FOR OFFICIAL USE

Total

X043/12/01

NATIONAL QUALIFICATIONS 2012

THURSDAY, 3 MAY
9.00 AM – 11.30 AM

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.

DO NOT WRITE IN THIS MARGIN

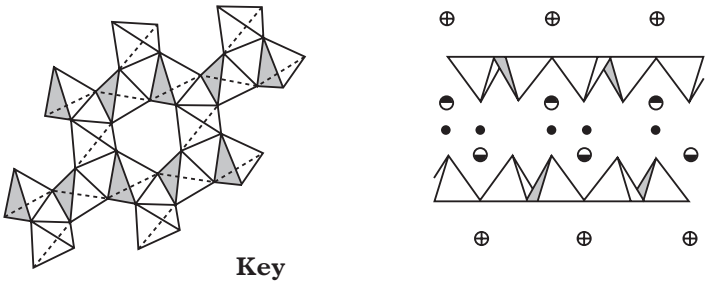
SECTION A

Marks

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

1. Use the diagram below to explain the following observations.

Quartz **Biotite mica**



Key

 tetrahedron of silicon and oxygen (SiO_4)

⊕ potassium ion

◓ hydroxide ion

• iron or magnesium ion

(*a*) (i) Biotite mica can split easily into thin flexible sheets.

.....

..... **1**

(ii) Quartz is less dense than biotite mica.

.....

..... **1**

(iii) Quartz has no cleavage.

.....

..... **1**

(*b*) Give **one** similarity and **one** difference between biotite and muscovite.

Similarity .....

Difference **2**

DO NOT WRITE IN THIS MARGIN

1. (continued) *Marks*

(*c*) Put four of the following minerals into their correct chemical groups in the table below:

Garnet, Barite, Dolomite, Fluorite, Galena, Cassiterite.

Halides	*Sulphides*	*Carbonates*	*Silicates*

2

(*d*) Complete the table below by selecting the correct mineral from the word box.

chalcopyrite, gypsum, malachite, calcite, talc, haematite, olivine

Colour	*Relative Density*	*Hardness*	*Name of mineral*
Dark and light green stripes	4	3	
Grey/white	2·7	1	
Usually colourless or white	2·7	3	
Black or browny red	5	6	

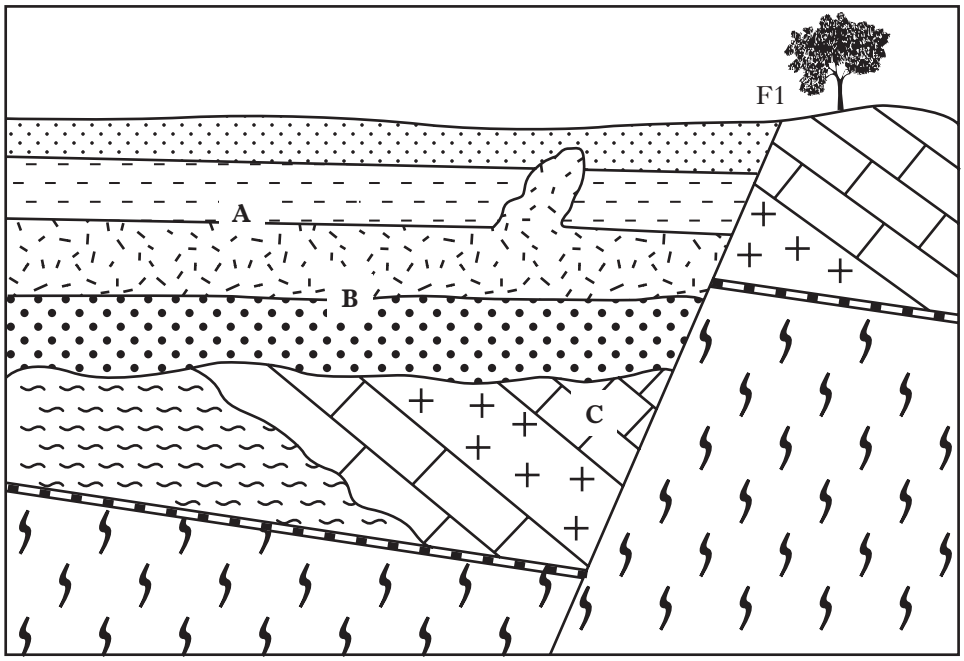
2

[Turn over

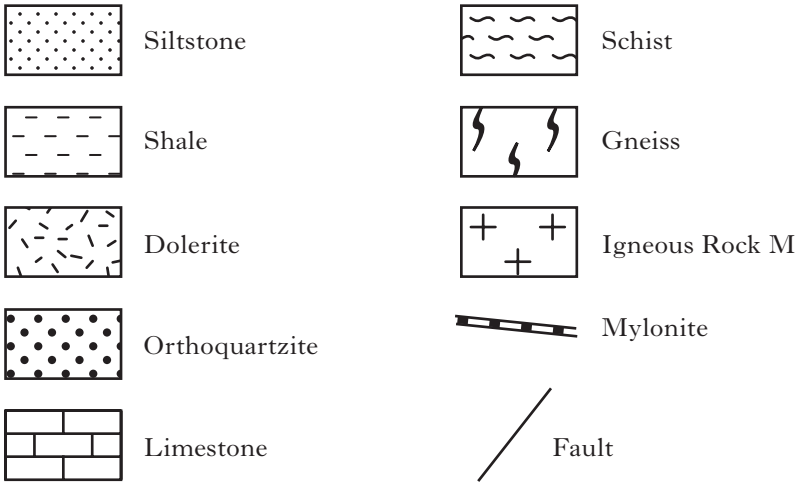
DO NOT WRITE IN THIS MARGIN

Marks

2. Study the diagram below of a quarry face and answer the questions based on it.



Key (Rocks not in order of age)



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

A The siltstone is the youngest rock in the quarry face.
B The dolerite is the youngest rock in the quarry face.
C Three unconformities are present in the quarry face.
D Three different sedimentary rocks are present in the quarry face.

