FOR OFFICIAL USE

Total

X043/301

NATIONAL QUALIFICATIONS 2007

THURSDAY, 24 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.

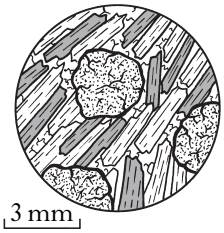
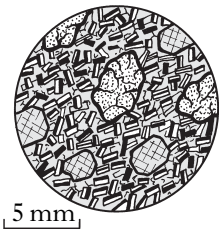
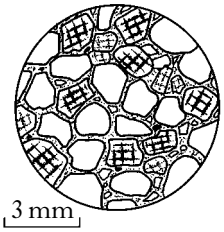
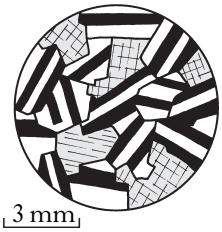
6 Before leaving the examination room you must give this book to the invigilator. If you do not, you may lose all the marks for this paper.

SECTION A

Marks

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

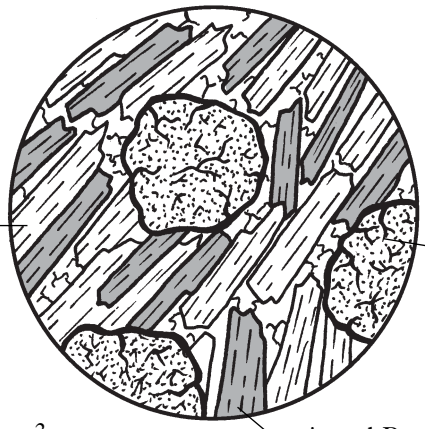
1. Complete the table below. Use the page opposite to get a more detailed view of the thin sections.

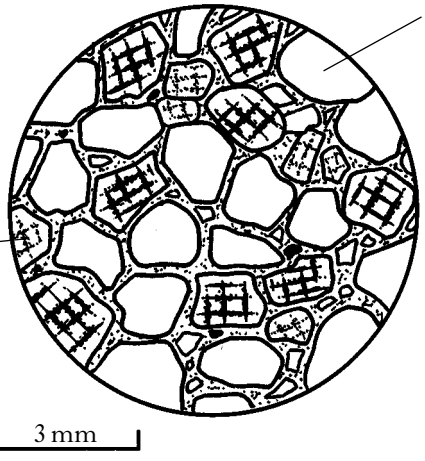
Thin section of rock	*Names of minerals*	*Name of rock*
	Mineral A ..... Mineral B ..... Mineral C	
	Mineral D ..... Mineral E	
	Mineral F ..... Mineral G	
	Mineral H	

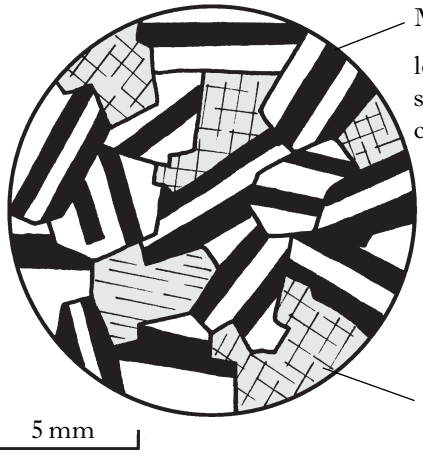
6

1. (continued)

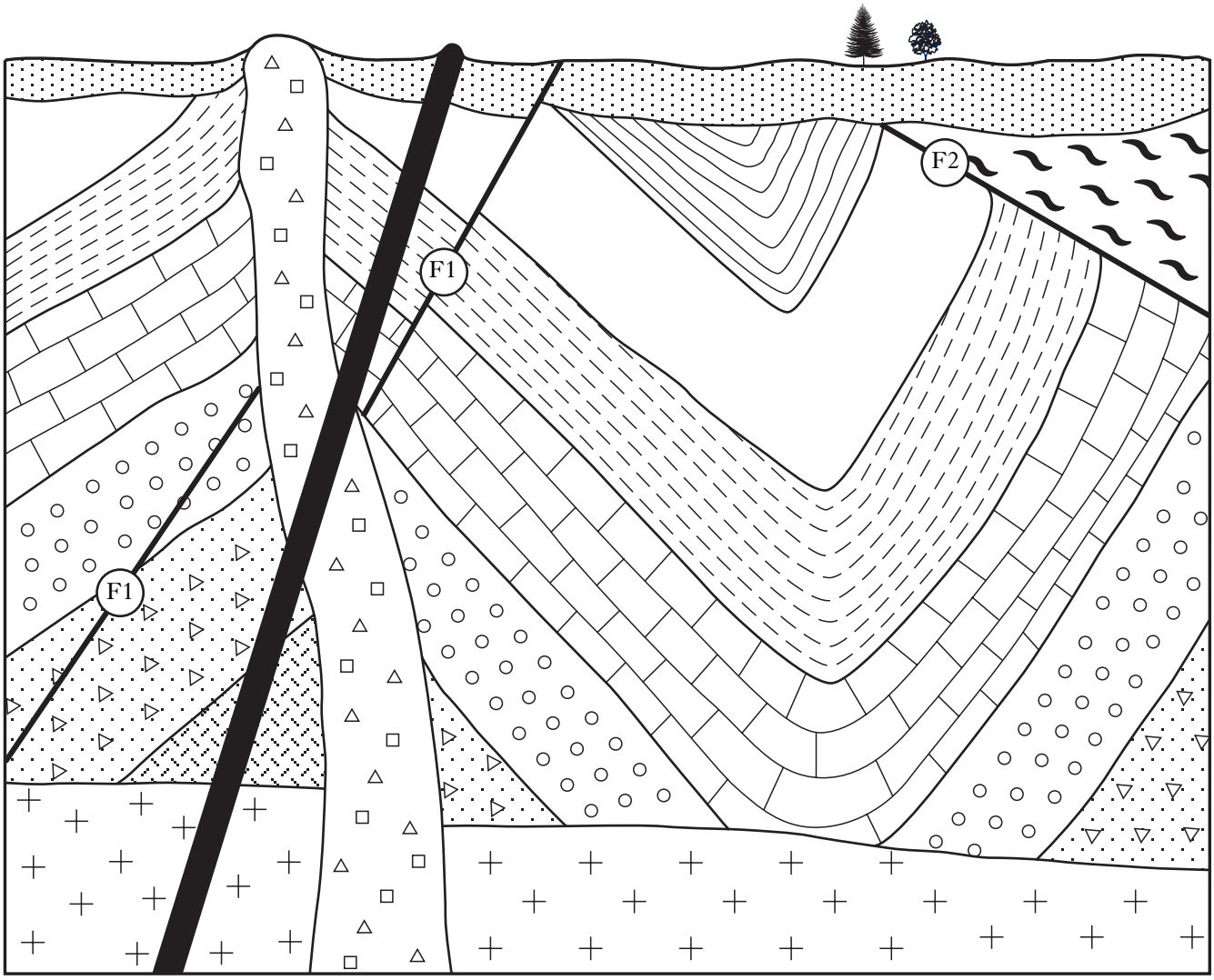
Thin section of rock







2. Examine the geological cross section below.



Key (rocks not in order of age)

dolerite
conglomerate
schist
limestone
shale
breccia
granite
mudstone
sandstone
broken volcanic rock
greywacke
andesite

Marks

2. (continued)

Which **three** of the following statements best describe the relationships shown in the cross section?

