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Total

# X043/301

NATIONAL QUALIFICATIONS 2009

FRIDAY, 29 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.** (*a*) Complete the table below which shows the chemical groups and properties of some minerals in hand specimen. Choose the correct terms from the word bank below.

Element, biotite, fluorite, bright green colour, barites, haematite, sulphate, oxide, Mohs scale hardness of 6, Mohs scale hardness of 8.

| *Name of mineral* | *Chemical group* | *Distinctive property in hand specimen* |
|---|---|---|
| | Sulphate | High relative density |
| Gypsum | | Can be scratched with fingernail |
| Malachite | Carbonate | |
| Quartz | | Cannot be scratched with steel blade |
| Graphite | | Easily cleaved |
| | Silicate | Platy cleavage into flexible sheets |
| Orthoclase feldspar | Silicate | |
| | Halide | Forms cubic crystals |

**4**

(*b*) Diamond and graphite are **polymorphs** of carbon. What is a polymorph?

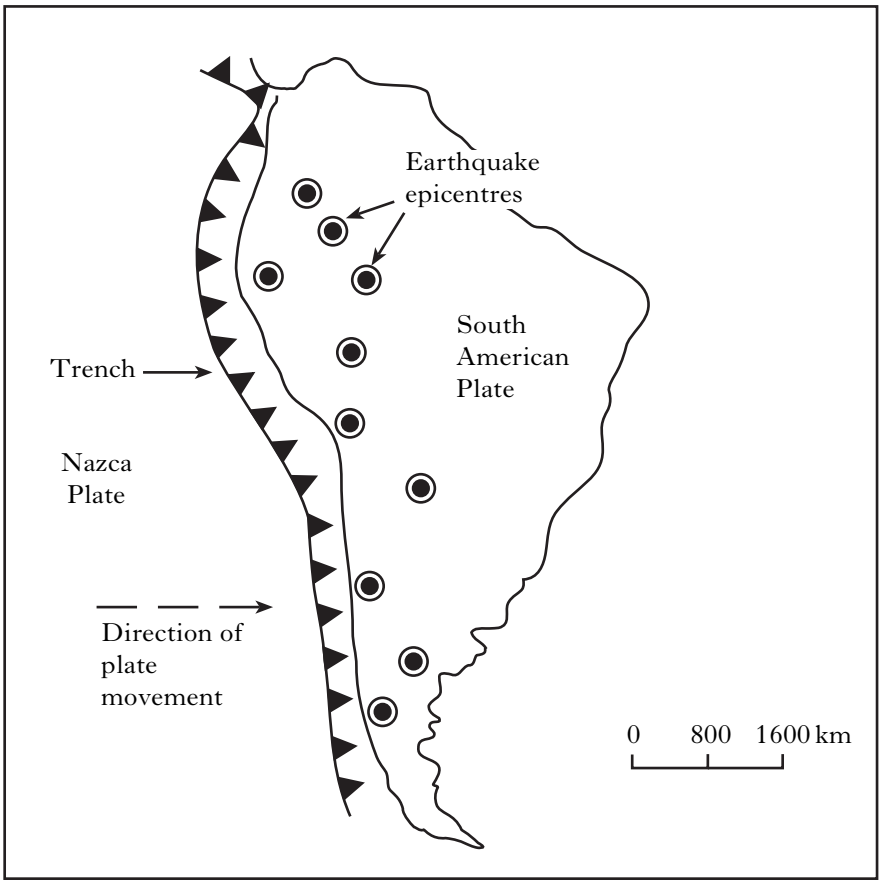
.....

.....

..... **1**

**[Turn over for Question 2 on *Page four***

**2.** Study the map below of the seismically active area around South America.




The distance and depth of the earthquakes recorded east of the oceanic trench are shown in the table below.

| *Distance from trench* (km) | *Depth of focus of earthquake* (km) |
|---|---|
| 150 | 30 |
| 300 | 70 |
| 450 | 70 |
| 500 | 150 |
| 750 | 180 |
| 900 | 200 |
| 1050 | 400 |
| 1200 | 470 |
| 1350 | 500 |
| 1500 | 680 |