Give only the letter **1**

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

A Fault F1 is a reverse fault.
B The rock at A is Hornfels.
C Mylonite is formed by contact metamorphism.
D New minerals will have formed at B as a result of contact metamorphism.

Give only the letter **1**

2. (continued) *Marks*

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

A Two different types of fault are evident in the quarry face.
B Dolerite is a fine grained basic igneous rock.
C Gneiss is a metamorphic rock formed at low temperatures and high pressures.
D The limestone rests conformably on the schist.

Give only the letter **1**

(*d*) Chalcopyrite is found at "**C**" in the quarry face. **Explain** how it was formed.

.....

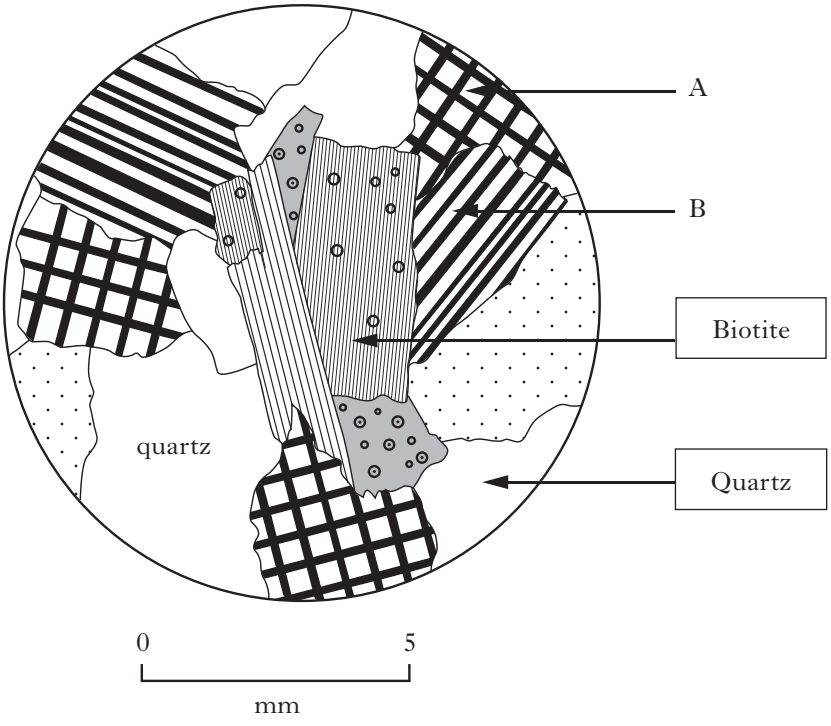
.....

.....

.....

..... **2**

(*e*) Study the thin section from igneous **rock M** shown under crossed polarised light.



(i) Identify minerals

A ..... B **2**

(ii) Name **rock M**

..... **1**

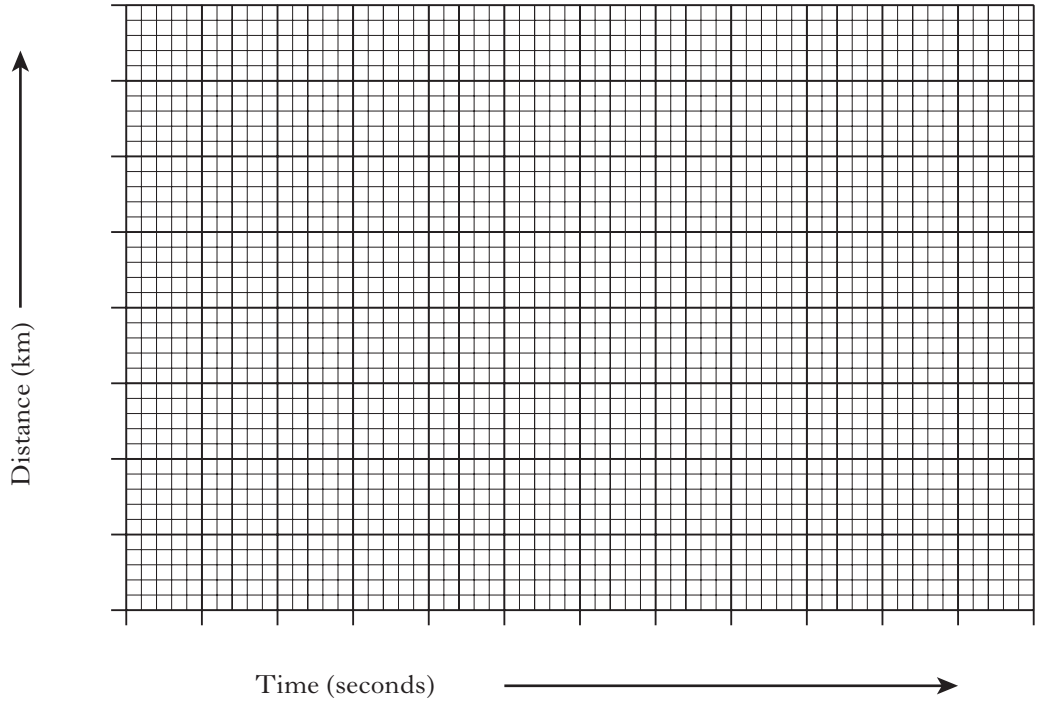
DO NOT WRITE IN THIS MARGIN

Marks

3. The table below shows information about earthquake waves near to the surface of the Earth.

P–Waves		*S–Waves*	
Distance from epicentre	Travel time (seconds)	Distance from epicentre	Travel time (seconds)
100 km	18	100 km	29
200 km	36	200 km	58
300 km	54	300 km	87
400 km	72	400 km	116

(*a*) Draw travel time lines on the graph paper below for P– and S–waves.



2

(*b*) Calculate the difference between P– and S–wave speed.

Space for working

Answer ..... km/s

1

3. (continued) *Marks*

(*c*) (i) A difference of 40 seconds is recorded between the arrival times of P– and S–waves. What distance is this seismometer from the epicentre?

