FOR OFFICIAL USE

Centre No.	Subject No.	H	Paper No.	Group No.	Marker's No.

Total

[CO43/SQP018]

Higher Geology

Time: 2 hours 30 minutes

NATIONAL QUALIFICATIONS

Specimen Question Paper
for use in and after 2006

Fill in these boxes and read what is printed below.

Full name of school or college

Town

First name and initials

Surname

Date of birth
Day Month Year

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.

SCOTTISH QUALIFICATIONS AUTHORITY

SECTION A

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

Marks

1. Use the information from the table to allow you to answer the questions which follow.

Element	*Symbol and charge*	*Ionic radius (picometres)*
Magnesium	Mg^{2+}	80
Calcium	Ca^{2+}	120
Iron	Fe^{2+}	86
Iron	Fe^{3+}	73
Manganese	Mn^{2+}	75
Sodium	Na^{+}	124
Potassium	K^{+}	159
Calcium	Ca^{2+}	120
Rubidium	Rb^{+}	168
Uranium	U^{4+}	108
Aluminium	Al^{3+}	47
Silicon	Si^{4+}	34
Zirconium	Zr^{4+}	80

(*a*) (i) In orthoclase, every fourth silicon ion is replaced by an aluminium ion. When this happens, why is a potassium ion added to the orthoclase?

.....

..... **1**

(ii) Explain why rubidium is more common in potassium feldspar than in sodium feldspar.

.....

..... **1**

Marks

1. (*a*) (continued)

(iii) Explain why there is complete solid solution between albite ($NaAlSi_3O_8$) and anorthite ($CaAl_2Si_2O_8$), while there is a very limited solid solution between anorthite and orthoclase ($KAlSi_3O_8$).

.....

.....

..... **2**

(*b*) (i) Common silicates are rich in silicon, magnesium, iron, sodium, potassium and aluminium. Explain why uranium is not abundant in common silicates.

.....

..... **2**

(ii) Explain why uranium is often found in zircon ($ZrSiO_4$).

.....

..... **1**

(*c*) Ankerite is a carbonate with this formula: $CaMgFe^{2+}Mn(CO_3)_2$. An analysis of ankerite showed ions to be present in these proportions:

Mg^{2+}	0·626
Fe^{2+}	0·330
Mn^{2+}	0·022
Ca^{2+}	1·000
CO_3^{2-}	2·000

Which statement correctly describes ionic substitution in ankerite?

A Magnesium, iron, manganese and calcium all substitute for each other.

B There is no substitution of calcium by another ion. Iron and manganese both replace magnesium.

C Because the carbonate ion (CO_3) has a negative charge it is not replaced by any other ion. Magnesium is replaced because it has a positive charge.

D In the atomic structure of ankerite, the magnesium, iron, manganese, calcium and carbonate all lie in different sites. This means that none of them substitute for each other.

Give only the letter: **1**

Marks

2. This table gives details of the chemistry of four igneous rocks.

Oxide (weight %)	*Rock A*	*Rock B*	*Rock C*	*Rock D*
SiO_2	70·4	54·9	50·0	40·2
Al_2O_3	14·4	17·7	15·7	0·8
Fe_2O_3	1·0	2·4	1·7	1·9
FeO	1·9	5·6	8·1	11·9
MgO	0·8	4·9	8·0	43·2
CaO	2·0	7·9	11·4	0·8
Na_2O	3·2	3·7	2·7	0·3
K_2O	5·0	1·1	0·2	0·1

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

A Rock A is a granite because it has a very high level of SiO_2.

B There is no quartz in Rock D because all of the SiO_2 is in silicate minerals such as olivine.

C 40% of Rock D is quartz.

D None of the oxides in the analyses appears as an oxide in any of the rocks.

E Rock A would be granite if coarse-grained or rhyolite if fine-grained.

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

(*b*) (i) Peridotite may partially melt to form magma. Describe one way in which the composition of the peridotite differs from the composition of the magma.

.....

..... **1**

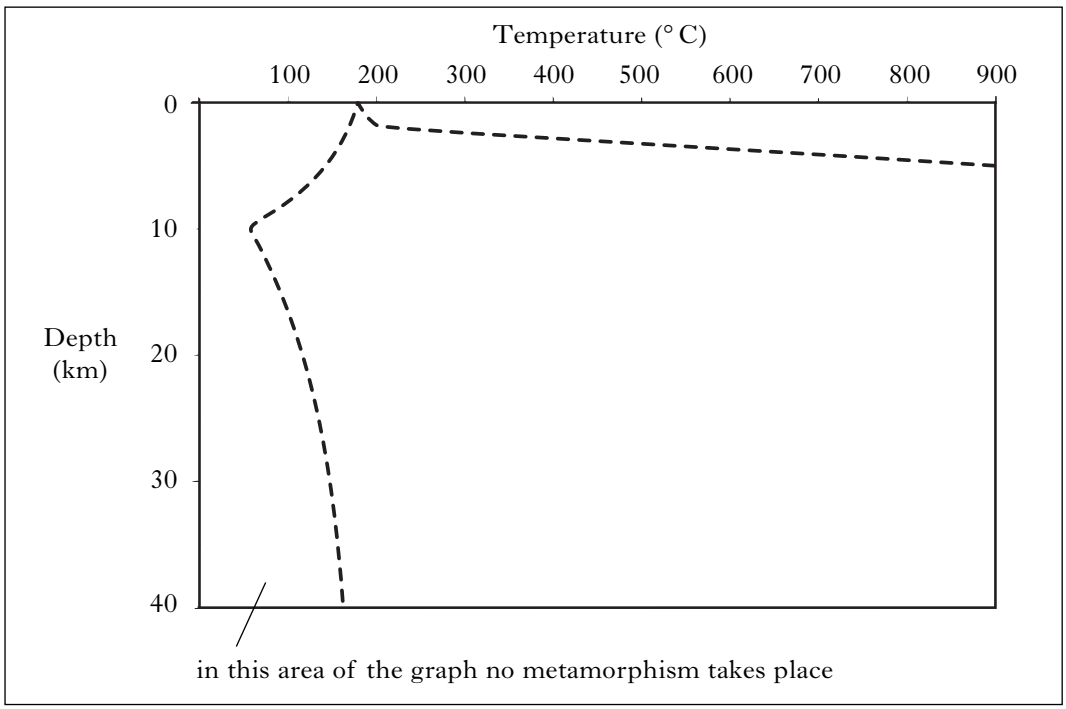
(ii) Describe one way in which granite magma may be formed.

.....

..... **1**

Marks

3. (*a*) This graph shows the temperature and pressure conditions under which metamorphic rocks form.



(i) On the graph, shade and label areas to show the range of pressure and temperature conditions under which the following would occur.

Spots appear on mudstones

Hornfels forms

Slate forms

Migmatite forms **2**

(ii) Blueschists form close to subduction zones where pressures are very high and where temperatures are very low. On the graph, shade and label the area to show the range of pressure and temperature conditions under which blueschists would form. **1**

(*b*) Which statement is correct?

A Contact metamorphism affects the chilled margin of an intrusion. Here the rock recrystallises in a finer-grained form.