DO NOT WRITE IN THIS MARGIN

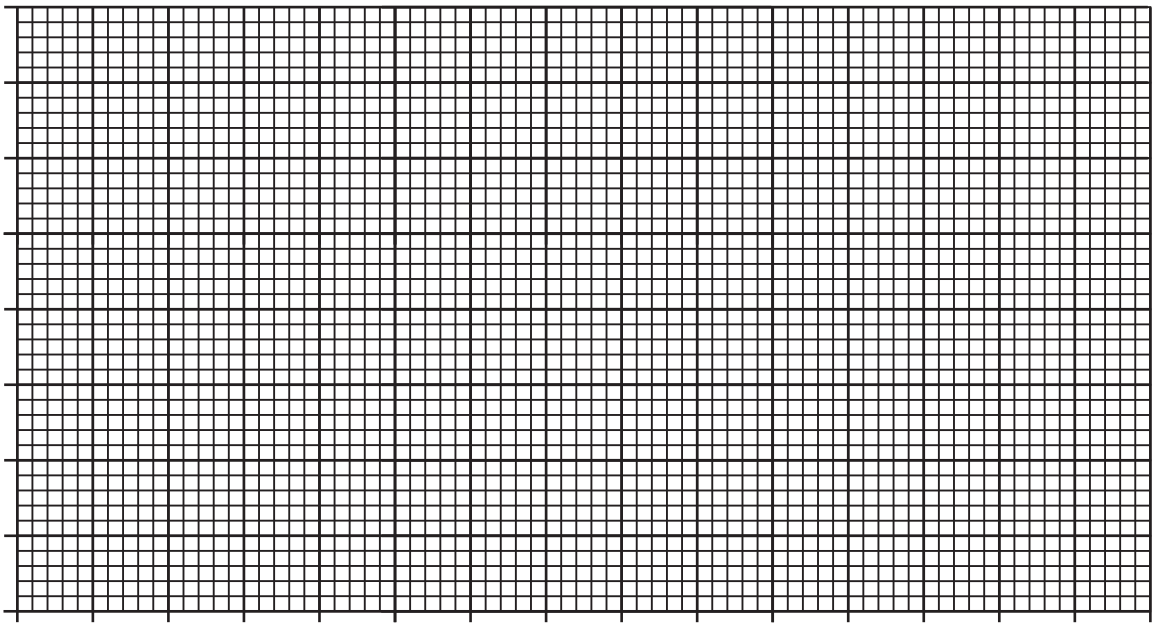
*Marks*

**2. (continued)**

(*a*) On the graph paper below, draw a graph of distance from trench (km) against depth of focus (km).

Distance from trench (km) ⟶

Depth of focus (km) ⟶



**2**

(*b*) **Describe** the general relationship shown by the graph.

.....

.....

..... **1**

**[Turn over**

Marks

**2. (continued)**

(*c*) **Explain** why such a relationship between depth and distance from trench exists. (You may wish to use diagrams.)

.....

.....

.....

.....

*Space for diagrams*

**2**

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

A The Mercalli scale of earthquake intensity is based on direct observation of the effects of earthquakes.

B The Wadati Benioff zone of inclined earthquake foci is associated with constructive plate boundaries.

C Every year there are many large magnitude earthquakes and only a few of small magnitude.

D A major hazard associated with large magnitude earthquakes in mountainous areas is the activation of major landslides.

E S–waves produced by earthquakes travel approximately twice as fast as P–waves.

F A seismometer is an instrument which records seismic vibrations.

G Isoseismal maps show lines of equal earthquake magnitude away from the focus.

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

(*e*) **Explain** why earthquakes do not occur at depths greater than 720 km in the earth.

.....

.....

.....

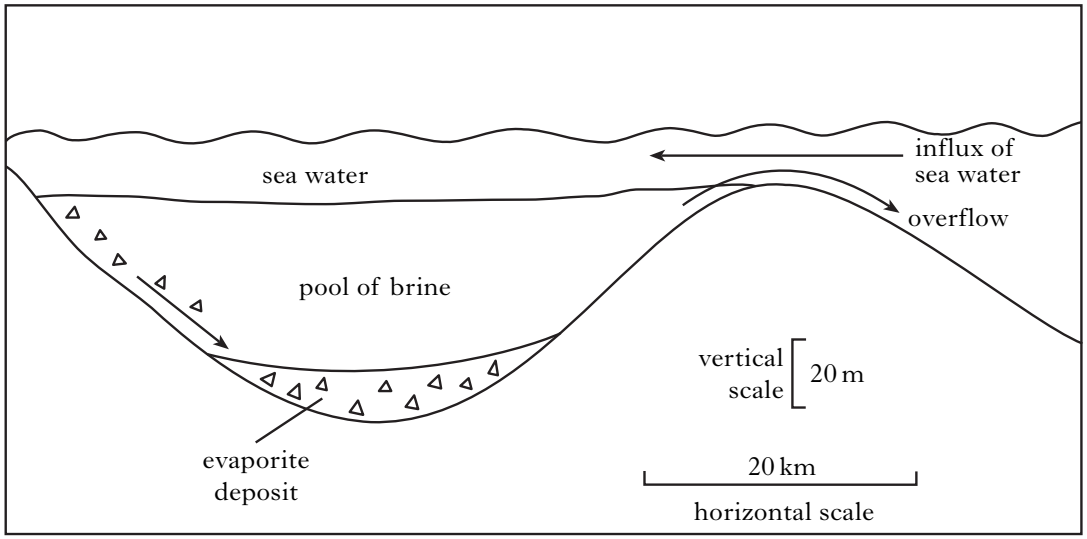
..... **1**

**[Turn over for Question 3 on *Page eight***

**3.** Study the diagram below which shows a cross section through an evaporite basin.

DO NOT WRITE IN THIS MARGIN

*Marks*




(*a*) Which **four** of the following statements best describe the processes operating in the basin and the minerals and rocks produced in such environments?

A Evaporation concentrates ions in the water until first potassium and magnesium salts crystallise out.

B Anhydrite is an isomorph of gypsum.

C The continuous inflow of seawater can produce great thicknesses of evaporite minerals over time.

D The thick salt deposits in North East England accumulated during the Carboniferous Period.

E The overflow of dense brine over the lip of the basin ensures that there is more gypsum but less magnesium salts than would be expected from such an evaporating body of seawater.

F The chemical formula for halite is NaCl.

G Evaporites are sedimentary rocks.

H Evaporites form most commonly in humid conditions.

Give only the letters: ....., ....., ..... and ..... **4**

(*b*) **Explain** the difference between placer and residual deposits. (You may use diagrams.)

.....

.....