A Fault F2 is a thrust fault.

B Fault F1 is older than fault F2.

C Fault F1 has been cut by another fault.

D The broken volcanic rock is the youngest rock.

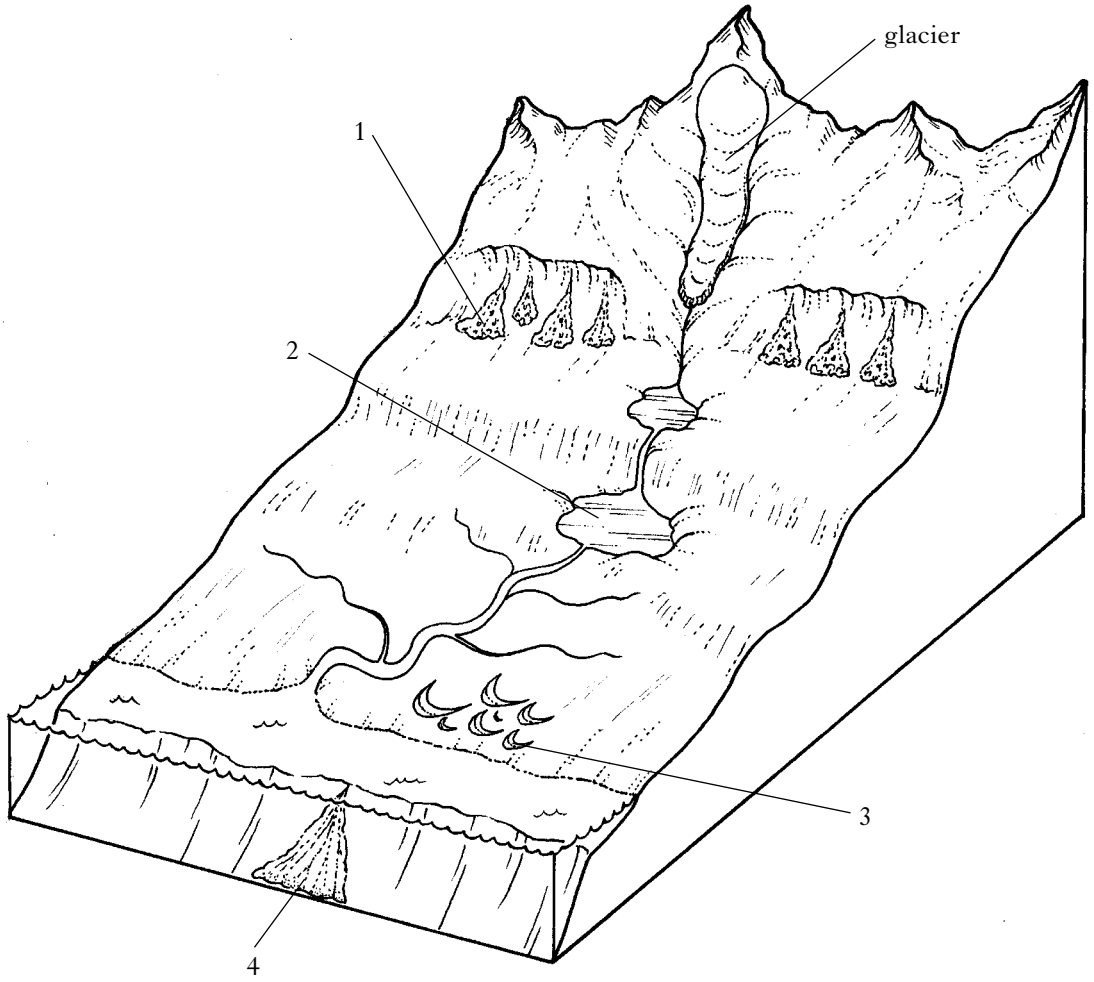
E There have been two faulting events.

F The dolerite is the youngest rock.

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

[Turn over

3. This diagram shows a variety of depositional environments numbered 1, 2, 3 and 4.



3. (continued)

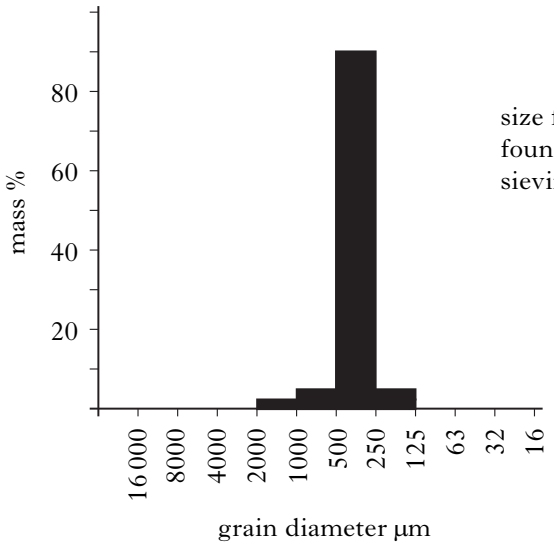
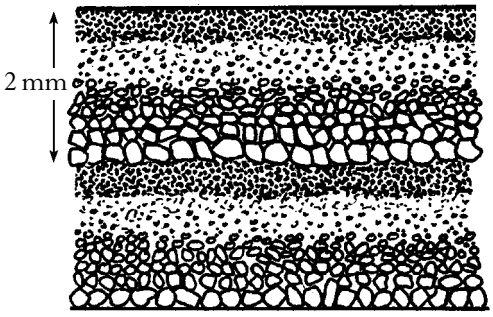
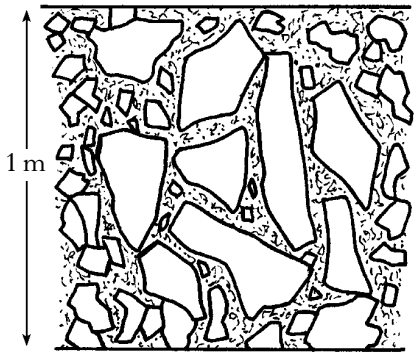
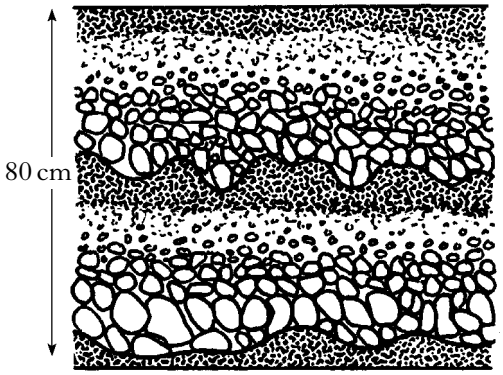
DO NOT WRITE IN THIS MARGIN