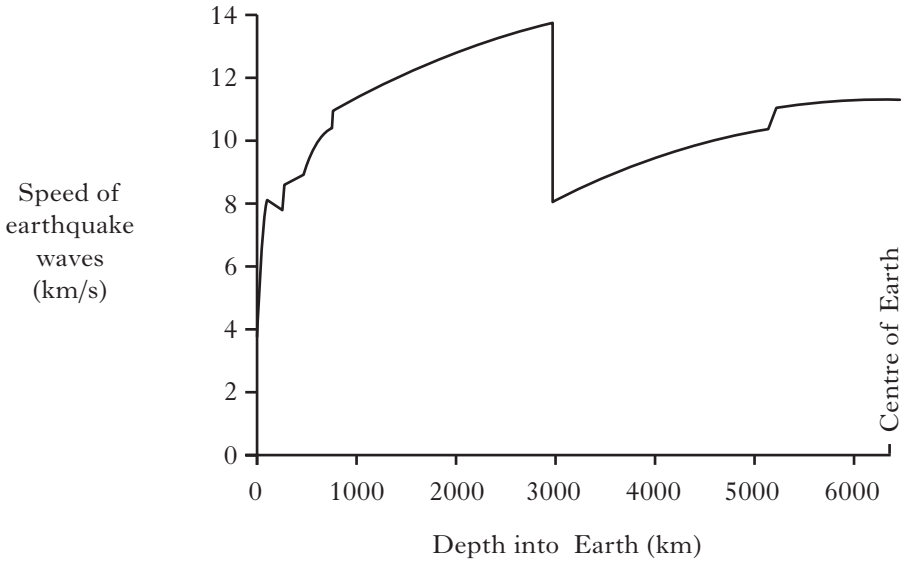
..... **1**

(ii) **Using a diagram**, **explain** why it is necessary to use seismic records from more than one place to locate the epicentre of an earthquake.

Space for diagram

2

(*d*) The graph below shows how the speed of P–Waves changes with depth within the earth.



Explain the changes in P–wave speed shown.

.....

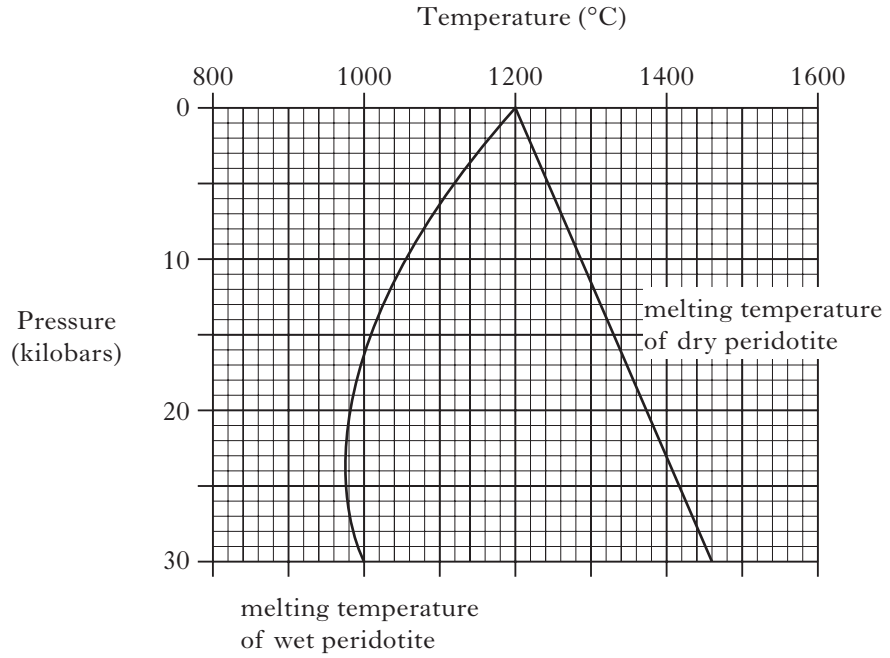
.....

..... **3**

[Turn over

Marks

4. The graph below shows how pressure affects the melting temperature of wet and dry peridotite.



Which **two** of the following statements are correct?

A At a pressure of 20 kilobars the difference between the melting temperatures of wet and dry peridotite is greatest.

B There is a positive relationship between pressures up to 23 kilobars and the melting temperature of wet peridotite.

C Basaltic magma produced at constructive plate boundaries is formed by the partial melting of peridotite.

D For a one kilobar increase in pressure, the melting temperature of dry perodotite rises by 8·7 °C.

E Oceanic crust is composed of peridotite.

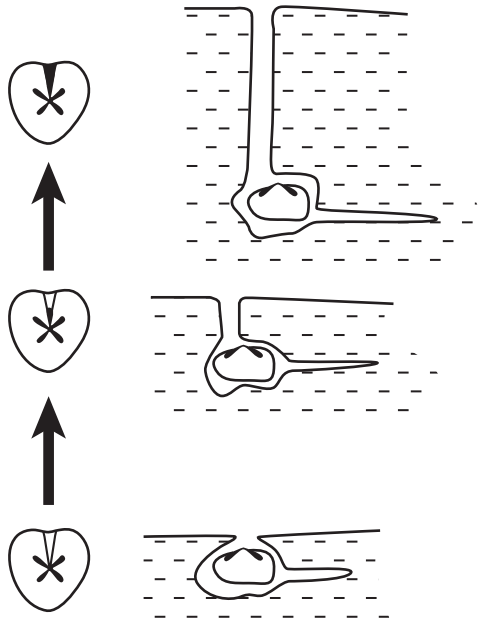
F Wet peridotite is associated with constructive plate boundaries.

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

DO NOT WRITE IN THIS MARGIN

Marks

5. The diagram below shows changes in the living positions of micraster over time.



Which **two** of the following statements are correct?

A Micraster is a regular echinoid.

B The anterior groove is found at the back of Micraster.

C As Micraster evolved, the anterior groove got deeper.

D Micraster is an important zone fossil for dating Jurassic rocks.

E Micraster was a planktonic organism.

F As Micraster evolved, the mouth moved further forward to allow better collection of food from the current.

