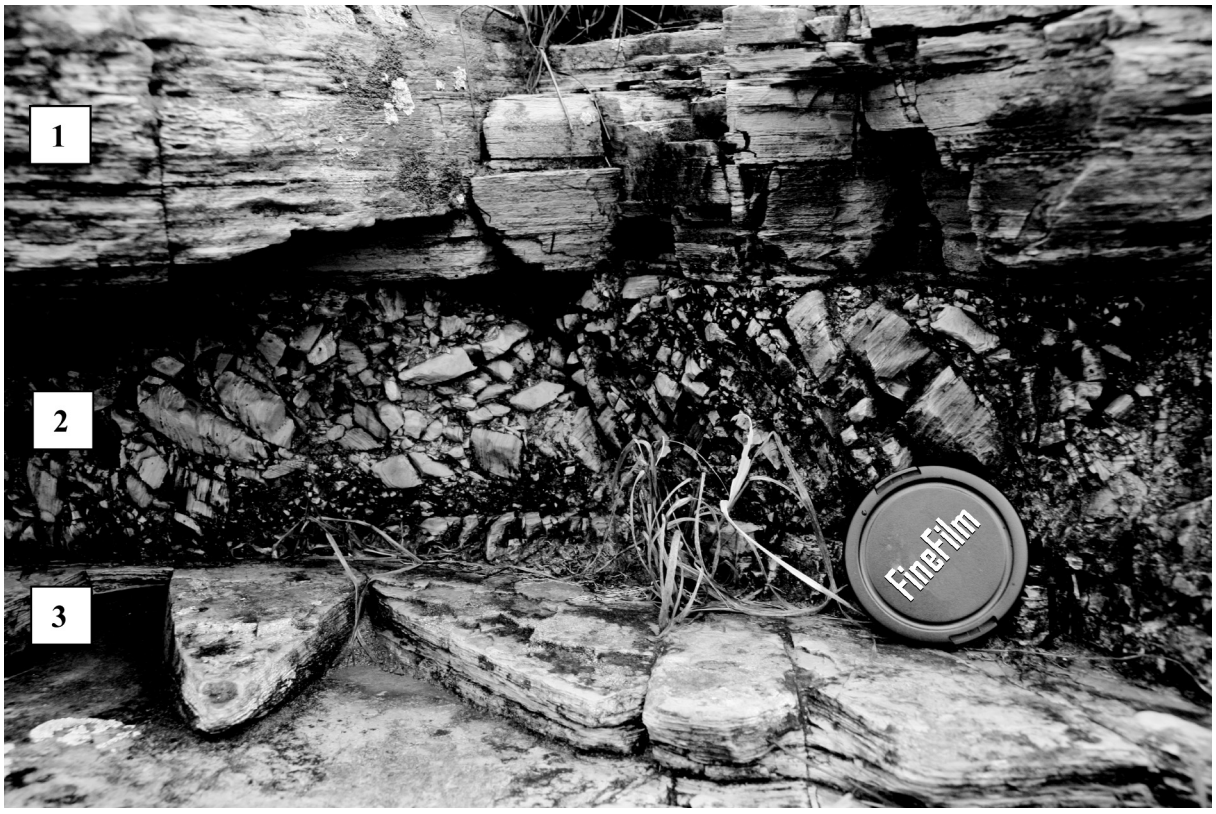
SPACE FOR ANSWERS

Marks

SECTION C

All questions in this section should be attempted. Forty marks are allocated to this section.

11. Look at the photograph below.



Layer 1: fine grained sandstone
Layer 2: consists of broken fragments from layer 3
Layer 3: fine grained sandstone

(*a*) Describe the depositional environment that would have led to the formation of rock layers one and three.

.....

.....

.....

..... **2**

(*b*) Why would it be unlikely to find fossils in layer two?

.....

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..... **1**

DO NOT WRITE IN THIS MARGIN

Marks

11. (continued)

(*c*) **Explain** how the three rock layers might have been formed. Diagrams may be used.

.....

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.....

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.....

.....

Space for diagrams

3

[Turn over for Question 12 on *Page twenty-four*

Marks

12. Study the map (on the **separate worksheet**) and answer the questions based on it.

(*a*) (i) Which **one** of the following statements correctly describes the movement of the rocks on the north west side of **fault F1**?

A They have moved to the north west.

B They have moved to the south east.

C They have moved upwards.

D They have moved downwards.

Give only the letter: **1**

(ii) Give a reason for your answer.

.....

..... **1**

(iii) The fault plane of **F1** dips 72° north west. What type of fault is **F1**?

..... **1**

(*b*) Which **three** of the following statements are correct?

A Two unconformities are shown on the map.