The table below gives information about each of the sediments deposited in environments 1 to 4.

Complete the table by matching each sediment to its environment of deposition.

Give a reason for each choice.

Marks

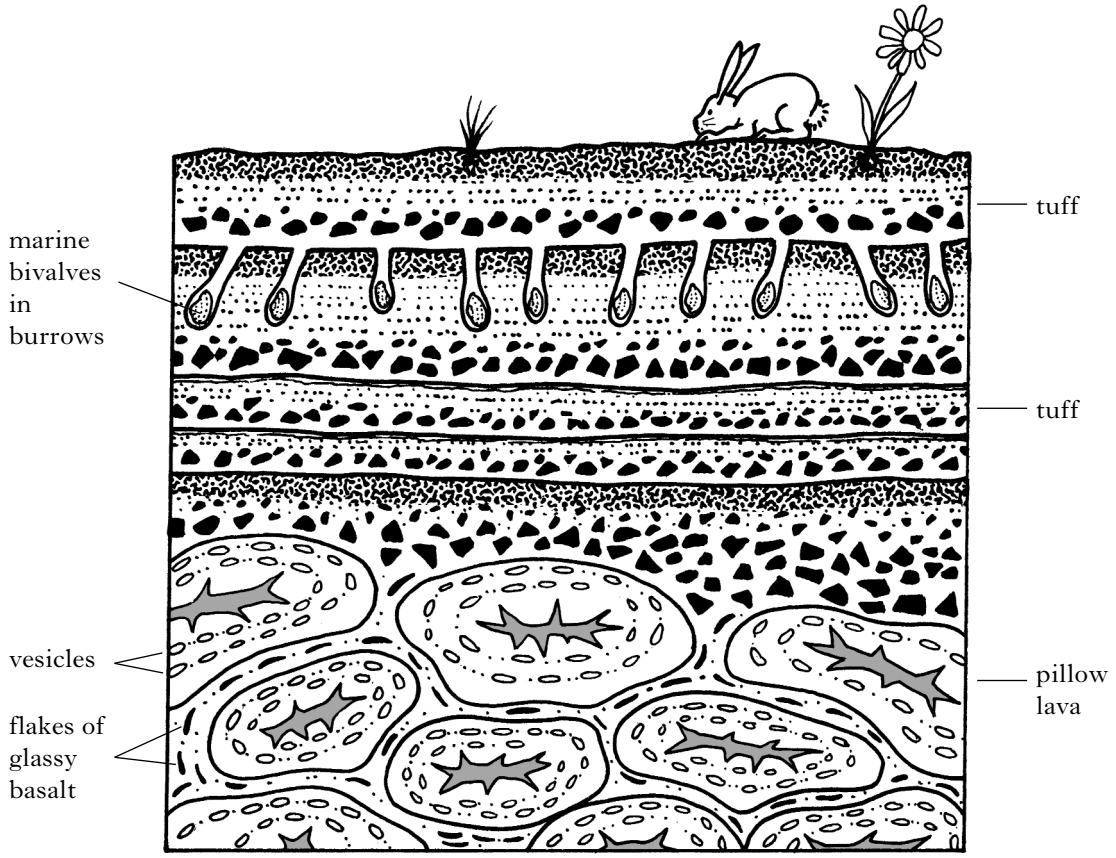
sediment W  size fractions found by sieving	Environment _____ Reason
sediment X  sedimentary structure	Environment _____ Reason
sediment Y  appearance of sedimentary sample	Environment _____ Reason
sediment Z  sedimentary structure	Environment _____ Reason

6

DO NOT WRITE IN THIS MARGIN

Marks

4. Study the diagram of the rock exposure and answer the questions based on it.



(*a*) Explain why pillow lavas show the following features:

(i) flakes of glassy basalt;

.....

..... **1**

(ii) vesicles in concentric bands.

.....

..... **1**

DO NOT WRITE IN THIS MARGIN

Marks

4. (continued)

(*b*) (i) How is tuff formed?

.....

..... **1**

(ii) Explain why the tuff in the diagram forms regular layers with graded bedding.

.....

.....

..... **2**

(*c*) Do the bivalves form a life or death assemblage? Give a reason for your answer.

Life or death assemblage .....

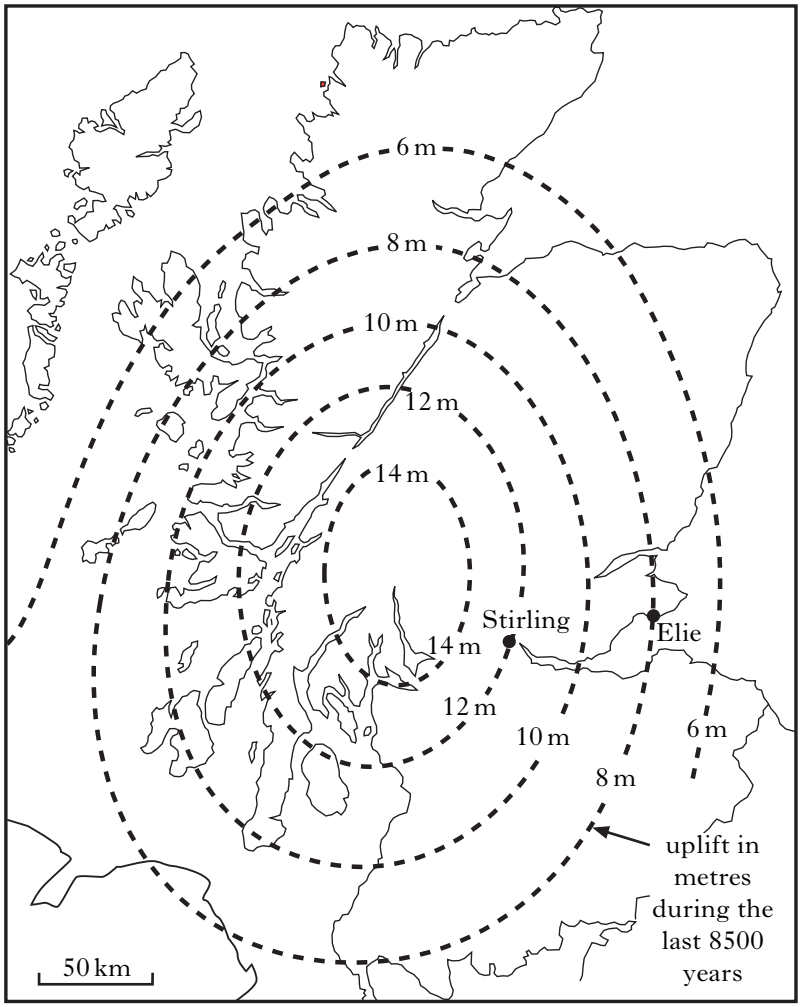
Reason .....