B In contact metasomatism, fluids from the magma enter and replace the surrounding rock. The new rock which is formed is called pegmatite.

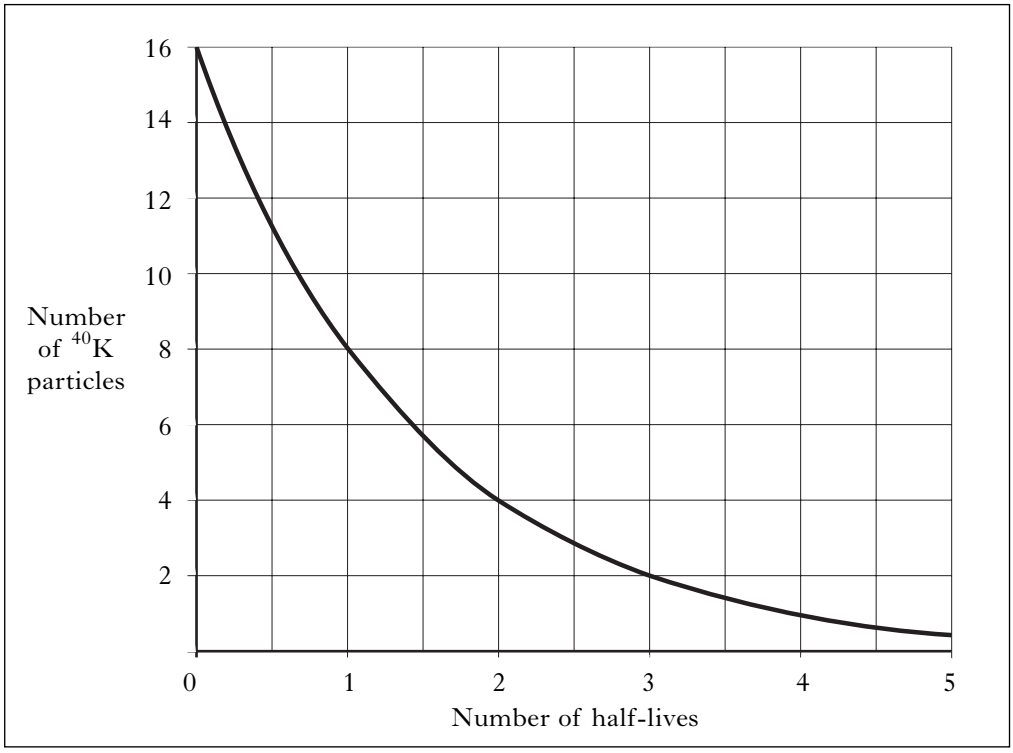
C In contact metamorphism, the rock close to an intrusion is heated and partly or completely recrystallised.

D Contact metasomatism affects the edge of an intrusion. The magma engulfs pieces of the surrounding rock so the composition of the magma is changed.

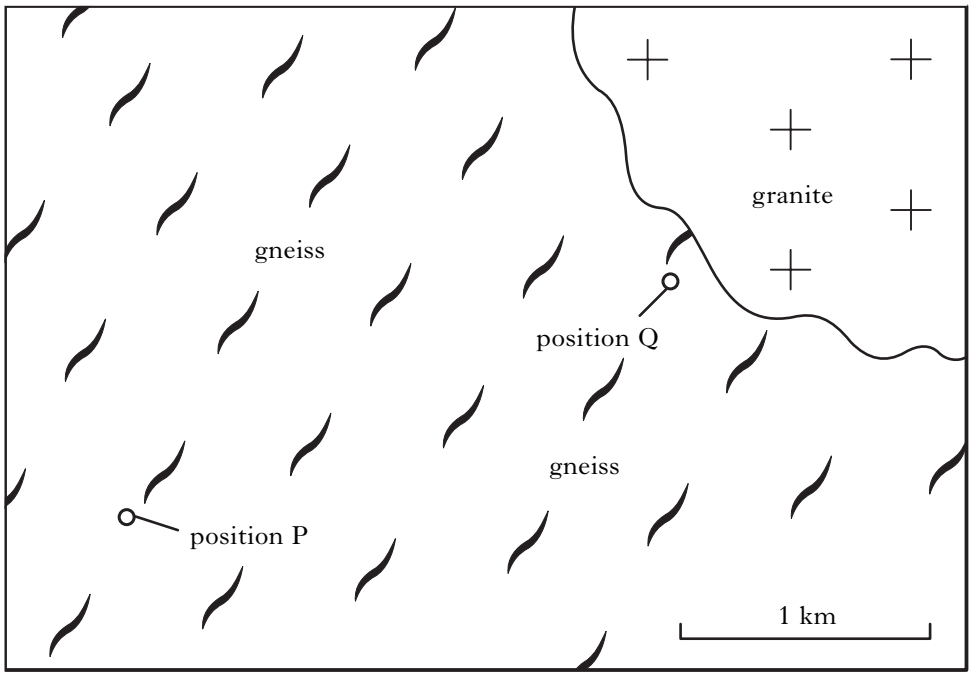
Give only the letter: **1**

Marks

4. Potassium-40 (^{40}K) decays to argon (Ar) with a half-life of 11 900 million years. The graph below shows the decay curve for ^{40}K.



Geology Map



4. (continued) *Marks*

(*a*) A crystal of muscovite taken from position Q on the geology map has a $^{40}K/Ar$ ratio of 15/1.

(i) From the graph, how many half-lives have passed since the muscovite crystallised?

..... **1**

(ii) What is the age of the muscovite?

..... **1**

(*b*) The gneiss at position P on the geology map has an age of 2000 million years. The muscovite in the granite is the same age as the muscovite in the gneiss at position Q. Explain why the muscovite in the gneiss at position Q is the same age as the muscovite in the granite.

.....

.....

..... **2**

(*c*) Explain why the decay of ^{14}C is not used to date Carboniferous coal seams.

.....

.....

..... **1**

Candidates must not write in this margin

5. (*a*) (i) What is meant by *environmental facies*? *Marks*

.....

.....

..... **1**

(ii) In stratigraphy, how does a period differ from a system?

.....

..... **1**

(*b*) (i) What features of ancient rocks would allow you to recognise them as having been deposited in a delta under hot, wet climatic conditions?

.....

.....

.....

.....