B Three unconformities are shown on the map.

C Fault **F2** cuts through the granite.

D Fault **F2** is a tear fault.

E Fault **F2** is a thrust fault.

F Fault **F2** is older than the microgranite dyke.

G The granite intrusion is younger than the conglomerate.

H The microgranite dyke is older than the basalt dyke.

I The metamorphic aureole around the granite is of constant width.

J There are three anticlines shown on the map.

K There are three synclines shown on the map.

L The breccia rests uncomformably on the dolerite.

Give only the letters: ....., ... and **3**

Marks

12. (continued)

(*c*) (i) Place an "**F**" on the geological map where you think this photograph of a vertical exposure was taken. **1**

(ii) Using diagrams, **explain** the formation of the structure shown in the photograph above.

.....

.....

.....

Space for diagrams

2

Marks

12. (continued)

(*d*) This photograph was taken at point "**S**" looking west.

(i) **Explain** the formation of the igneous structures shown in the diagram above (**Diagrams may be used**).

.....

.....

.....

2

(ii) Using diagrams, **explain** why this layer of igneous rock is younger than the breccia.

.....

.....

.....

Space for diagrams

2

DO NOT WRITE IN THIS MARGIN

Marks

12. (continued)

(*e*) Place a letter "**H**" on the map where you would expect to find hornfels. **1**

(*f*) On the topographic profile, (on the **separate worksheet**), complete the geological section between points X and Y on the map. **4**

(*g*) Place the geological events of this map area in the correct order by inserting the correct letters from the list below.

The events in this table are not in the correct order.

A	Formation of schist
B	Basalt dyke
C	Microgranite dyke
D	Deposition of sandstone and mudstone
E	Dolerite intrusion
F	Folding
G	Granite intrusion
H	Fault F2
I	Fault F1
J	Deposition of conglomerate and breccia