..... **1**

[Turn over

Marks

5. The diagram shows the amount of uplift which has taken place over Scotland during the last 8500 years.



(*a*) Calculate the average rates of uplift per year at Stirling and Elie over the last 8500 years.

Average rate at Stirling .....

Average rate at Elie **2**

Space for working

(*b*) Explain why the rates of uplift for Stirling and Elie are different.

.....

..... **1**

[Turn over for Question 6 on *Page twelve*

6. Rocks containing fossils have been collected from Canada and Scotland.

Data collected on species, grouped by age, are shown in the table below.

Age of rocks (millions of years)	*Number of same species found in both Canada and Scotland*	*Total number of species found in Canada*	*Total number of species found in Scotland*	*Similarity of species in Canada and Scotland* (%)
185	80	127	94	
165	74	90	132	82
125	68	87	118	
88	62	90	106	
36	32	62	51	63
18	15	36	25	

(*a*) Complete the table to show the similarity of species between Canada and Scotland.

Use this equation.

$$\text{Similarity of species} = \frac{\text{Number of same species found in both Canada and Scotland}}{\text{Smaller total number of species found in Canada or Scotland}} \times 100\%$$

2

Space for working

(*b*) (i) On the graph paper provided opposite, draw a graph of age of rocks against similarity of species (%). **2**

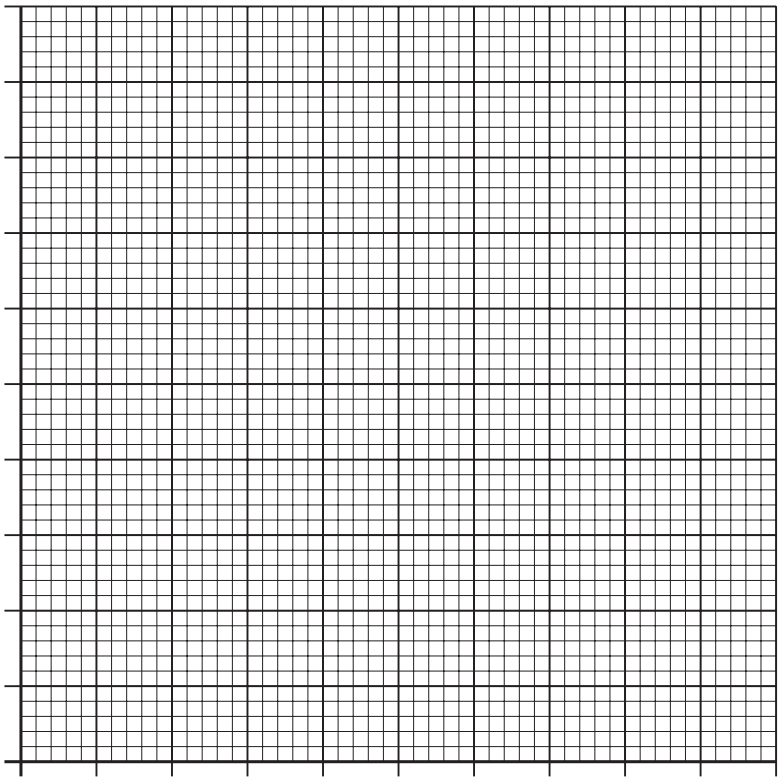
(ii) Describe the general relationship shown by the graph.

.....

..... **1**

Marks

6. (continued)



(*c*) What percentage similarity would you expect to find between species living now in Canada and Scotland?

.....

..... **1**

(*d*) What does the fossil evidence indicate about the width of the Atlantic Ocean between Canada and Scotland over the last 185 million years?

.....

..... **1**

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks

7. (*a*) Which **two** statements correctly describe the Earth's magnetic field?

A The field is approximately axial and dipolar.

B The inner core is a solid magnet. This is what produces the Earth's magnetic field.

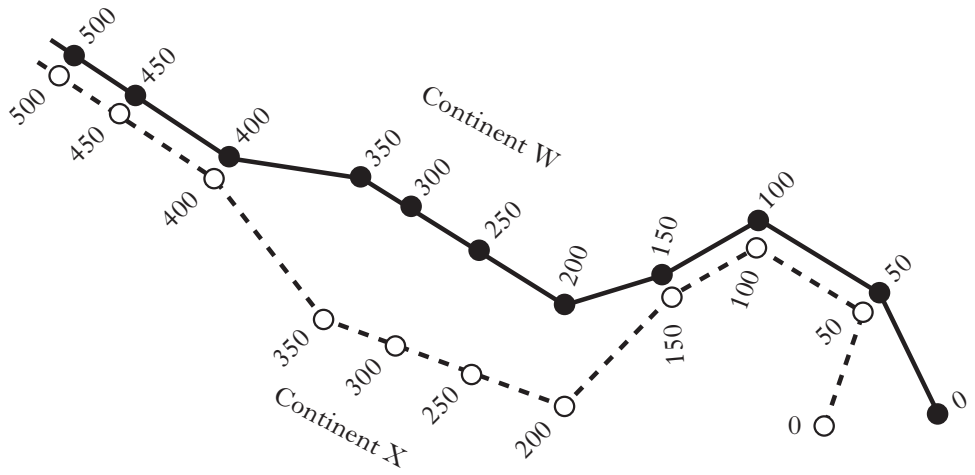
C The magnetic field is produced by convection currents flowing in the Earth's mantle.