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

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks

6. The table below gives information about the temperature and viscosity of different magmas.

Magma	*Temperature* °C	*Viscosity (dry) magma* measured in poises	*Viscosity (wet) magma* measured in poises
Rhyolite	785	10^{12}	10^{6}
Andesite	1000	10^{4}	$10^{3\cdot5}$
Basalt	1250	10^{2}	10^{2}

(*a*) Explain the term viscosity.

.....

..... **1**

(*b*) What effect does the addition of water to a magma have on its viscosity?

.....

..... **1**

(*c*) The table below gives information about the viscosity of two lava flows.

Lava flow	*Distance travelled from vent* (km)	*Increase in viscosity of lava flow over distance travelled*
Mauna Loa—Hawaii	17	2×
Mount Etna—Sicily	0·5	375×

Provide possible explanations for the difference between the two lavas.

.....

.....

.....

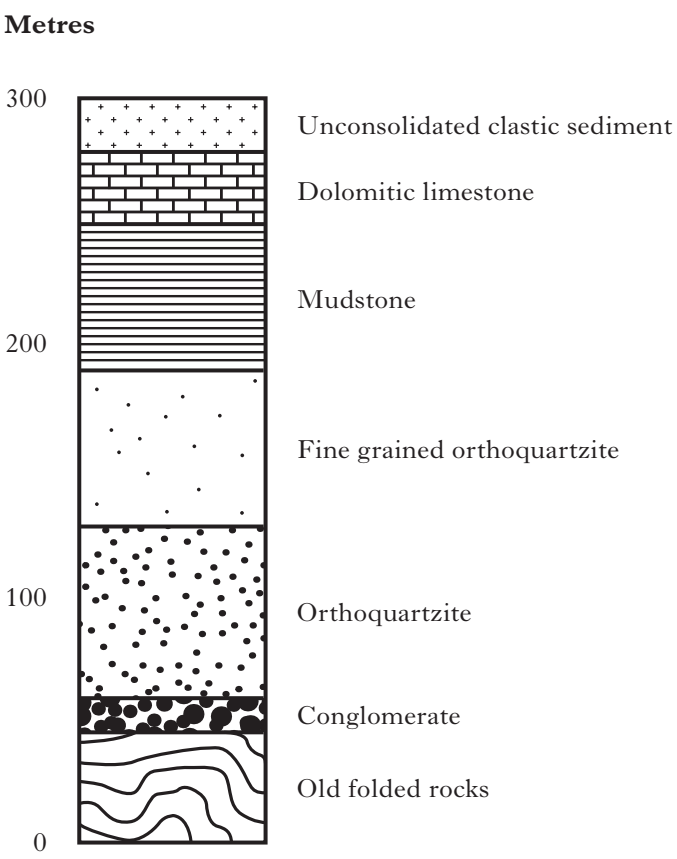
..... **2**

[Turn over for Question 7 on *Page twelve*

DO NOT WRITE IN THIS MARGIN

Marks

7. The diagram below shows a sequence of rocks obtained from a borehole.



(*a*) Choose the correct statement that best describes the sequence.

A Turbidite facies
B Cyclothem
C Deltaic facies
D Marine transgression

Give only the letter **1**

(*b*) Which rock is most likely to have been deposited as an evaporite?

..... **1**

(*c*) Why is it difficult to date sedimentary rocks using radiometric dating methods?

.....

.....

..... **1**

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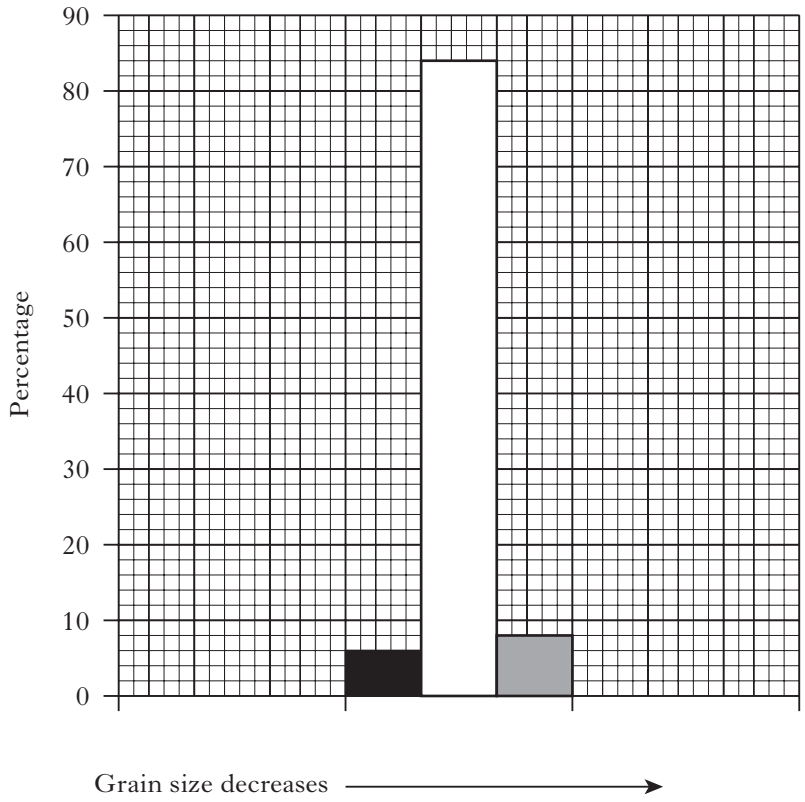
7. (continued) *Marks*

(*d*) The histogram below shows sediment analysis by grain size of the unconsolidated clastic sediment in the borehole.



Describe the methods used to obtain such a sediment analysis.

.....

.....

.....

..... **2**

(*e*) Which statement best describes the sorting of the unconsolidated clastic sediment?

A Poorly sorted
B Randomly sorted
C Well sorted
D Unevenly sorted

Give only the letter **1**

Section A: Total (40) marks

[Turn over

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 15, 16, 17 and 18.

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

8. Write an essay on geological fieldwork.

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

Give details as follows.

(*a*) Testing and identifying rocks and minerals in the field **3**

(*b*) Different methods of recording and processing information in the field **3**

(*c*) Using **sketch maps and diagrams,** give an account of the geology of an area you have studied.

This could include:

- 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. **9**

(15)

9. Write an essay on metamorphism.

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

Give details as follows.