..... **2**

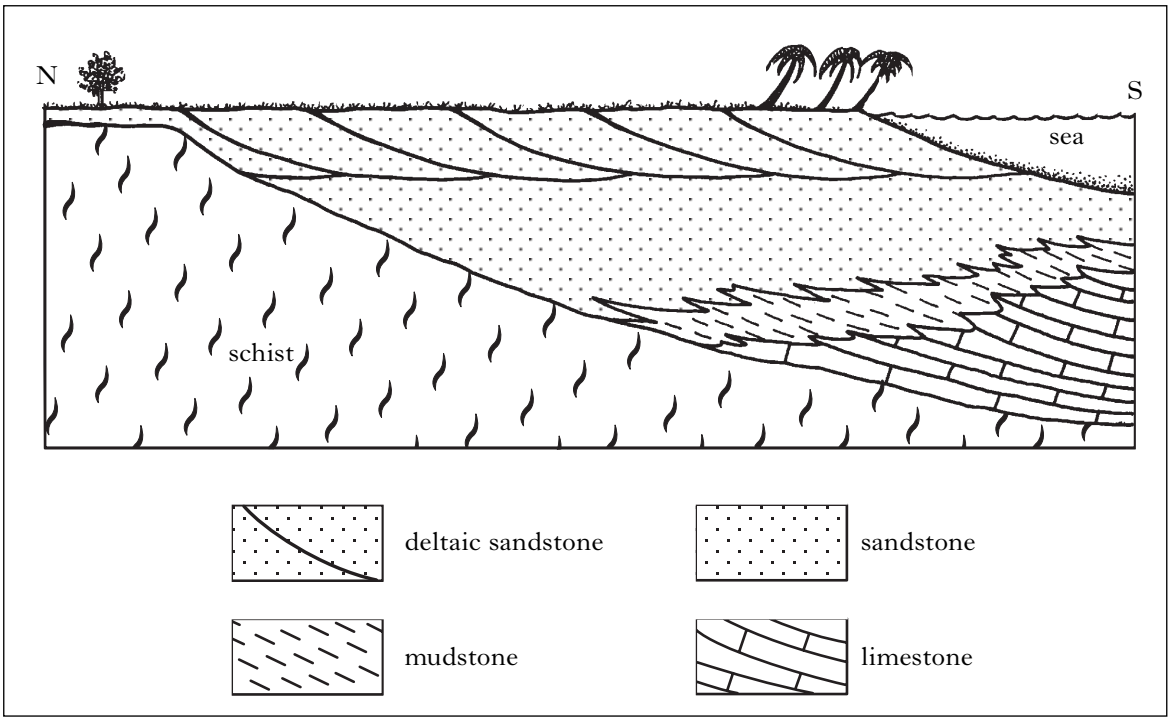
(ii) Name a geological period when deltaic rocks were deposited in Scotland under hot, wet climatic conditions.

..... **1**

Marks

5. (continued)

(*c*)



(i) Which **two** statements correctly describe relationships shown on the diagram above?

A There is an unconformable relationship between the deltaic sandstone and the underlying sandstone.

B The deltaic sandstone is diachronous because different parts of it were deposited at different times.

C The sea is in the process of advancing from the south towards the north.

D The mudstone has all been deposited in the sea.

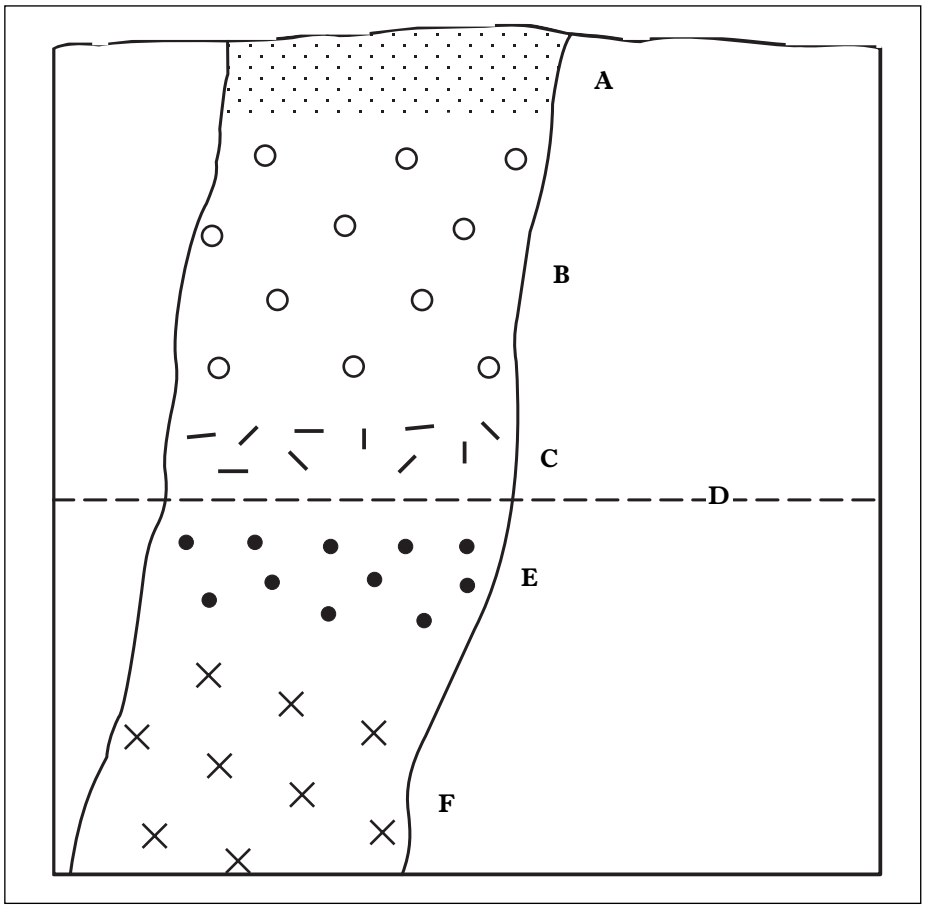
E The deltaic sandstone is diachronous because it forms a single layer which covers all the other rocks.

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

(ii) On the diagram, draw lines to divide the rocks by age rather than by type. The rocks between any pair of lines should be of approximately the same age. **2**

Marks

6. This diagram shows a copper ore body which has been subjected to secondary enrichment.



(*a*) From the diagram, choose a letter to show the position at which the described features would be found. A letter may be used once, more than once or not at all.

	Feature	*Letter*
(i)	Ore which has not been affected by any process of secondary enrichment	_____
(ii)	A high concentration of sulphides produces the richest copper ore	_____
(iii)	The water table	_____

3

Marks

6. (continued)

(*b*) How are ore bodies formed by the process of magmatic segregation?

.....