D The field is exactly axial and dipolar.

E The magnetic field is produced by electrical currents flowing in the Earth's liquid outer core.

Give only the letters: ..... and **2**

(*b*) The diagram shows apparent polar wandering curves for two continents. Figures are millions of years ago.



(i) How have continents W and X moved relative to each other over the last 500 million years?

.....

.....

..... **2**

(ii) Why are the polar wandering curves described as "apparent"?

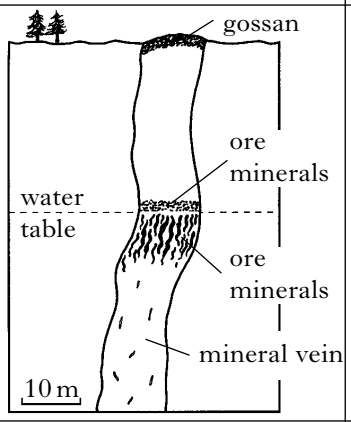
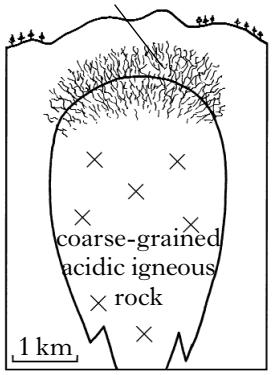
.....

..... **1**

DO NOT WRITE IN THIS MARGIN

Marks

8. Complete the table below.

Diagram of ore deposit	*Type of ore deposit*	*Ore mineral or metal commonly found in ore deposit*
		
	Magmatic segregation	
	Placer	
ore minerals in stockwork 		

4

Section A: Total (40) marks

SECTION B

Marks

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 and 19.

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

9. Write an essay on metamorphic rocks.

Credit will be given for the use of maps and diagrams.

Give details as follows.

(*a*) Regional metamorphism in the Scottish Highlands

(Include mention of the following: how regional metamorphism is caused; metamorphic grades; index minerals; part played by regional metamorphism in the rock cycle.) **8**

(*b*) How slate would be changed by metamorphism caused by a large igneous intrusion **4**

(*c*) Dynamic metamorphism **3**

(15)

10. Write an essay on plate tectonics.

Credit will be given for the use of maps and diagrams.

Give details as follows.

(*a*) The evidence for continental drift **5**

(*b*) The causes of plate movement **2**

(*c*) Igneous activity at destructive plate margins **4**

(*d*) Igneous activity at constructive plate margins **4**

(15)

11. Give an account of the geology of an area you have studied.

Maps and diagrams must be used.

Give details as follows:

- location of the area
- rock types and how they were formed
- geological features and structures, eg, folds, faults, fossils, igneous and sedimentary structures
- methods of establishing the relative ages of the rocks, eg cross cutting relationships, way up criteria, unconformity, etc
- any other relevant information. **(15)**

Section B: Total (15) marks

NOW GO TO SECTION C ON PAGE TWENTY

DO NOT WRITE IN THIS MARGIN

SPACE FOR ANSWERS

DO NOT WRITE IN THIS MARGIN

SPACE FOR ANSWERS

DO NOT WRITE IN THIS MARGIN

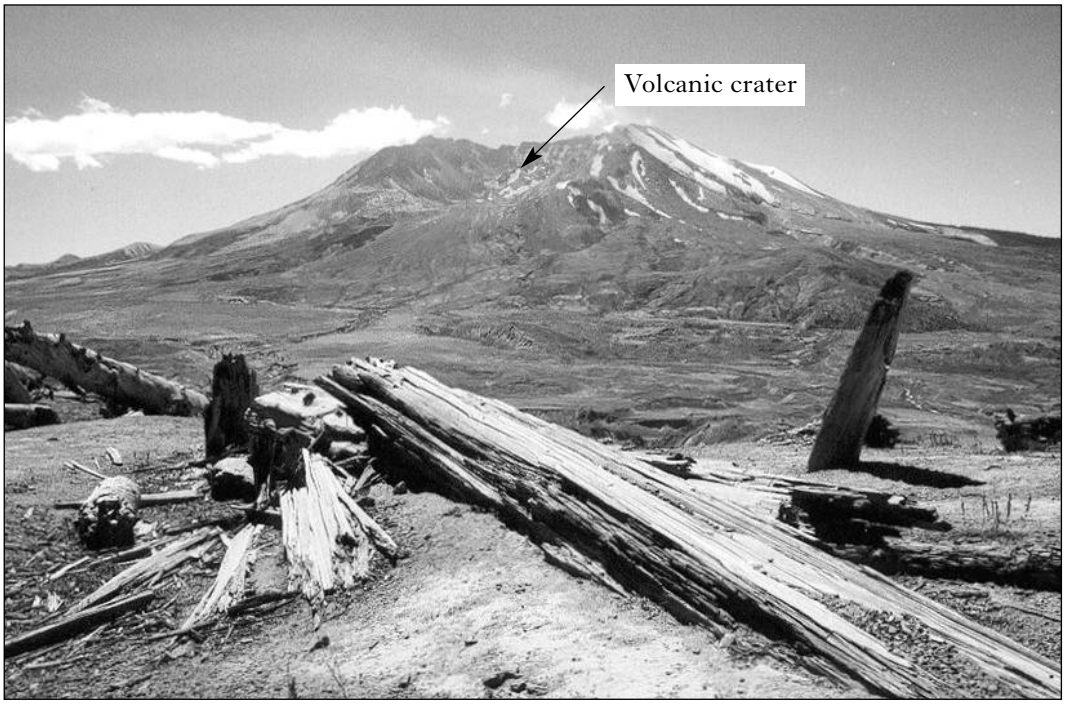
SPACE FOR ANSWERS

SECTION C

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

Marks

12. Look at the photograph below.



(*a*) What geological process created the landscape shown in the picture above?

..... **1**

(*b*) Using diagrams, explain how this process happens.

2

Marks

13. Look at the photograph below.

(*a*) Name the geological deposit shown in the photograph.