(*a*) Contact metamorphism around large igneous intrusions and the changes to country rocks which may occur **6**

(*b*) Textural and mineralogical changes which may occur within sedimentary rocks when they are subjected to regional metamorphism. Mention rock types, metamorphic grades and metamorphic zones. **6**

(*c*) Dynamic metamorphism, mentioning fault breccia, slickensides and mylonite **3**

(15)

10. Write an essay on resources and reserves.

Credit will be given for the use of diagrams.

Give details as follows.

(*a*) How oil and coal are formed and extracted **8**

(*b*) Factors affecting the lifetime of reserves **3**

(*c*) Cut off grades and place value **4**

(15)

Section B: Total (15) marks

NOW GO TO SECTION C ON PAGE NINETEEN

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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

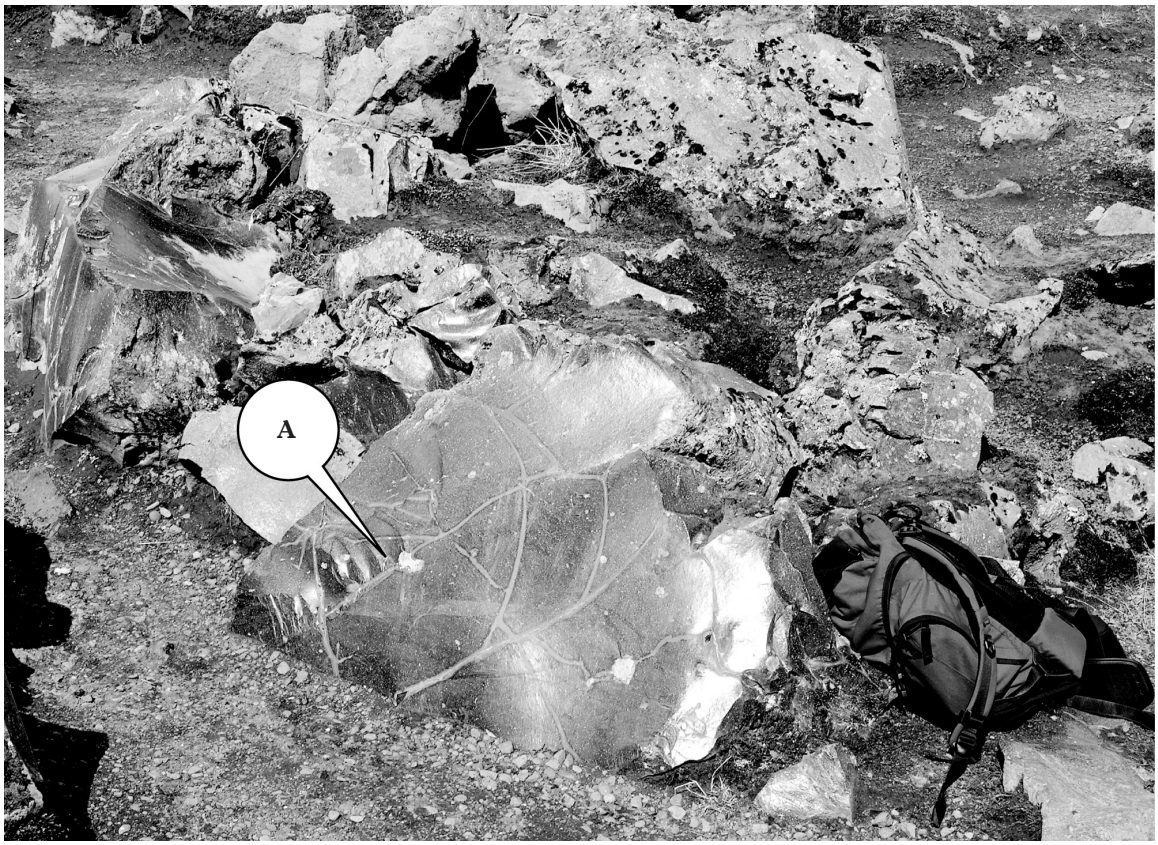
DO NOT WRITE IN THIS MARGIN

SPACE FOR ANSWERS

SECTION C

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

11. Look at the photograph below of a glassy rock taken on land after a recent eruption in south west Iceland.



DO NOT WRITE IN THIS MARGIN

Marks

Choose **three** correct statements from the list below about **rock A**.

A The rock has a glassy appearance because it has cooled quickly.

B Rocks like this are normally found in deep oceans near conservative plate margins.

C The rock has a glassy appearance because it may have been erupted underneath a glacier.

D Rocks like this are normally found in deep oceans near destructive plate margins.

E The correct term to describe this rock is a pillow lava.

F The correct term to describe this rock is a vesicular basalt.

G A possible name for this rock is obsidian.

H Rocks like this are normally associated with granitic intrusions.

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

Marks

12. The photograph below shows students conducting geological fieldwork in front of an ancient volcanic vent.

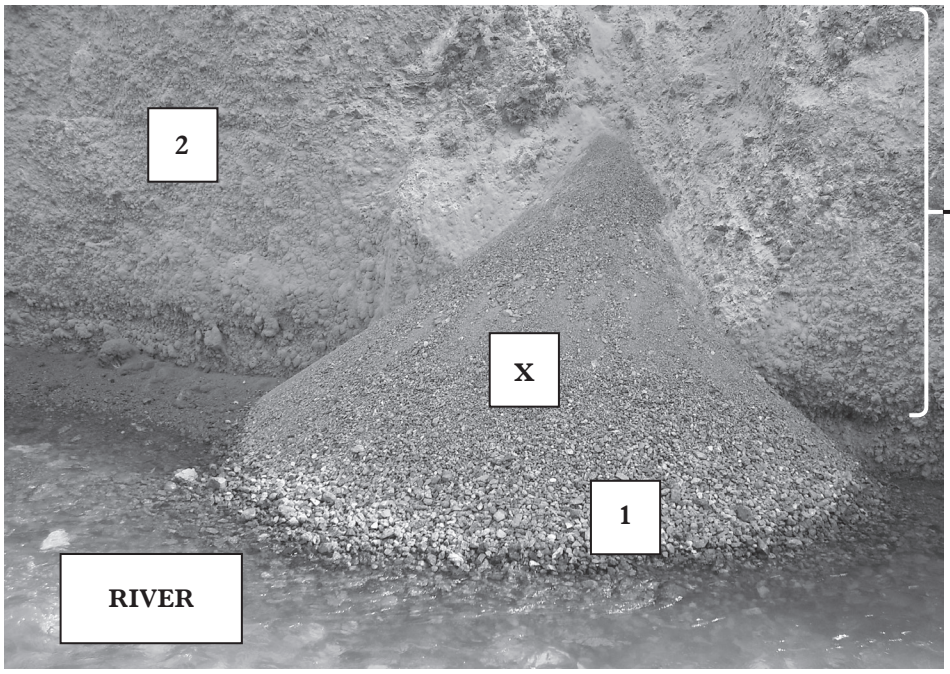
Using diagrams, **explain** why the cooling cracks form this particular pattern.