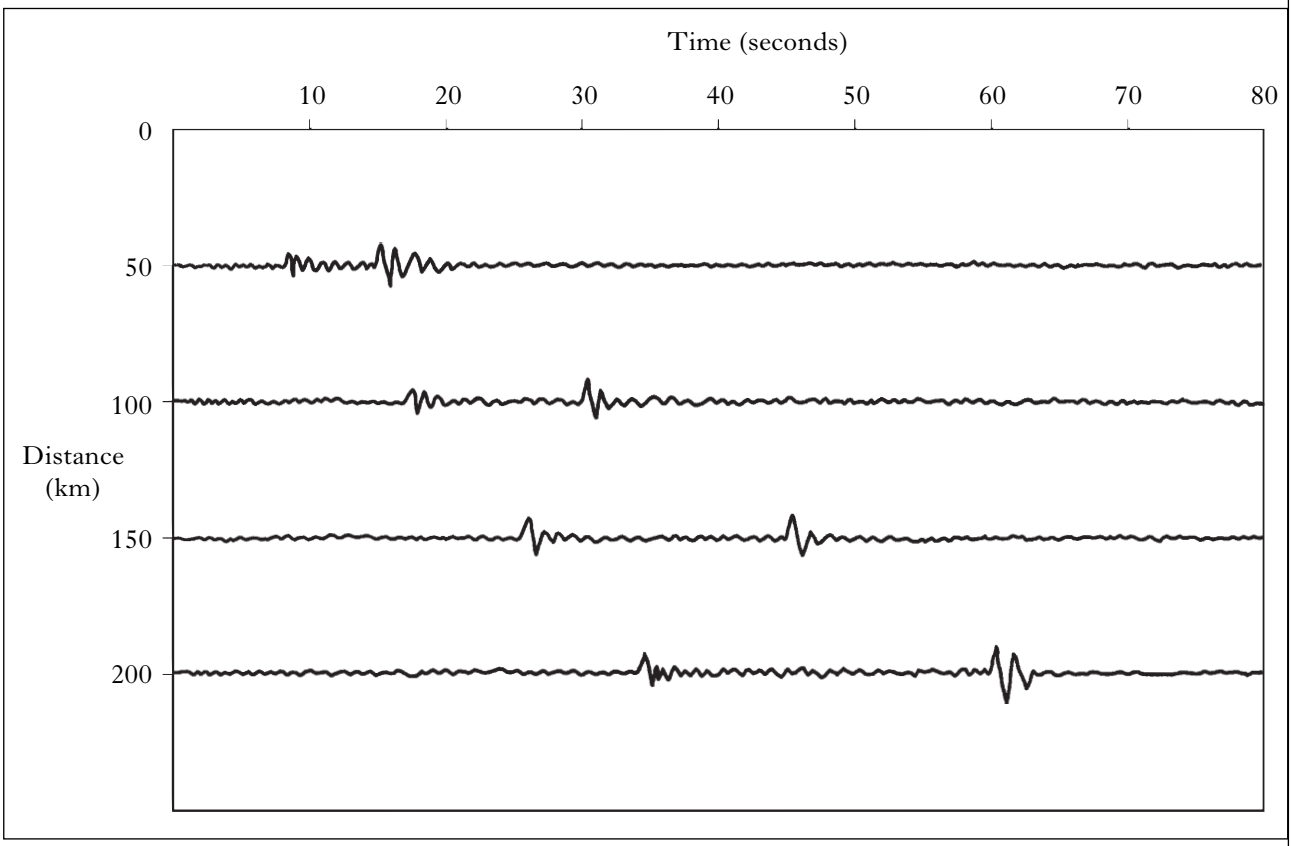
.....

.....

..... **2**

Marks

7. The diagram shows a series of seismograms obtained at different distances from an earthquake focus.



(*a*) Calculate the speeds of the P and S waves.

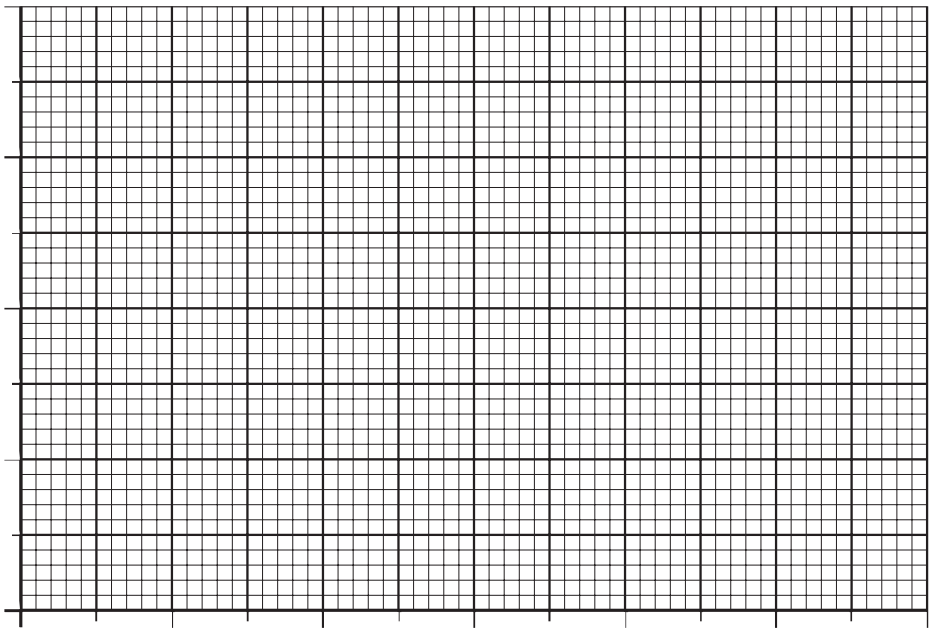
Speed of P waves: _____

Speed of S waves: _____ **2**

Marks

7. (continued)

(*b*) (i) On the graph paper provided below, draw a line graph to show how the time interval between the arrival of the P and S waves changes with distance.



2

(ii) If the time interval between the arrival of the P and S waves was 60 seconds, what is the distance between the earthquake focus and the recording station?

.....

1

Section A: Total (40) marks

SECTION B

Marks

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

Candidates should write their answers to the question chosen on pages 15 and 16.

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

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

8. Write an essay on aspects of fossils and stratigraphy. Give details as follows:

(*a*) The evolution of *Micraster*. **3**

(*b*) The characteristics of zone fossils. **4**

(*c*) Problems which arise when correlating sedimentary sequences in different areas. **4**

(*d*) The formation of cyclothems. **4**

(15)

9. Write an essay on aspects of sedimentary processes. Give details as follows:

(*a*) The processes which change a soft surface sediment into a hard rock. **3**

(*b*) The formation of coal. **5**

(*c*) The formation of evaporites. **3**

(*d*) The formation and characteristics of placer deposits. **4**

(15)

10. Write an essay on aspects of plate tectonics. Give details as follows:

(*a*) Igneous processes at constructive and destructive margins. **7**

(*b*) How study of apparent polar wander curves contributes to our knowledge and understanding of continental drift. **4**

(*c*) How study of plate tectonics has contributed to our understanding of the geological history of the British area. **4**

(15)

Section B: Total (15) marks

NOW GO TO SECTION C ON PAGE SEVENTEEN

SPACE FOR ANSWERS

SPACE FOR ANSWERS

SECTION C

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

Marks

11. Identify the features in the photograph and describe how these features were formed.
Diagrams should be used where necessary.

Photograph

Name of features **1**

Method of formation

.....

.....

..... **2**

Marks

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

(*a*) Which statement correctly describes the age relationships of Rock R?

A The conglomerate lies under the gneiss. Rock R cuts the conglomerate. Rock R is younger than the conglomerate.

B Rock R is younger than Structure W but older than Structure Z.

C Rock R is younger than the gneiss. No other age relationships are known.

D Rock R forms an igneous intrusion. It is the youngest rock shown on the map.

Give only the letter: **1**

(*b*) (i) Give one reason to explain why you may not be able to find the exact amount of movement.

.....

..... **1**

(ii) Describe the movements which have taken place on faults F1 and F2 on the map.

Movement on F1: .....

.....

Movement on F2: .....