Give only the letters

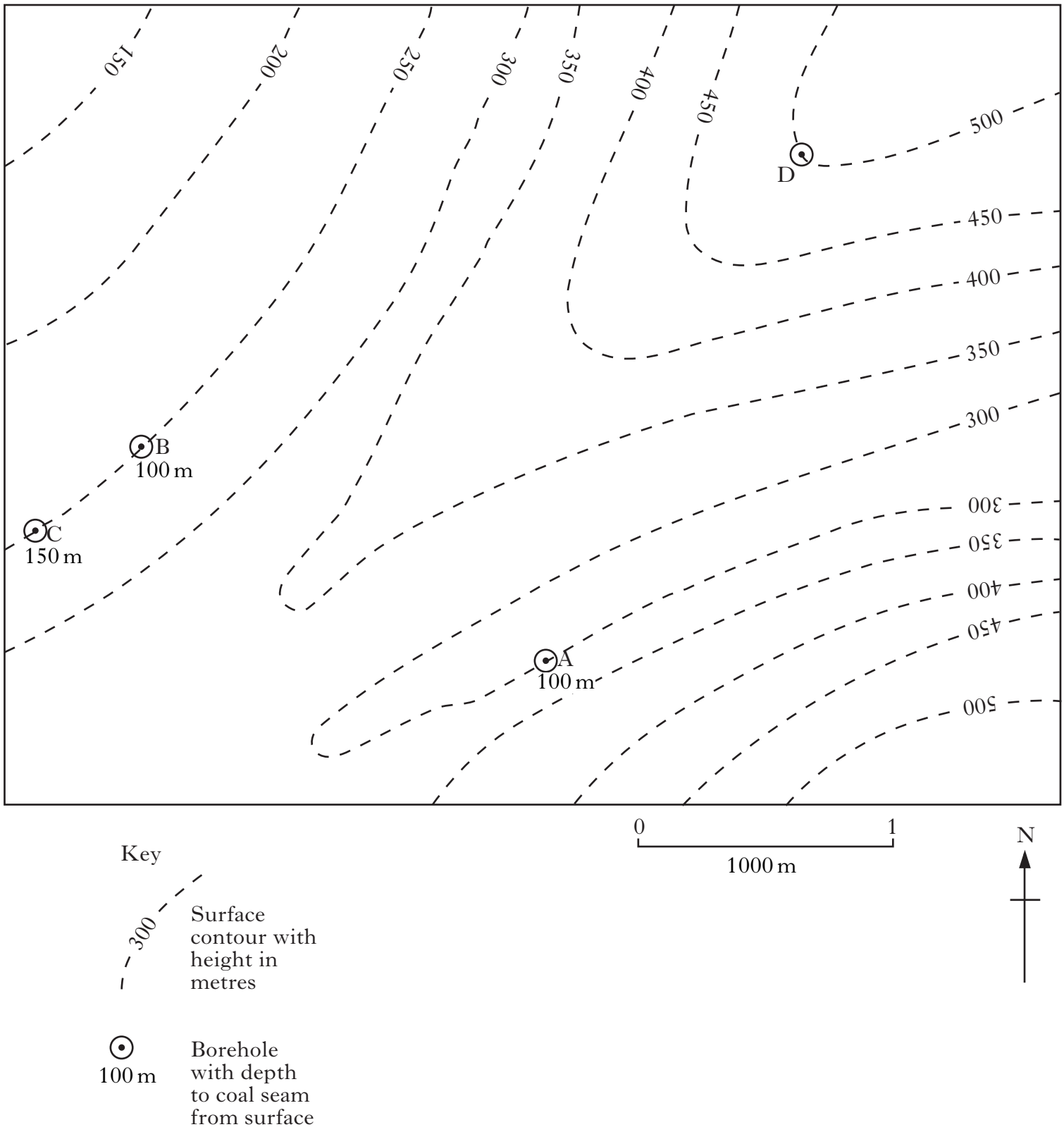
YOUNGEST

G
A

OLDEST **4**

13. Study the map below then answer the questions on the next page.

A constantly dipping coal seam has been found in boreholes, A, B and C at depths shown on the map below.



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Marks

13. (continued)

(*a*) Draw structure contours across the whole map for the coal seam. **4**

(*b*) At what angle and direction does the coal seam dip?

..... degrees to the .....

Space for working

2

(*c*) Draw the outcrop of the coal seam. **3**

(*d*) At what depth below the surface will the coal seam be found in borehole D?

..... **1**

(*e*) Shade in the area or areas not underlain by the coal seam. **2**

Section C: Total (40) marks

[*END OF QUESTION PAPER*]

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SPACE FOR ANSWERS OR FOR ROUGH WORK

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SPACE FOR ANSWERS OR FOR ROUGH WORK

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NATIONAL QUALIFICATIONS 2011

MONDAY, 16 MAY
1.00 PM – 3.30 PM

GEOLOGY
HIGHER
Worksheet for Question 12

Fill in these boxes and read what is printed below.

Full name of centre

Town

Forename(s)

Surname

Date of birth

Day Month Year

Scottish candidate number

Number of seat

To be inserted inside the front cover of the candidate's answer book and returned with it.

Key (Rocks not in order of age)

- dolerite
- microgranite
- basalt
- sandstone
- conglomerate
- schist
- granite
- mudstone
- limestone
- metamorphic aureole
- breccia