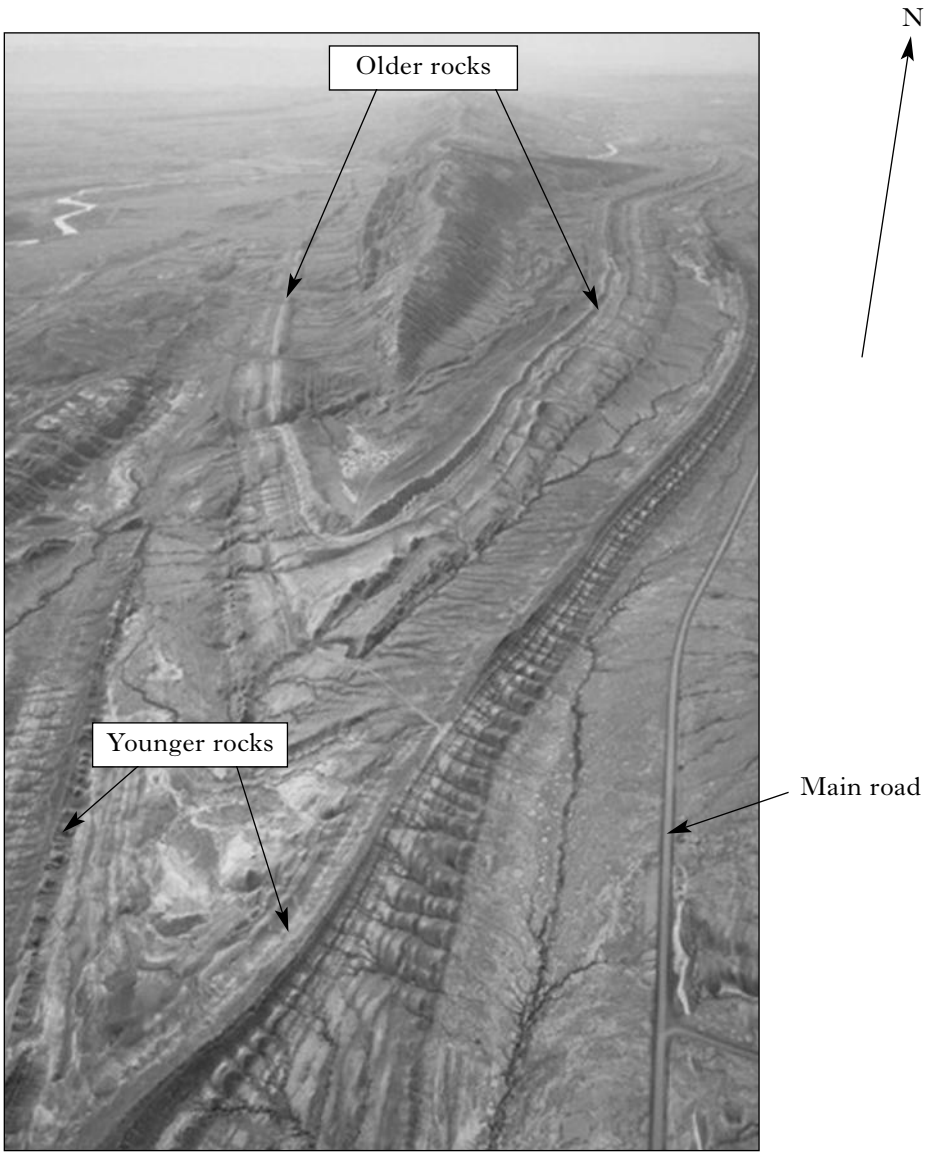
..... **1**

(*b*) Using diagrams, suggest at least **one** way a feature like this could be formed.

2

Marks

14. Look at the aerial photograph below.



(*a*) The rocks in the centre of this structure are older than those on the outside.
What type of geological structure is this?

..... **1**

(*b*) The structure plunges in a ..... direction. **1**

DO NOT WRITE IN THIS MARGIN

Marks

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

(*a*) (i) On which side of fault F1 have the rocks moved up? Give a reason for your answer.

Answer .....

Reason .....

..... **1**

(ii) On which side of fault F2 have the rocks moved up? Give a reason for your answer.

Answer .....

Reason .....

..... **1**

(*b*) The granite has xenoliths of diorite and gneiss. Explain why the granite has no xenoliths of quartzite or conglomerate.

.....

..... **1**

(*c*) Which **two** statements are correct?

A The dolerite lies on top of faults F1 and F2.

B Two unconformities are present.

C The gneiss has not been folded.

D The granite will cut through the felsite.

E The map shows an anticline and a basin.

F In the area east of the map, the diorite will cut fault F2.

Give only the letters: ..... and **2**

(*d*) From the map, how can you tell that the felsite forms a sill and not a lava flow?

.....

.....

..... **1**

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks

15. (continued)

(*e*) Give **one** reason to explain each of the following observations.

(i) Gneiss xenoliths in the granite show more recrystallisation than the diorite xenoliths.

Reason .....

..... **1**

(ii) Xenoliths at the western end of the granite outcrop show much less recrystallisation than xenoliths at the eastern end of the outcrop.

Reason .....

..... **1**

(iii) The number of diorite xenoliths changes along the granite outcrop. The number of gneiss xenoliths does not change.

Reason .....

..... **1**

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

Marks

15. (continued)

(*g*) Place the geological events of this map area in the correct order by inserting the correct letters from the box at the bottom of the page. (Give only the letters.)

YOUNGEST

D	Intrusion of dolerite
C	Folding of conglomerate
A	Deposition of arkose
K	Folding of sedimentary quartzite
B	Extrusion of basalt
L	Intrusion of diorite