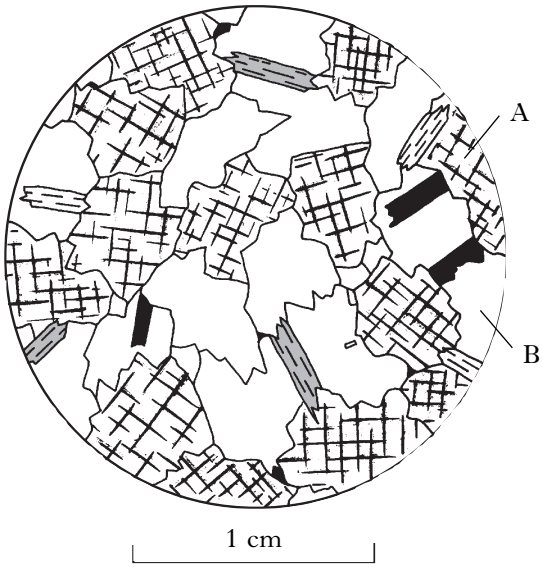
..... **2**

Marks

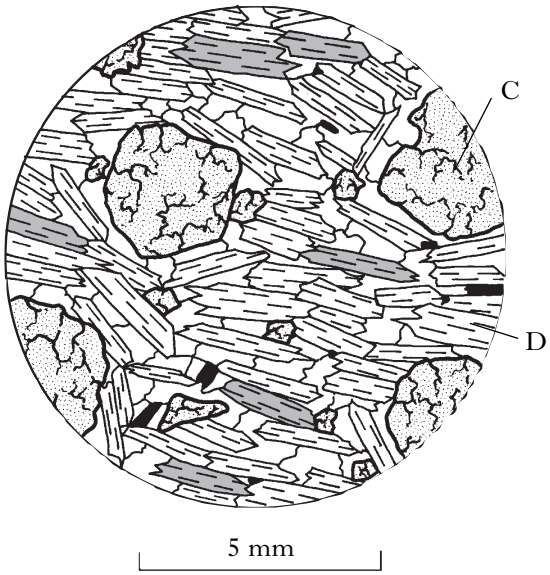
12. (continued)

(*c*) These diagrams show Rocks P and Q under the microscope.

Rock P



Rock Q



(i) Name Minerals A–D.

Name of Mineral A: .....

Name of Mineral B: .....

Name of Mineral C: .....

Name of Mineral D: **2**

(ii) Name Rocks P and Q.

Name of Rock P: .....

Name of Rock Q: **2**

(iii) Which statement is correct?

A Rock P is an igneous rock which has been partly metamorphosed.

B Rock P is a metamorphic rock which has been partly melted.

C Rock P is younger than Rock R.

D Rock P is older than Rock Q.

Give only the letter: **1**

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

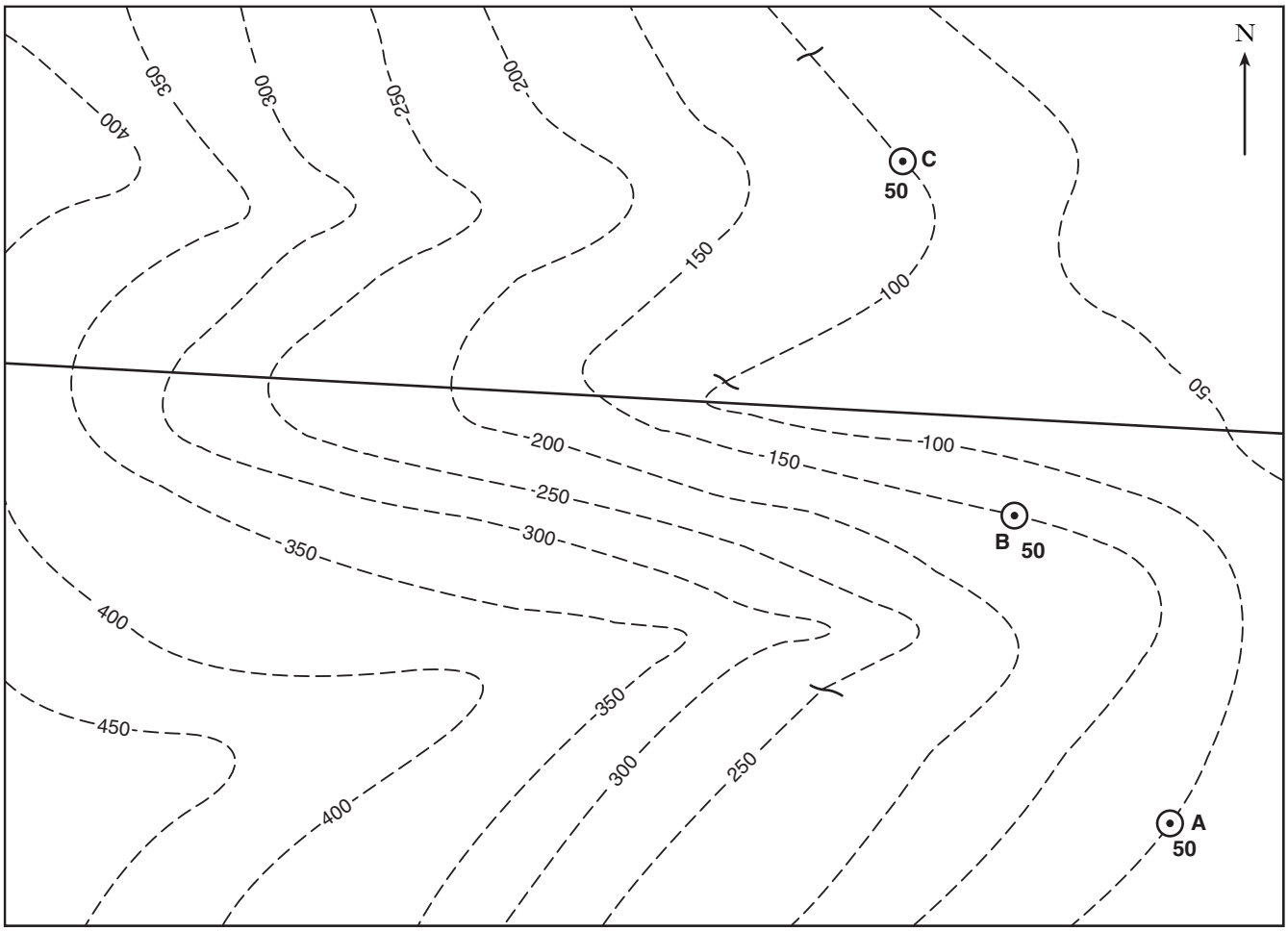
Marks

12. (continued)

(*e*) Describe the geological history of the area shown on the map.

6

13.



Key

200 — surface contour with height in metres

outcrop of coal seam

A 50 — borehole with depth to coal seam in metres

0 200 400 600 800 metres

Candidates must not write in this margin

Marks

(*a*) South of the fault on the map, a coal seam outcrops at the position shown. The seam is found in boreholes A and B at depths shown. The seam has a uniform dip.

Borehole A: Depth to seam from surface: 50 m

Borehole B: Depth to seam from surface: 50 m

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

(ii) What is the angle and direction of dip of the seam south of the fault?