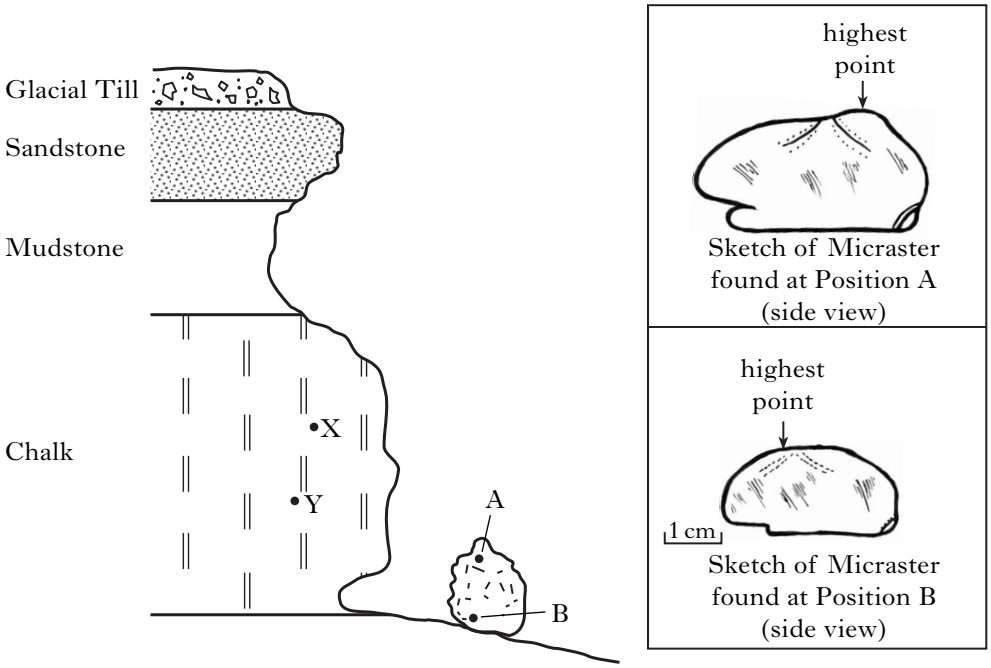
.....

.....

*Space for diagrams* **2**

*Marks*

**4.** Examine the annotated field sketch below.




X: Micraster specimen found here with deep anterior groove

Y: Micraster specimen found here with shallow anterior groove

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

A Micraster is an Upper Cretaceous echinoid.

B As Micraster evolved, its test remained the same shape.

C The block fallen from the cliff face has come to rest with the oldest bed at the bottom.

D The sequence of rocks in the cliff face shows that over time the depositional environment changed from shallow to deep water.

E Chalk is formed from the calcareous skeletons of micro organisms.

F The evolutionary changes in Micraster are related to its improved adaptation to swimming.

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

(*b*) Give **two** characteristics of good zone fossils.

.....

..... **2**

**[Turn over**

*Marks*

**5.** Study the table below.

| *Type of meteorite* | *Percentage of all meteorites falling to Earth* |
|---|---|
| Stony | 95·0 |
| Iron | 3·5 |
| Stony – iron | 1·5 |

How does the information in the table support the idea that meteorites are fragments of early formed planets?

.....

.....

.....

..... **2**

**6.** Heat flow is the rate at which heat transfers through the Earth's surface. Heat flow is measured in milliwatts per square metre.

The table below shows some information about heat flow of the ocean floor.

| *Age of ocean floor* (Ma) | *Heat flow* ($mW/m^2$) |
|---|---|
| 0–4 | 149 |
| 20–35 | 60 |
| 65–80 | 57 |
| 110–125 | 55 |
| 160+ | 50 |

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

A There is a positive relationship between heat flow and the age of oceanic crust.

B At present most heat within the Earth is generated by the decay of long lived radioisotopes.

C Heat mainly travels through the crust by convection.

D There is no relationship between heat flow and age of oceanic crust.

E All the heat flowing through the ocean floor comes from the Earth's core.

F At a heat flow of 56 $mW/m^2$, the age of the crust would be about 90 million years.

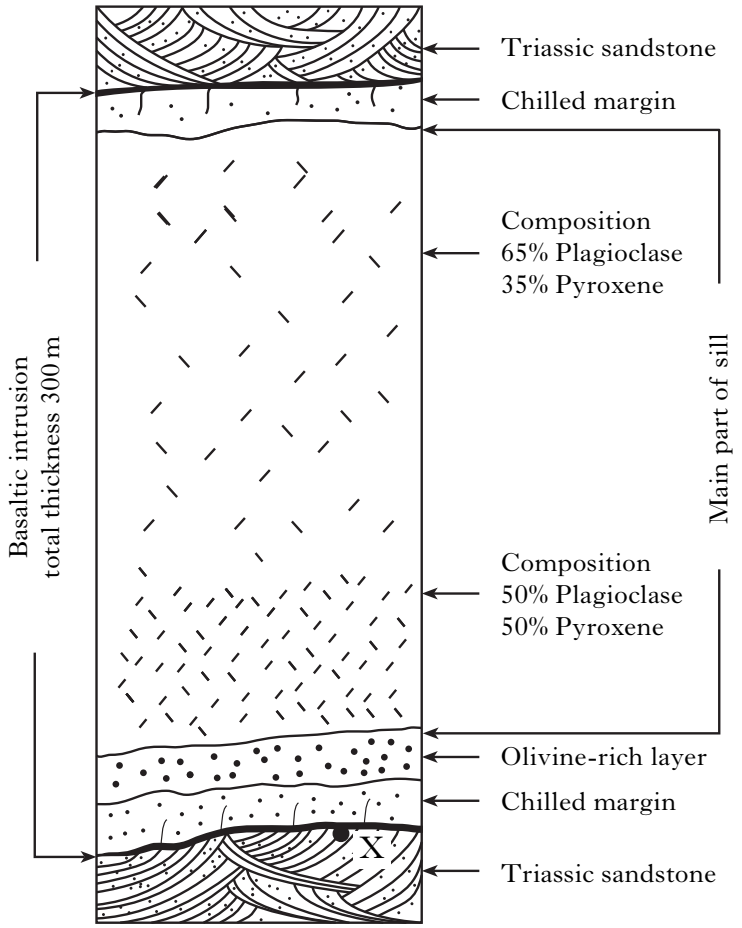
G Mid ocean ridges have steep geothermal gradients.