3

DO NOT WRITE IN THIS MARGIN

Marks

13. Look at the photograph below taken of the foot of a steep cliff face.



Choose **three** correct statements from the list below about **feature X**.

A The largest clasts are found at the foot of this feature.

B Rocks in zone 1 are older than those in zone 2 because they lie below those in zone 2.

C The rock clasts in this feature will be less rounded than the rocks in the river.

D The rock clasts in this feature will be more rounded than the rocks in the river.

E The correct term for this feature is a river cone.

F The correct term for this feature is an alluvial fan.

G The correct term for this feature is a scree slope.

H The largest clasts are found at the top of this feature.

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

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks

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

(*a*) How many unconformities are shown?

…….. **1**

(*b*) (i) What type of fault is F1?

…….. **1**

(ii) How much movement has there been on F1?

…….. **1**

(*c*) What type of igneous intrusion is the micro diorite?

…….. **1**

Give a reason for your answer.

……

…… **1**

(*d*) Place a letter **H** on the map where hornfels will be found. **1**

(*e*) On the topographic profile (on the **separate worksheet**), complete the geological section between points X and Y on the map. **7**

DO NOT WRITE IN THIS MARGIN

14. (continued) *Marks*

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

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

A	Formation of Gneiss
B	Folding of conglomerate, shale, sequence
C	Granite intrusion
D	Faulting at F2
E	Micro diorite intrusion
F	Basalt dyke intrusion
G	Deposition of conglomerate, shale, limestone, sandstone
H	Micro granite dyke intrusion

(Give only the letters)

YOUNGEST

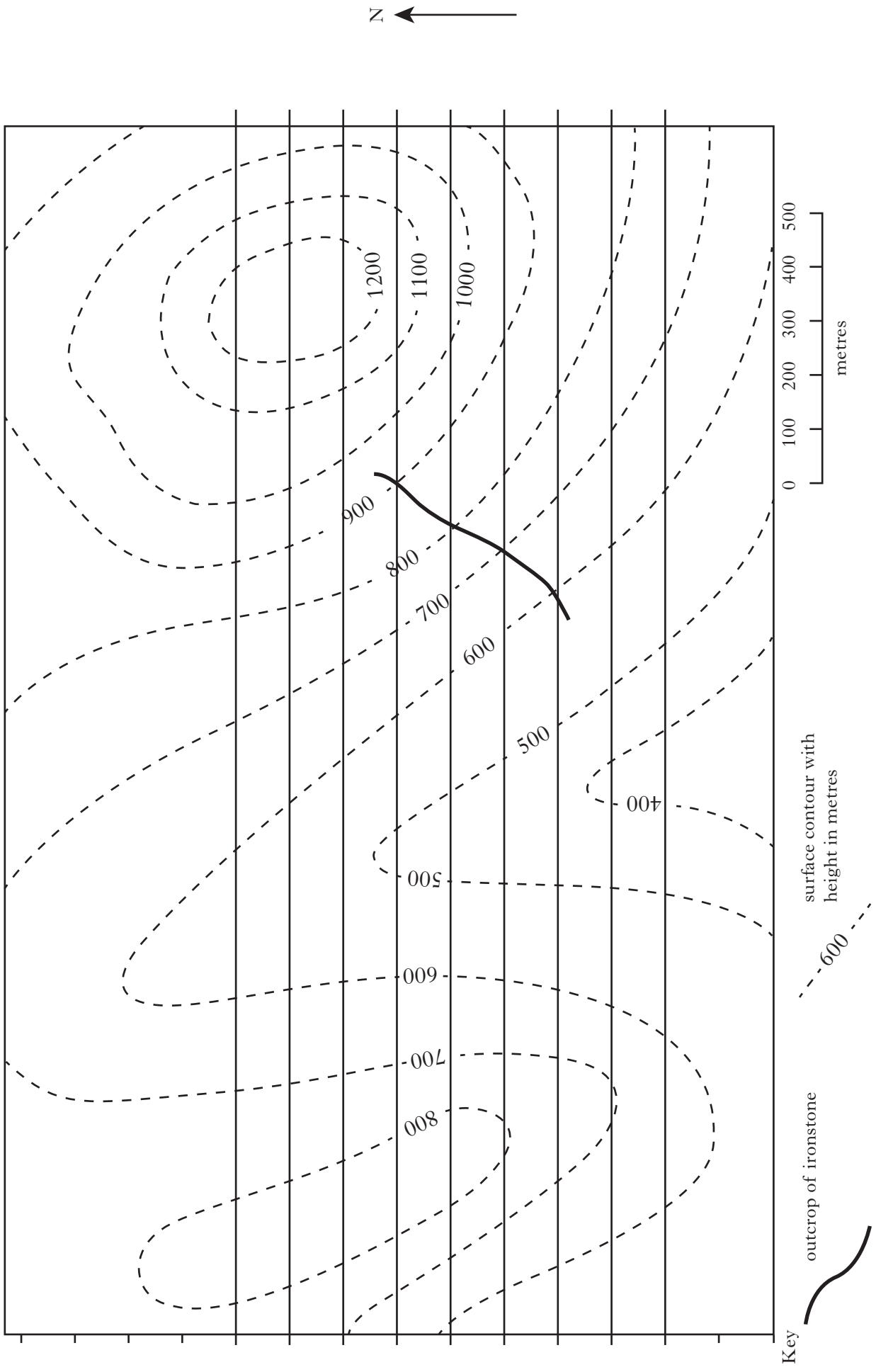
C
A

OLDEST

3

[Turn over

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



DO NOT WRITE IN THIS MARGIN

15. (continued) *Marks*

The map on *Page twenty-four* shows ironstone outcropping at the positions shown.