..... **2**

Space for working

(iii) Complete the outcrop of the seam south of the fault. **3**

Marks

13. (continued)

(*b*) North of the fault the same coal seam outcrops at the positions shown. The seam is found in Borehole C at a depth of 50 m.

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

(ii) What is the angle and direction of dip of the seam north of the fault?

..... **2**

Space for working

(iii) Complete the outcrop of the seam north of the fault. **3**

(*c*) In what **three** ways has the coal seam been affected by movement on the fault?

1. .....

2. .....

3. ..... **2**

Section C: Total (40) marks

[*END OF QUESTION PAPER*]

SPACE FOR ANSWERS OR FOR ROUGH WORK

SPACE FOR ANSWERS OR FOR ROUGH WORK

FOR OFFICIAL USE

Centre No.	Subject No.		Paper No.	Group No.	Marker's No.
		H			

Total

[CO43/SQP018]

Higher Geology

Time: 2 hours 30 minutes

NATIONAL QUALIFICATIONS

Worksheet for Question 12
Specimen Question Paper

Fill in these boxes and read what is printed below.

Full name of school or college

Town

First name and initials

Surname

Date of birth
Day Month Year

Candidate number

Number of seat

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

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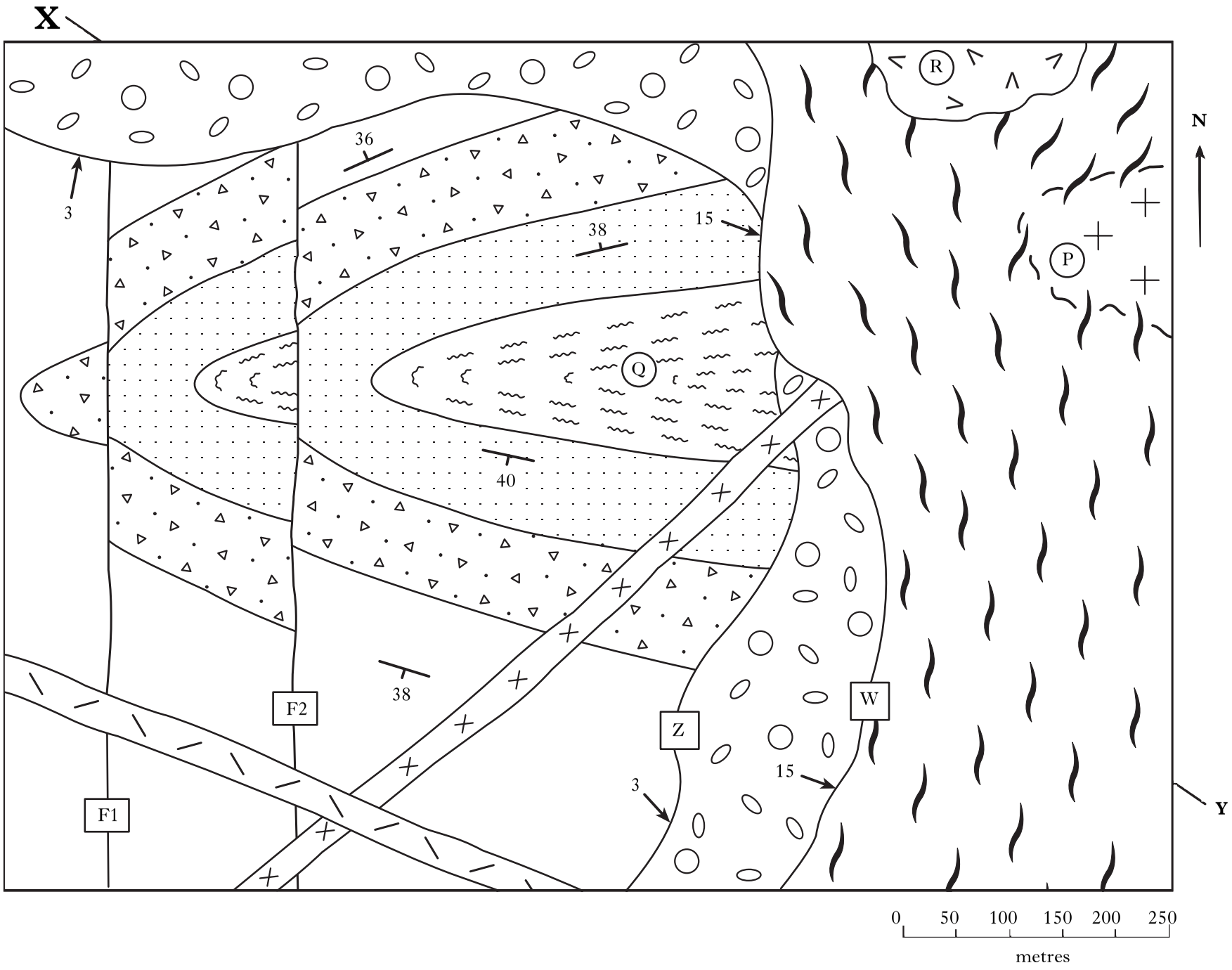
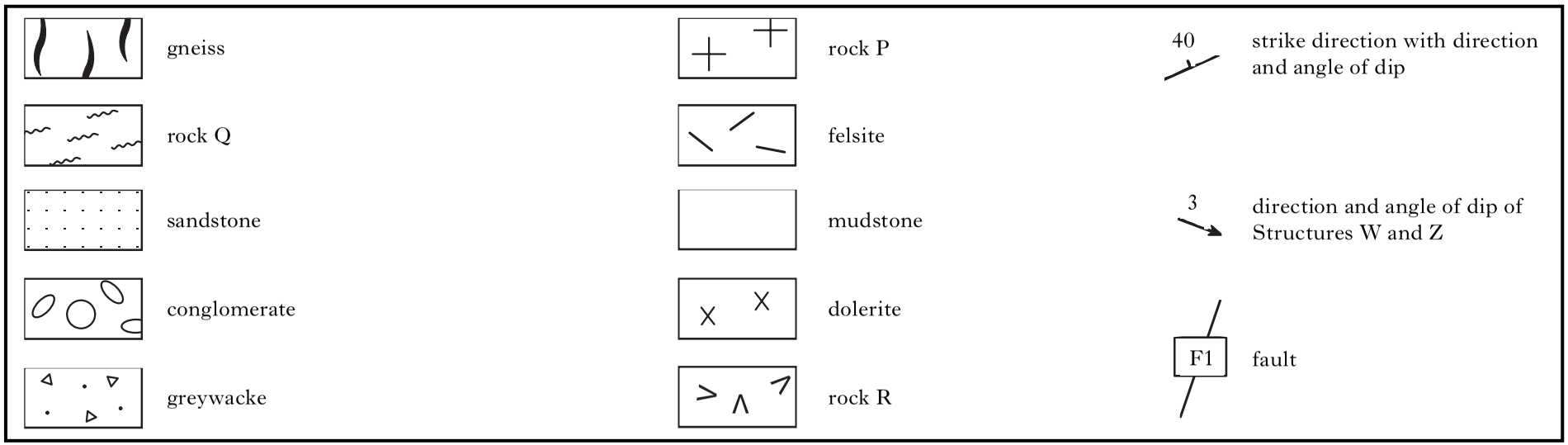
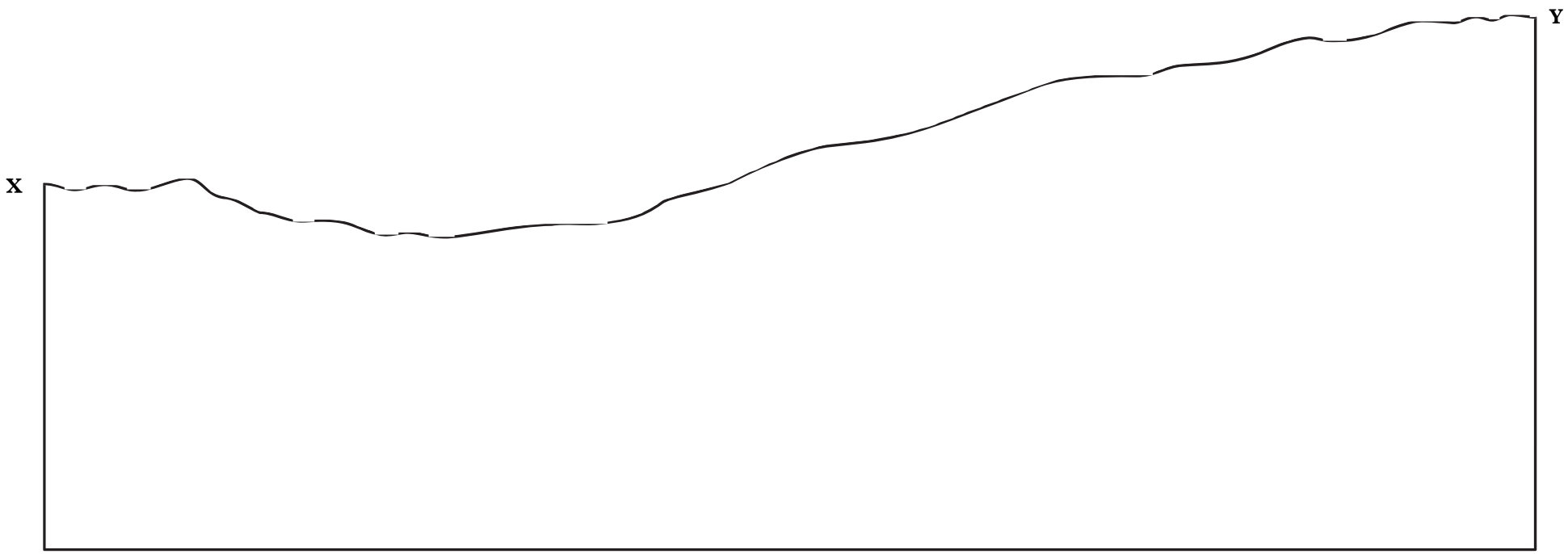