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

**[Turn over**

*Marks*

**7.** Examine the cross section through the Palisades Sill, New York.




(*a*) Name the country rock. ..... **1**

(*b*) With the aid of a diagram **explain** why there are two chilled margins. **1**

*Space for diagram*

*Marks*

**7. (continued)**

(*c*) Why is there an olivine-rich layer at the base of the sill?

.....

..... **1**

(*d*) **Explain** the variations in the mineral composition of the main part of the sill.

.....

.....

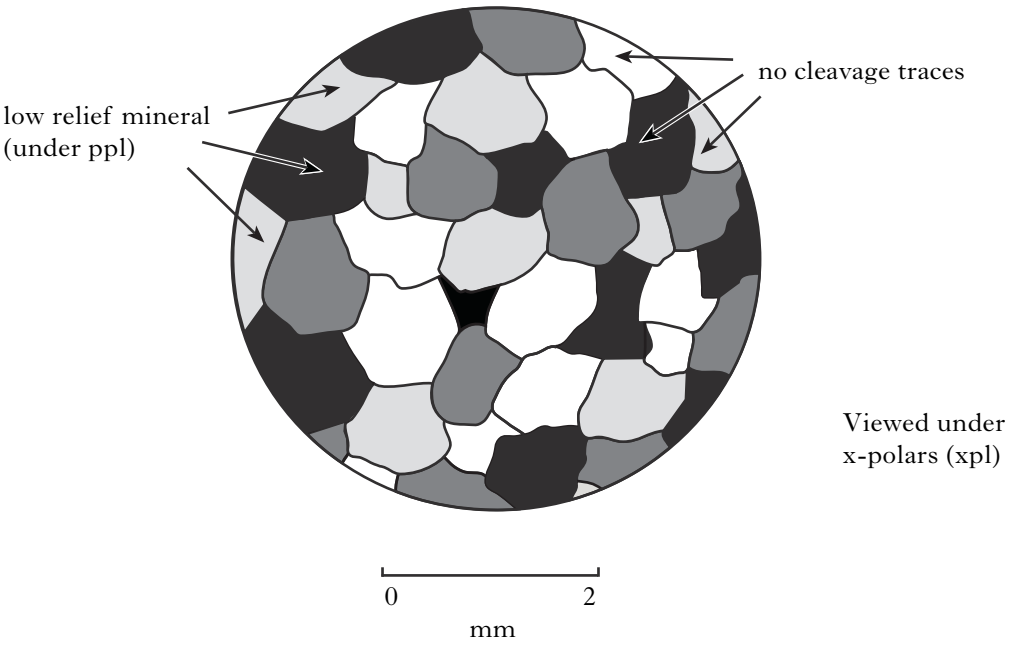
.....

..... **2**

(*e*) Which labelled layer best represents the original composition of the intruded magma?

..... **1**

(*f*) Examine the thin section below which was taken from a rock sample at point X.



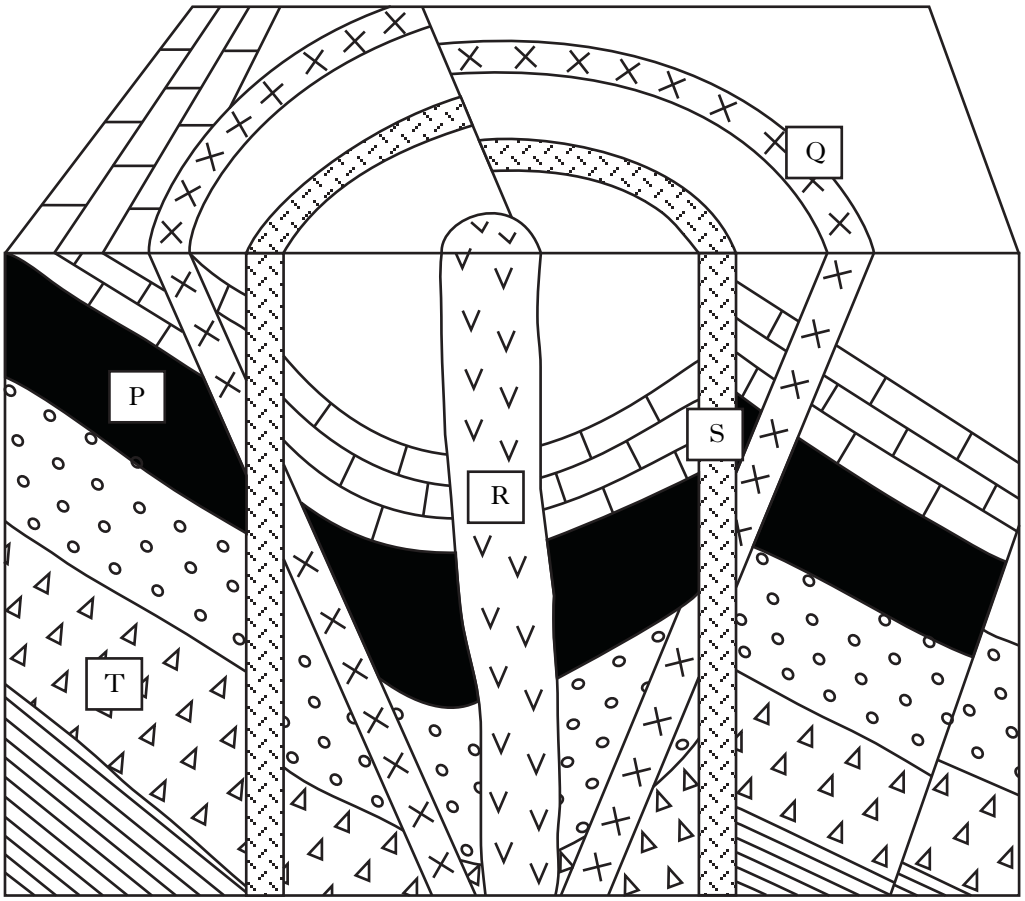

Name this metamorphic rock.