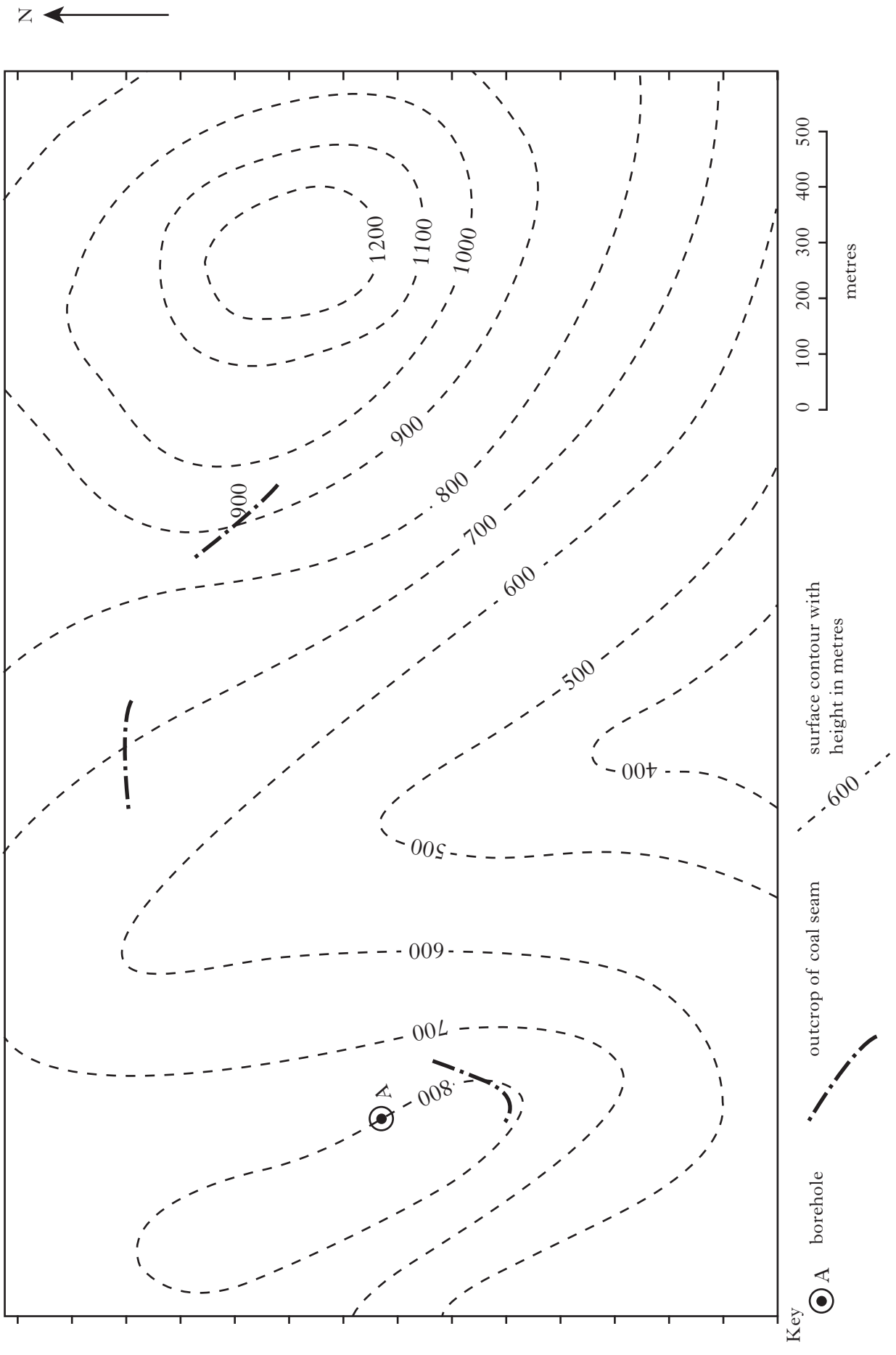
(*a*) Number the structure contours for the ironstone. **1**

(*b*) Draw the outcrop of the ironstone across the map. **2**

(*c*) Calculate the angle of dip of the ironstone. **2**

[Turn over

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



16. (continued) *Marks*

The map on *Page twenty-six* shows a coal seam outcropping at the positions shown. The coal seam has a uniform dip.

(*a*) Draw structure contours for the coal seam across the map. **2**

(*b*) Number the structure contours. **1**

(*c*) In which direction does the coal seam dip?

…….. **1**

(*d*) At what angle does the coal seam dip? (Working **must** be shown.)

……..

Space for working

2

(*e*) Draw the outcrop of the coal seam. **2**

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

…….. **1**

(*g*) Shade in the area not underlain by the coal seam. **1**

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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X043/12/11

NATIONAL QUALIFICATIONS 2012

THURSDAY, 3 MAY
9.00 AM – 11.30 AM

GEOLOGY
HIGHER
Worksheet for Question 14

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.