X
Y
N
R
P
Q
36
38
15
3
40
38
F1
F2
Z
W
3
15
0
50
100
150
200
250
metres

Key (Rocks not in order of age)





[CO43/SQP018]

Higher Geology

NATIONAL QUALIFICATIONS

Specimen Marking Instructions

SCOTTISH QUALIFICATIONS AUTHORITY

Section A

1. (*a*) (i) Replacing silicon Si^{4+} with aluminium Al^{3+} means that there is a reduction of one positive charge. Adding a potassium ion K^{+} restores the overall charge to zero.

(ii) The rubidium ion (radius 168 pm) is closer to the potassium ion (radius 159 pm) in size. It can replace potassium more easily than it can replace sodium (radius 124 pm).

(iii) Although sodium and calcium have different charges (Na^{+} and Ca^{+}) they are close to each other in size (sodium ionic radius 124 pm; calcium radius 120 pm). In substitution, similarity of ionic radius is more important than similarity of charge. This means that sodium and calcium can easily substitute for each other. (1 mark)

Potassium has a much bigger ionic radius (159 pm) than calcium so these ions do not easily substitute for each other. (1 mark)

(*b*) (i) Uranium (U^{4+}) differs in charge from Mg, Fe, Na, K and Al so it cannot easily substitute for these ions. (1 mark)

U and Si have the same charge but the ionic radii are very different so U cannot replace Si. (1 mark)

(ii) U and Zr have the same charge and their ionic radii (U 108 pm; Zr 80 pm) are near enough to allow U to substitute for Zr.

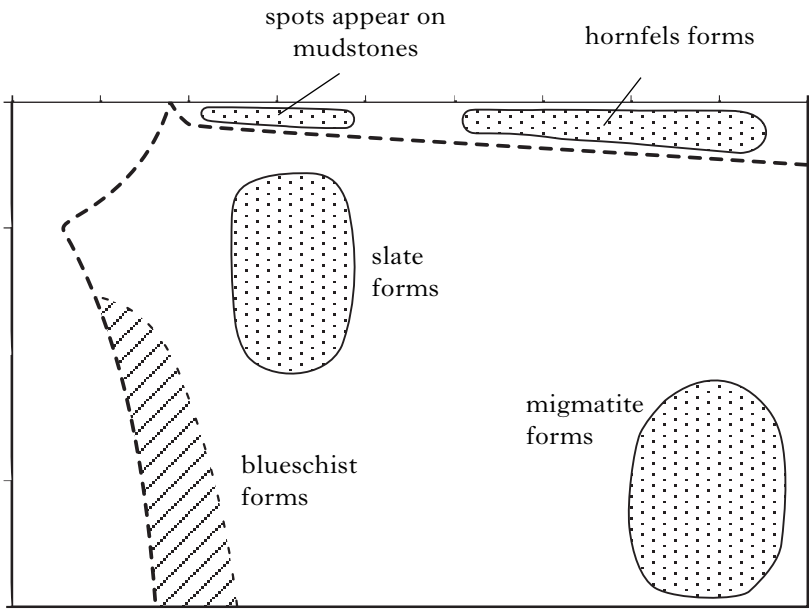
(*c*) B

2. (*a*) B, E

(*b*) (i) Basaltic magma is formed when peridotite partially melts. In Table Q2, Rock C is basalt and D is peridotite. Any described difference would be acceptable. (Eg higher percentage of SiO_2, Al_2O_3, CaO, Na_2O, or K_2O in basaltic magma. Lower percentage of MgO in basaltic magma.)

(ii) Any one of: Partial melting of crust at destructive margins; Fractionation of andesitic or basaltic magma; Partial melting of diorite intrusions above subduction zones.

3. (*a*)



(*b*) C

4. (*a*) (i) By calculation the answer is 0·093 half-lives. Take 0·08–0·10.

(ii) By calculation the answer is 1108 Ma. Take 950–1200 Ma.