..... **1**

**[Turn over**

*Marks*

**8.** Examine the geological section below.




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

A Rock P is a lava flow.

B Rock R is cut by a tear fault.

C Igneous intrusion Q is a cone sheet.

D Igneous intrusion S is a cone sheet.

E Three faults cut the rocks in this area.

F There are two unconformities shown.

G Rock Q is cut by a tear fault.

H Rock T is the oldest rock.

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

**Section A: Total (40) marks**

**[Turn over for SECTION B on *Page sixteen***

DO NOT WRITE IN THIS MARGIN

## 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 resources and reserves.

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

Give details as follows.

(*a*) Different types of resources **4**

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

(*c*) Place value **2**

(*d*) Oil and coal formation **6**

**(15)**

**10.** Write an essay on stratigraphy.

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

Give details as follows.

(*a*) Stratigraphic relationships including unconformity, overlap and diachronism **5**

(*b*) The use of way-up criteria **5**

(*c*) Correlation: how sequences are matched up in different areas, the use of marker horizons and varves **5**

**(15)**

**11.** Write an essay on metamorphism.

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

Give details as follows.

(*a*) Regional metamorphism mentioning processes, tectonic setting, rock types, structures, metamorphic grades and metamorphic zones **8**

(*b*) Contact metamorphism around large igneous intrusions **5**

(*c*) Dynamic metamorphism **2**

**(15)**

**Section B: Total (15) marks**

**NOW GO TO SECTION C ON PAGE TWENTY**

SPACE FOR ANSWERS

DO NOT WRITE IN THIS MARGIN

SPACE FOR ANSWERS

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 of a sedimentary rock.

Choose **two** correct statements from the list below about the structures shown.

A This is found in desert deposits.

B This is found in wind blown deposits.

C This is found in river deposits.

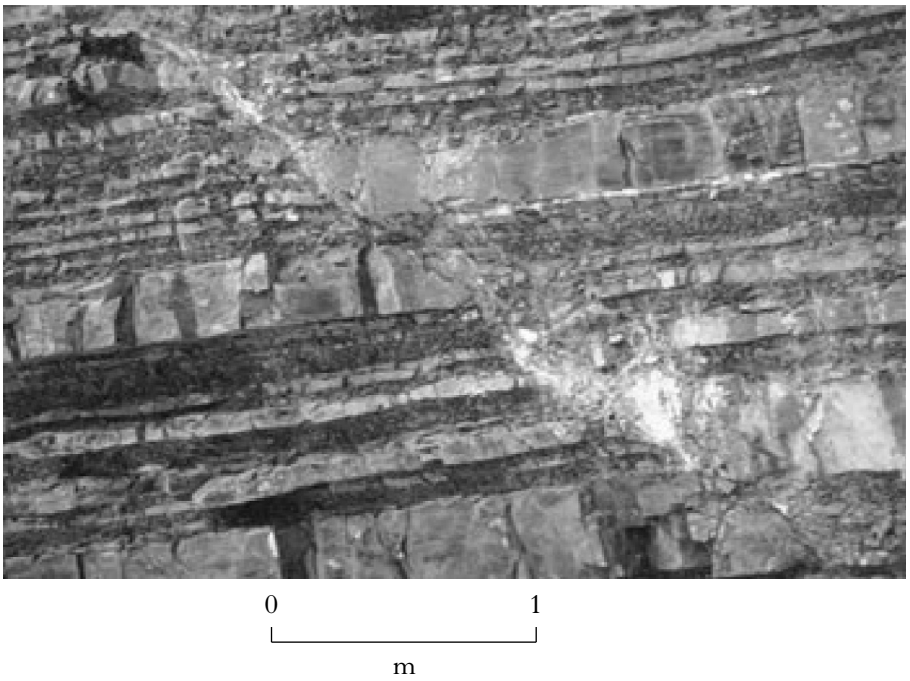
D This is called cross bedding.

E This is called graded bedding.

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

*Marks*

**13.** Look at the photograph below of a quarry face showing an exposed fault.




(*a*) Choose **three** correct statements from the list below.

A This type of fault is normally associated with crustal stretching.

B This type of fault is normally associated with crustal compression.

C This is an example of a low angle thrust fault.

D This is an example of a normal fault.

E This is an example of a reverse fault.

F There is a 1 metre displacement along the fault plane.

G There is a 50 cm displacement along the fault plane.

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

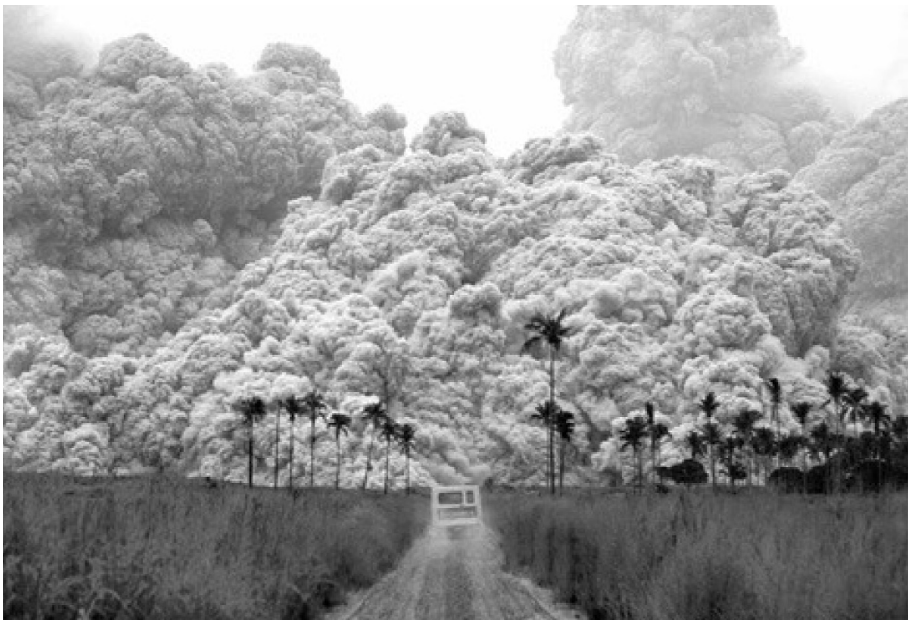
(*b*) Annotate the photograph using the following labels.