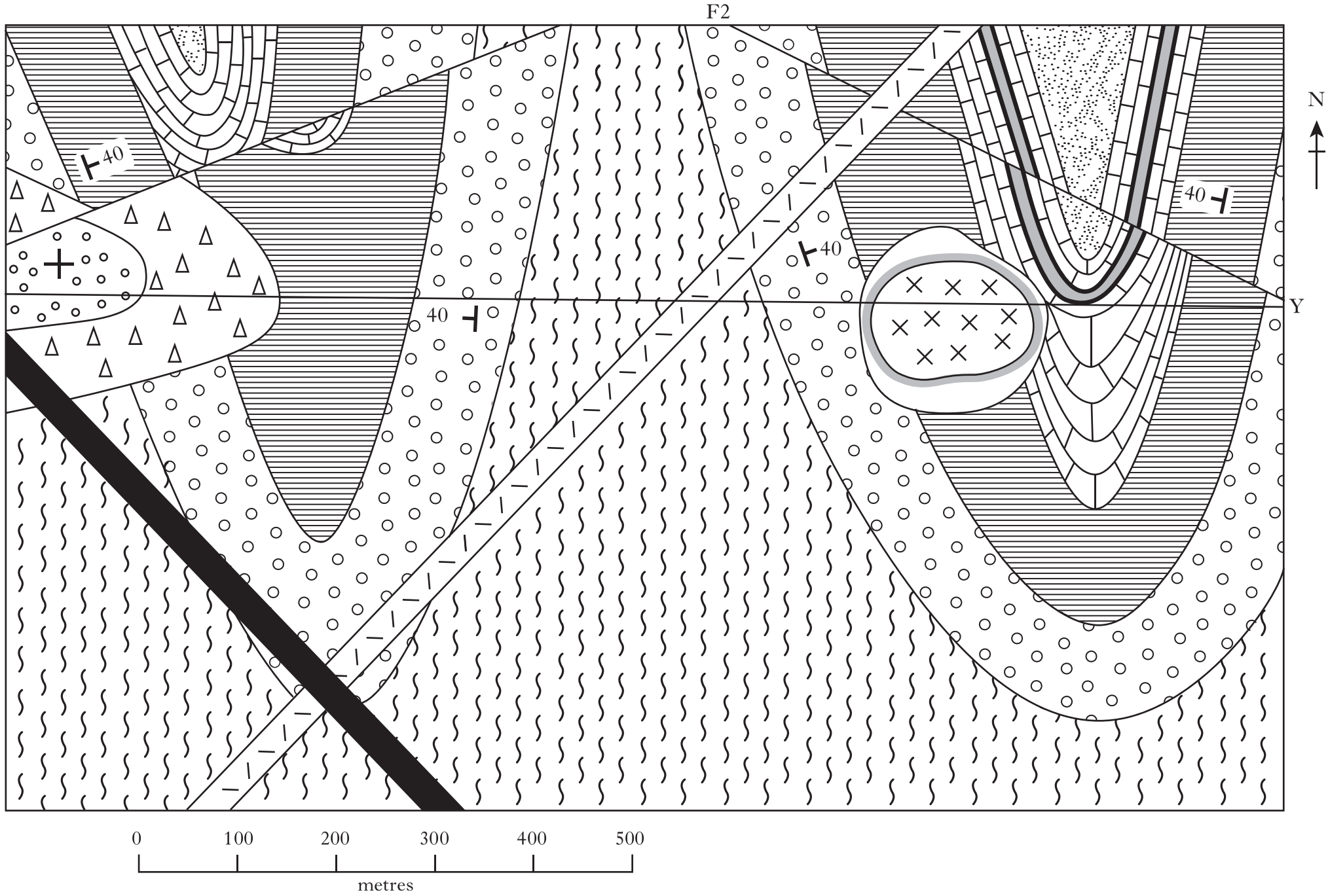

F2
N
40
40
40
40
F1
X
Y
0
100
200
300
400
500
metres

Figure Q14(*e*)

Key (Rocks not in order of age)

limestone

breccia

conglomerate

sandstone

horizontal strata

gneiss

arkose sandstone

granite with metamorphic aureole

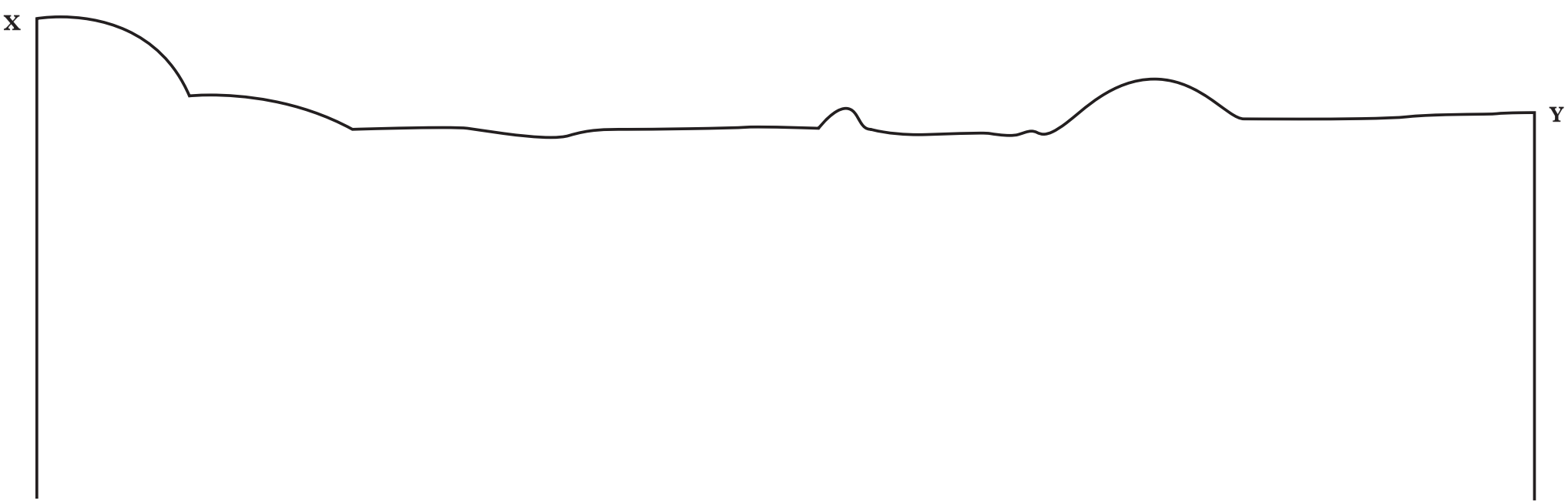
micro diorite

basalt

shale

micro granite

40 strike and dip directions with dip in degrees



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