6

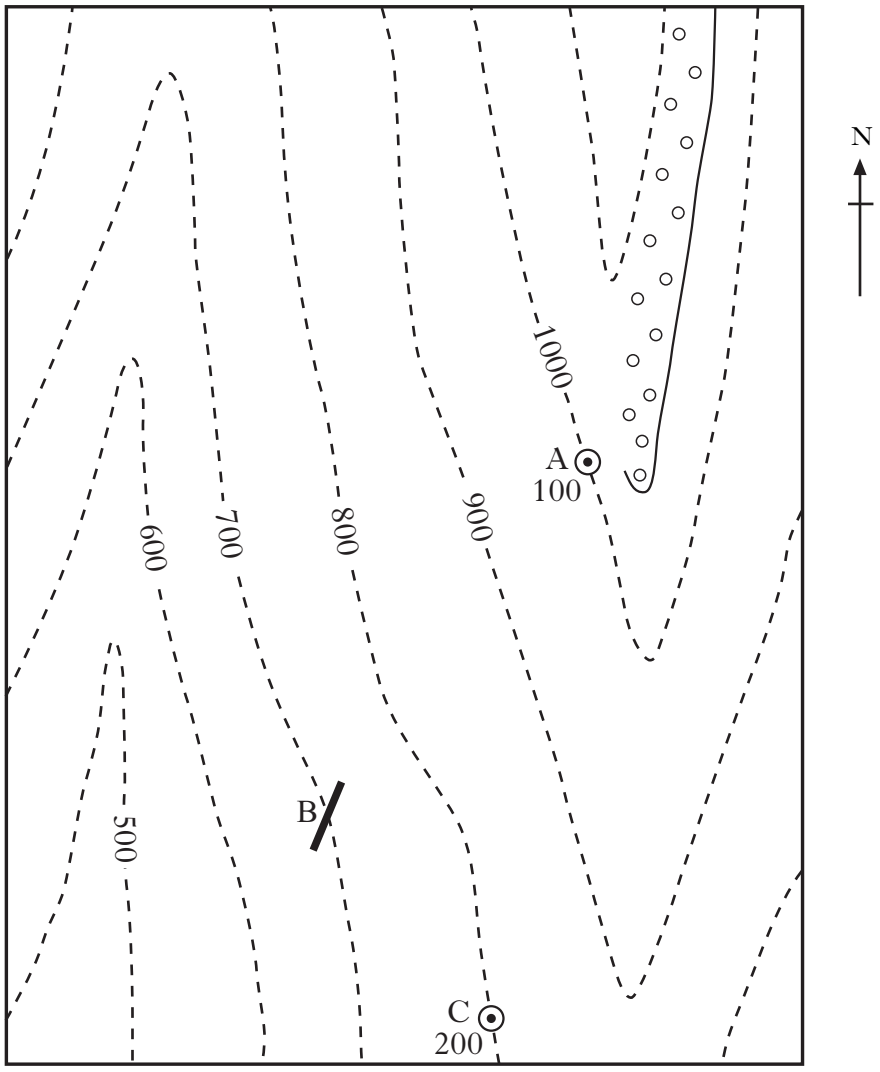
OLDEST

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

A	Deposition of arkose	**G**	Intrusion of granite
B	Extrusion of basalt	**H**	Movement on fault F2
C	Folding of conglomerate	**I**	Formation of gneiss
D	Intrusion of dolerite	**J**	Intrusion of felsite
E	Deposition of siltstone	**K**	Folding of sedimentary quartzite
F	Movement on fault F1	**L**	Intrusion of diorite

[Turn over

16. The map below shows part of an outcrop of conglomerate and an underlying coal seam.
Study the map and answer the questions on the page opposite.



Key

1000 surface contour with height shown in metres

outcrop of conglomerate

A borehole with depth in metres to coal seam from surface

B outcrop of coal seam

Marks

16. (continued)

(*a*) Part of the outcrop of a bed of conglomerate is shown. Complete the outcrop of the conglomerate. **1**

(*b*) A coal seam of uniform dip is found in boreholes A and C, at the depths from the surface shown. The coal seam outcrops at B.

(i) Draw structure contours for the coal seam over the whole area of the map. **3**

(ii) Draw in the outcrop of the coal seam. **3**

(iii) Calculate the angle of dip of the coal seam.

..... **2**

Space for working

(*c*) A lower coal seam with the same strike and dip occurs 200 metres beneath the coal seam in question 16(*b*).

Renumber the structure contours and draw in the outcrop of the lower coal seam. **2**

(*d*) Shade the area in which both coal seams could be mined. **2**

Section C: Total (40) marks

[*END OF QUESTION PAPER*]

DO NOT WRITE IN THIS MARGIN

SPACE FOR ANSWERS OR FOR ROUGH WORK

FOR OFFICIAL USE

Total

X043/302

NATIONAL QUALIFICATIONS 2007

THURSDAY, 24 MAY
1.00 PM – 3.30 PM

GEOLOGY
HIGHER
Worksheet for Question 15

Fill in these boxes and read what is printed below.

Full name of centre

Town

Forename(s)