- Hanging wall
- Foot wall
- Zone of fault breccia **3**

**[Turn over**

*Marks*

**14.** Examine the photograph below of a volcanic eruption.



Choose **two** correct statements from the list below.

A This sort of eruption is typical of shield volcanoes.

B This sort of eruption is typical of basaltic eruptions.

C This sort of eruption might happen on an andesite volcano.

D This is an example of a nuees ardentes or hot avalanche.

E This is an example of a fissure eruption.

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

DO NOT WRITE IN THIS MARGIN

*Marks*

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

(*a*) How can you tell that the following statements are correct?

(i) Fault F2 is a tear fault.

.....

..... **1**

(ii) Fault F2 is younger than fault F1.

.....

..... **1**

(*b*) There are two unconformities shown on the map. Write the letter "U" on each unconformity on the map. **2**

(*c*) (i) On which side of Fault F1 have the rocks been **upthrown**?

..... **1**

(ii) Give a reason for your answer.

.....

..... **1**

(iii) The dolerite dyke continues north of fault F1. Draw the outcrop of the dolerite dyke north of fault F1 on the map on the separate worksheet. **1**

**[Turn over**

DO NOT WRITE IN THIS MARGIN

*Marks*

**15. (continued)**

(*d*) Why is the outcrop of the sandstone narrower at **A** than at **B**? Use diagrams in the space below to explain your answer.

.....

.....

*Space for diagrams*

**1**

(*e*) In which direction do the two synclines plunge?

..... **1**

(*f*) By how many metres has fault F2 moved?

..... metres **1**

*Marks*

**15. (continued)**

(*g*) On the topographic profile, (on the **separate worksheet**), complete a geological section between points X and Y on the map. **3**

(*h*) 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 gneiss | E dolerite |
| B basalt | F granite and microgranite intrusion |
| C folding | G limestone, sandstone, greywacke |
| D breccia, conglomerate, arkose sandstone | H F2 |