- horizontal strata
- 70 strike and dip with dip in degrees
- F fault

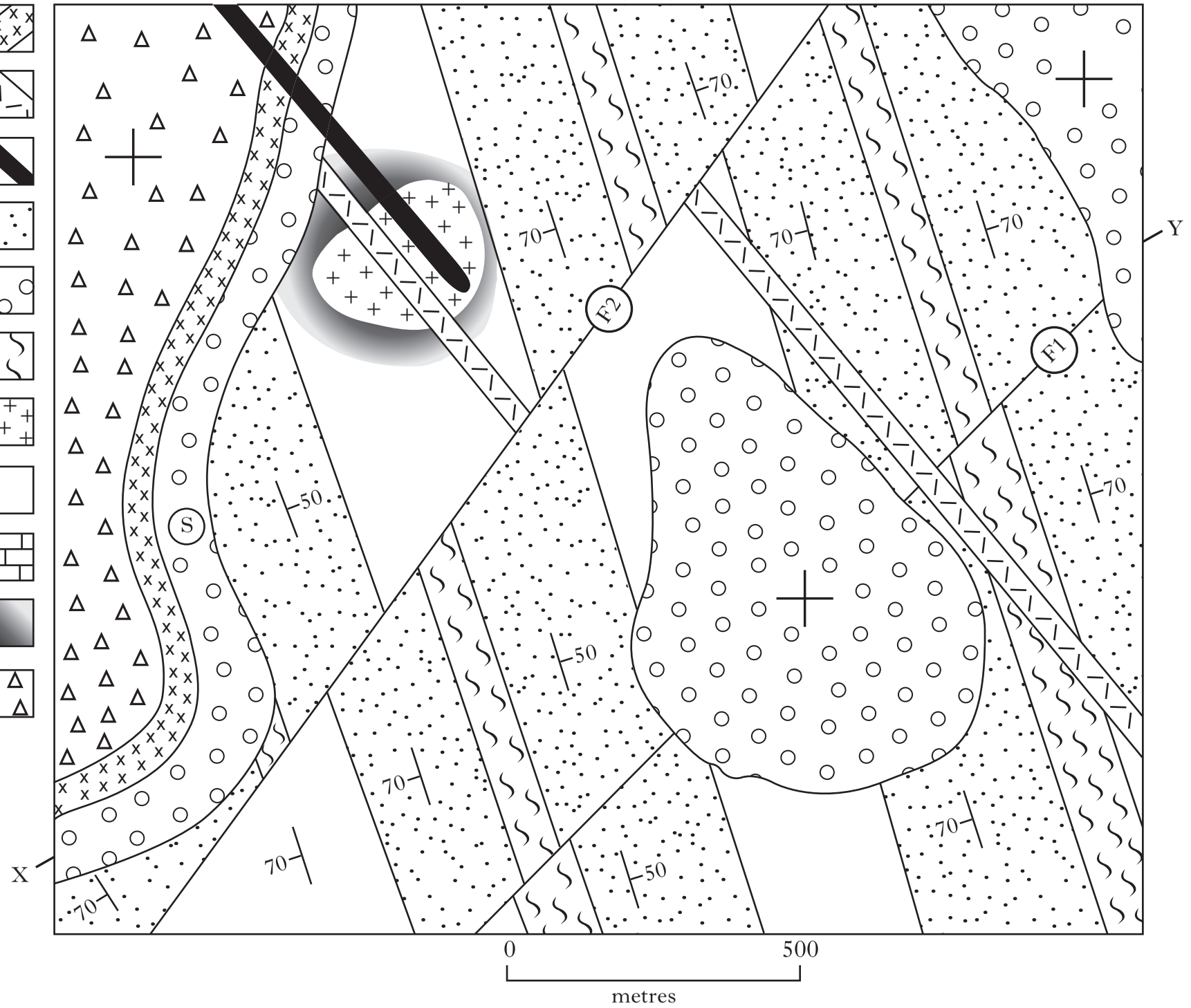
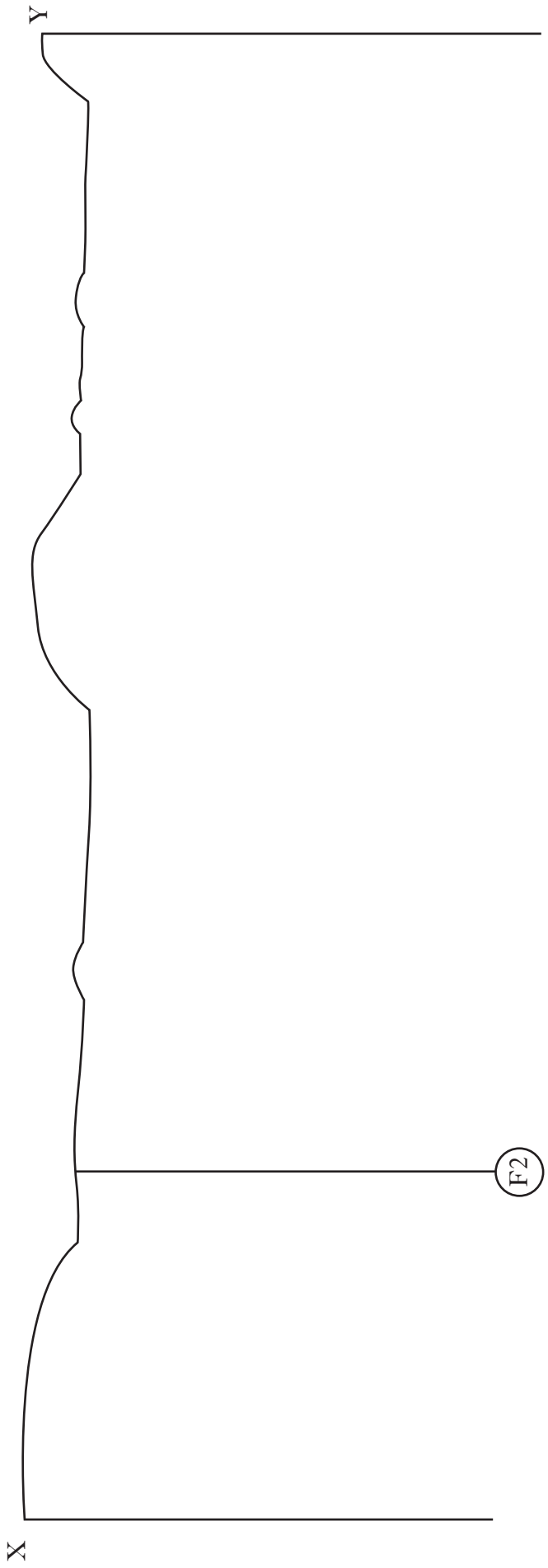


Figure Q12(*f*)



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