Surname

Date of birth
Day Month Year

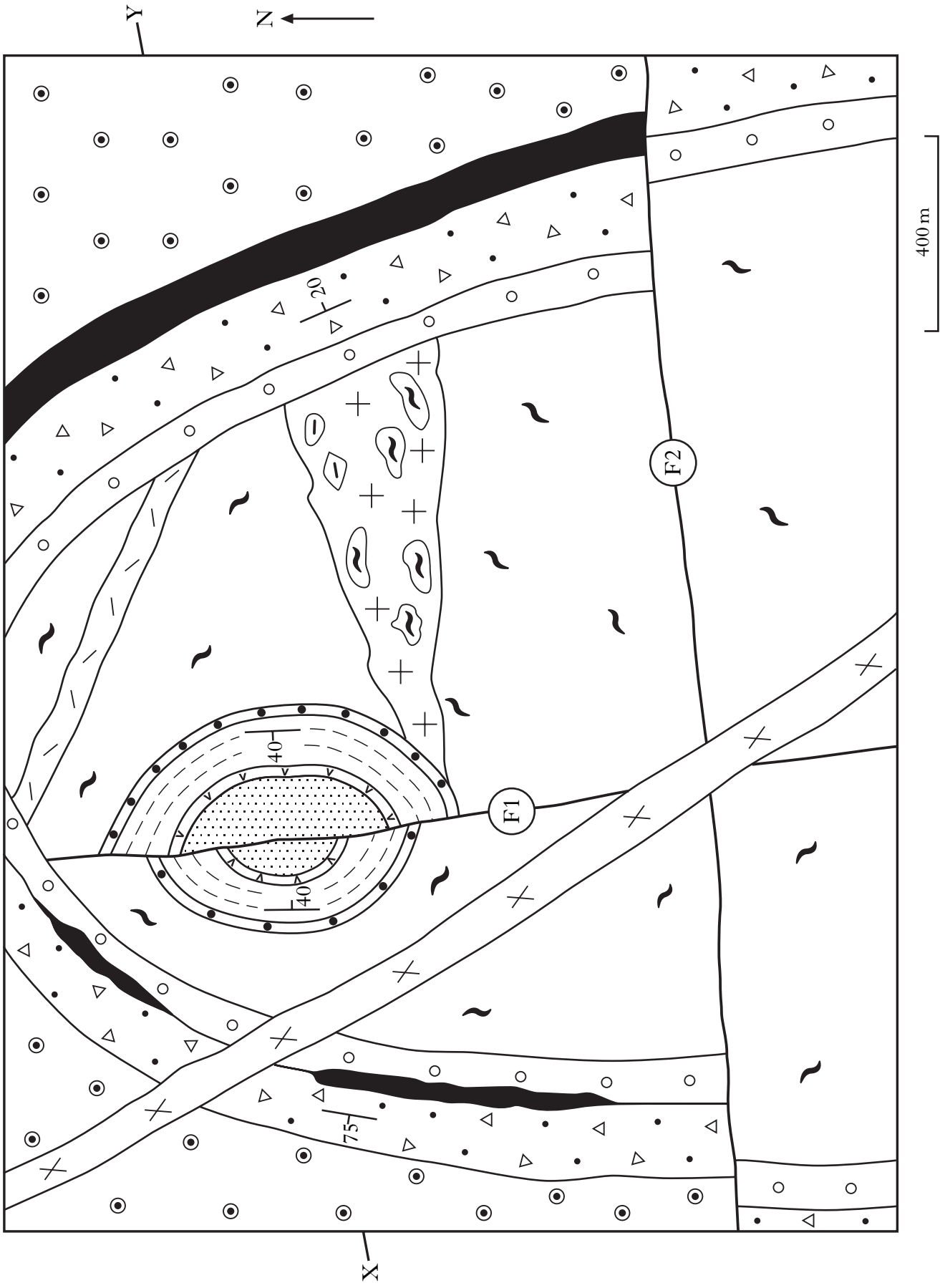
Scottish candidate number

Number of seat

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

LI X043/302 6/670

Worksheet Q15



Key (Rocks not in order of age)

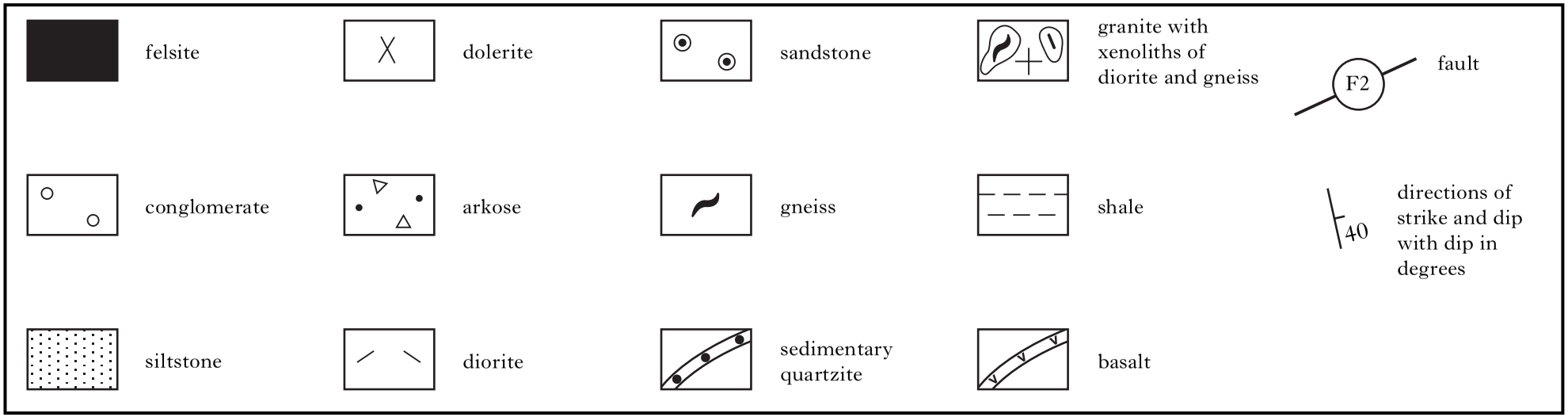
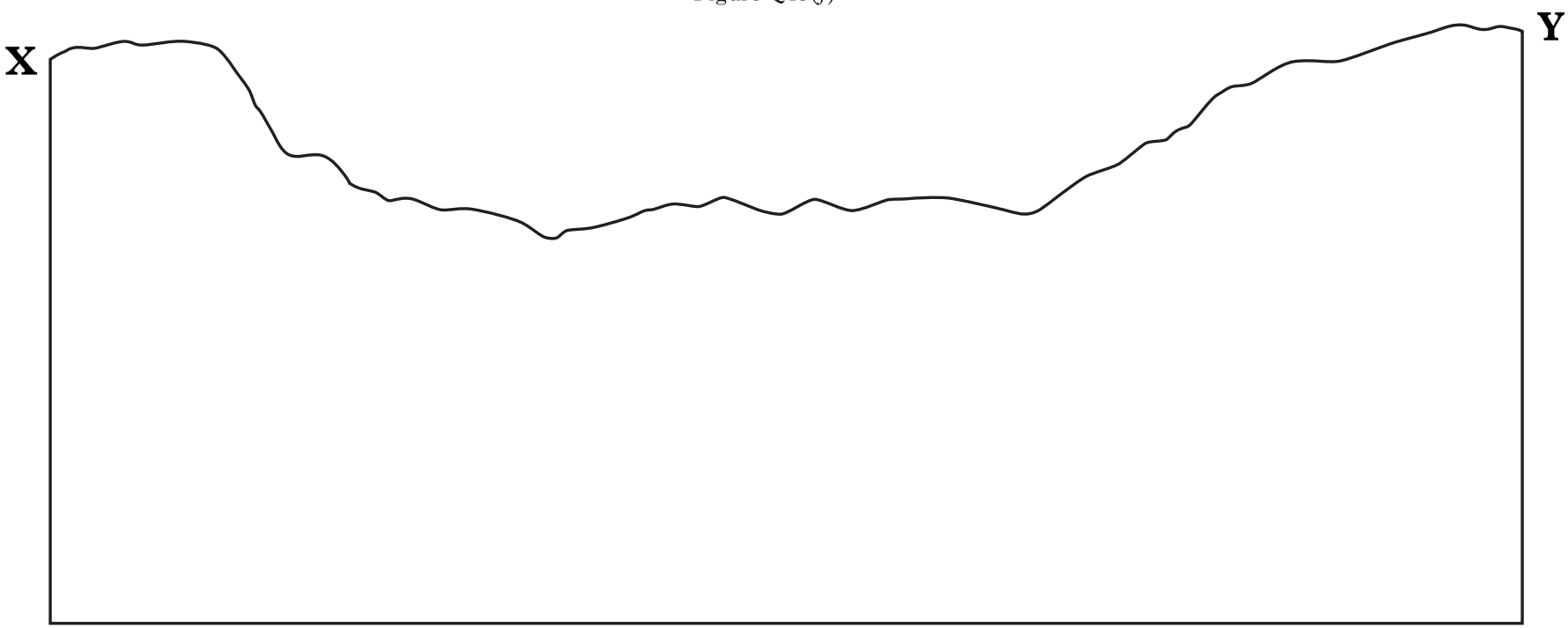


Figure Q15(*f*)



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