**(Give only the letters)**

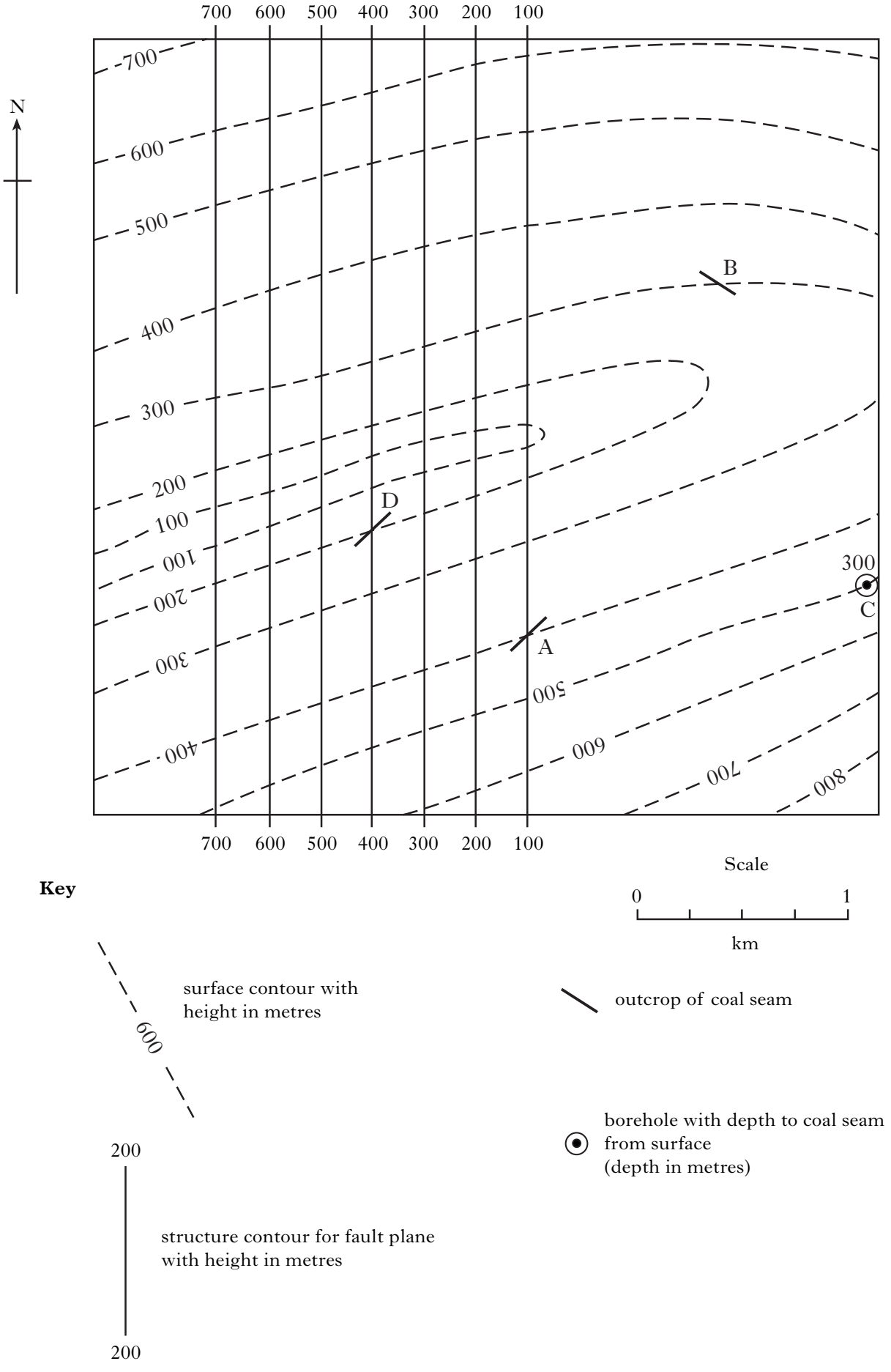
**YOUNGEST**

| |
|---|
| |
| H |
| |
| |
| E |
| |
| |
| |

**OLDEST** **3**

**[Turn over**

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



DO NOT WRITE IN THIS MARGIN

*Marks*

**16. (continued)**

(*a*) Structure contours have already been drawn for a fault plane which crosses this area. Draw in the outcrop of the fault plane, **remembering** that the fault will outcrop **where relief contours cross structure contours** of the same height. **2**

(*b*) What is the angle and direction of dip of the fault?

.....

*Space for working*

**2**

(*c*) A coal seam of uniform dip outcrops at A and B. The coal seam is also found in borehole C at a depth of 300 metres below the surface.

(i) Draw and number the structure contours for the coal seam in the area east of the fault. **3**

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

(*d*) (i) The coal seam outcrops at D. Renumber the structure contours west of the fault. **2**

(ii) Draw the outcrop west of the fault. **2**

**Section C: Total (40) marks**

[*END OF QUESTION PAPER*]

DO NOT WRITE IN THIS MARGIN

SPACE FOR ANSWERS OR FOR ROUGH WORK

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| | | | | | |
|---|---|---|---|---|---|
| | | | | | |

# X043/302

NATIONAL QUALIFICATIONS 2009

FRIDAY, 29 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)

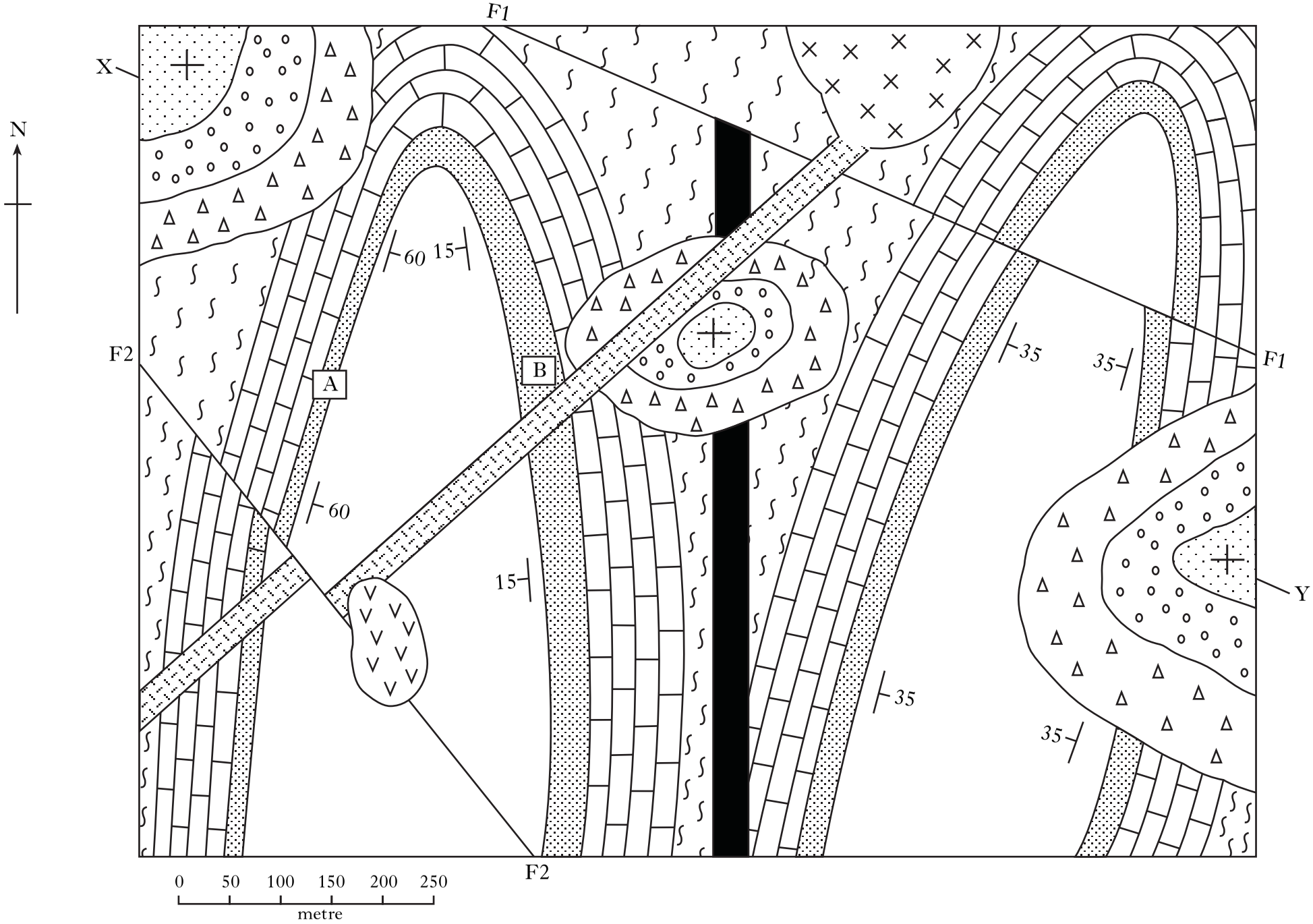
Surname

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.


F1
X
N
F2
A
B
60
15
60
15
35
35
F1
35
35
Y
F2
0
50
100
150
200
250
metre

**Key (Rocks not in order of age)**

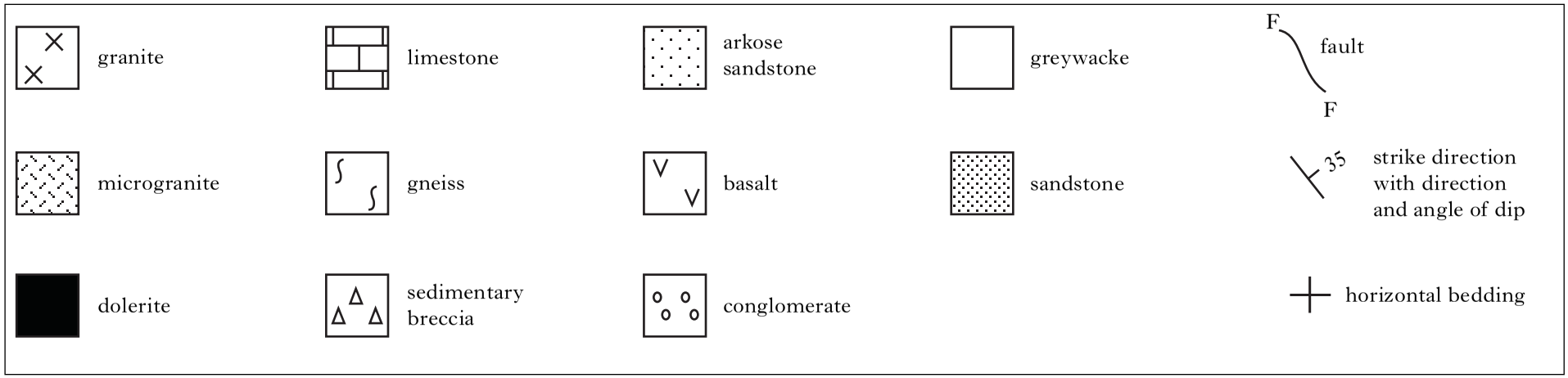
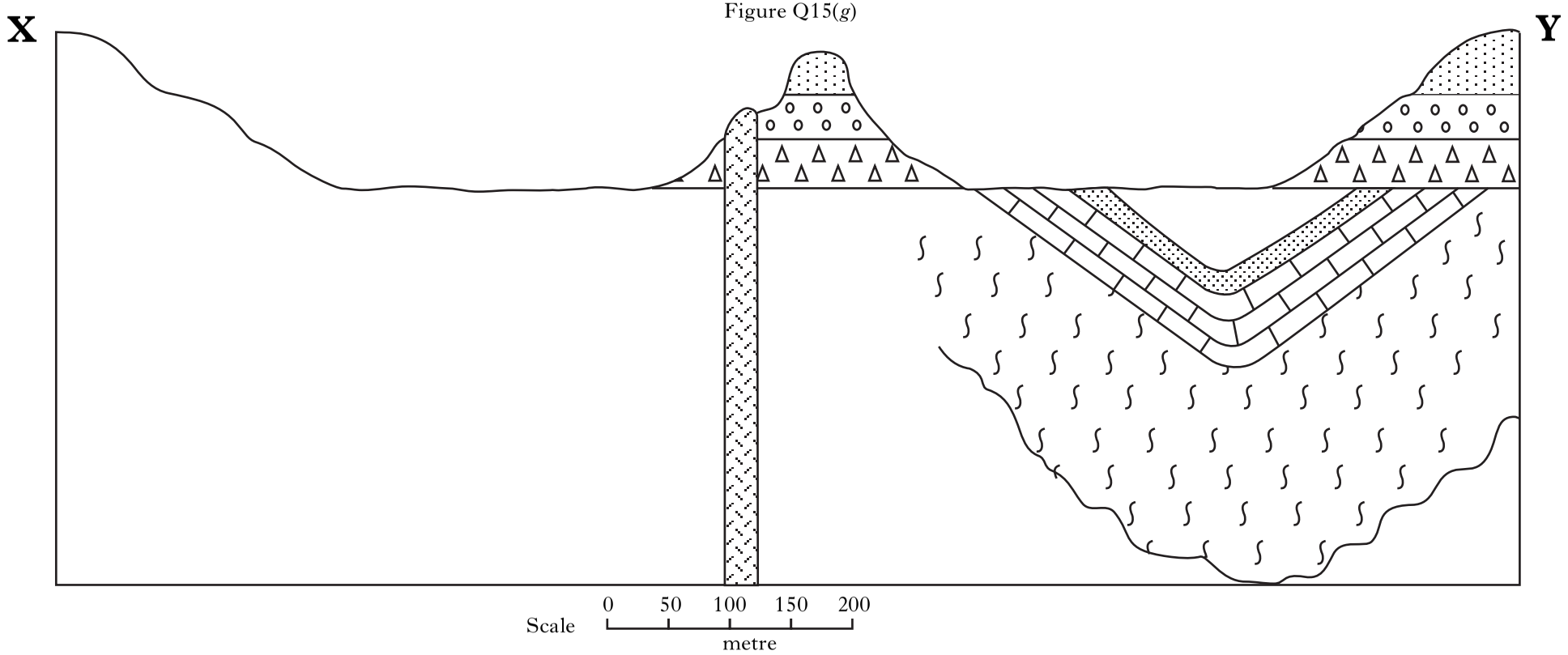



Figure Q15(*g*)



**[BLANK PAGE]**