(*b*) The gneiss was formed 2000 Ma ago. At Position Q the gneiss was metamorphosed when the granite was intruded 1100 Ma ago. (1 mark) The muscovite in the granite crystallised from the granite magma. During the metamorphism, the muscovite at position Q recrystallised so its K–Ar clock was reset giving an age which is the same as that of the muscovite in the granite. (1 mark)

(*c*) Carboniferous coal seams are about 300 million years old. ^{14}C has a very short half-life (5700 years) so by this time it would all have decayed away. (Radioactive isotopes can only be used to date events up to an age of about ten half-lives. This means that ^{14}C can be used to date events within the last 60 000 years. For Carboniferous rocks more than 50 000 half-lives would have passed.)

5. (*a*) (i) A complete description of all of the characteristics of a sediment deposited in a particular environment.

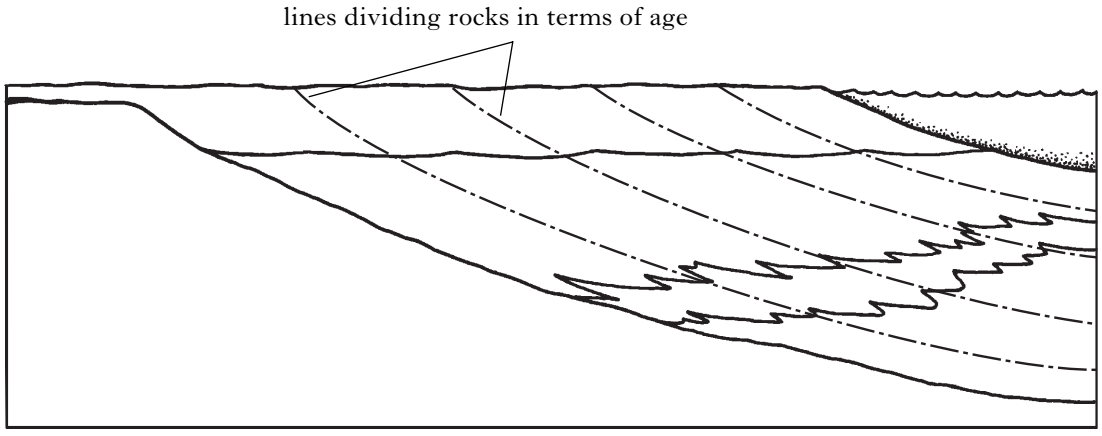
(ii) A period is a time unit. A system is a rock-time unit. It is made up of all the rocks formed during a period.

(*b*) (i) Four features should be mentioned: eg thick cross-bedded sandstones; coal seams; abundant plant fossils; fossils of fresh or brackish water animals; lake and marsh deposits; evidence of stream channels; presence of sedimentary features such as mudcracks, convolute bedding, cyclothems and coarsening-upward successions.

(ii) Carboniferous or Jurassic.

(*c*) (i) B, D

(ii)



6. (*a*) (i) F

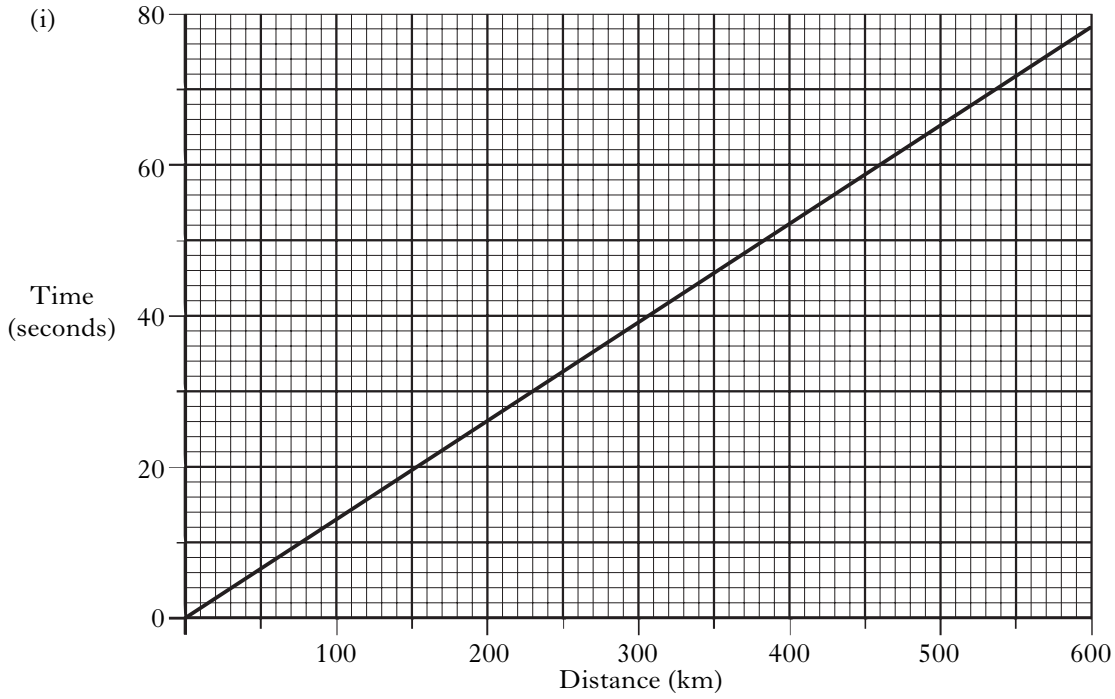
(ii) E

(iii) D

(*b*) When a basic magma crystallises, dense early-formed crystals such as those of chromite (1 mark) sink from the magma to form layers at the base of the magma chamber. (1 mark)

7. (*a*) Speed of P waves: $5{\cdot}8\,\text{km}\,\text{s}^{-1}$
Speed of S waves: $3{\cdot}3\,\text{km}\,\text{s}^{-1}$

(*b*) (i)



Appropriate scales + labelling of axes (1 mark)
Correctly drawn line (1 mark)

(ii) By calculation, the answer is 460 km. Take 440–480 km.

Section B

Essays should be marked on the basis of one mark per valid point. In all examples, give credit for other valid points. Credit should also be given for useful diagrams.

8. (*a*)
- *Micraster* evolved to become better adapted to deeper burrowing. **1**
- The test gets higher and broader and the highest and broadest part moves backwards. **1**
- Anterior groove gets deeper. Mouth moves forward and labrum (lip) becomes more pronounced. **1**
- These changes probably allowed for better food collection. **1**
- Petaloid ambulacra get longer to allow for better gas exchange. **1**

(Maximum marks 3)

(*b*) Good zone fossils should:
- be widespread to allow correlation over a large area **1**
- be rapidly evolving forms so that they are restricted to a narrow part of the geological column **1**
- be common and easy to identify **1**
- not be restricted to any particular environment **1**
- so they are the remains of planktonic organisms. **1**

(Maximum marks 4)

(*c*)
- The rocks may have no fossils.
- The rocks may have been deposited in different environments (eg on land or in the sea; in deltas or coral reefs) **1** **1**
- so having different rock types and fossils. **1**
- There may be no marker horizons.
- There may be a complete sequence in one area but only a partial sequence (because of non deposition or erosion) in the other area. **1**

(Maximum marks 4)

(*d*)
- Cyclothems are repeated sequences of sedimentary rocks. **1**
- Formed by the advance of deltas **1**
- into subsiding marine basins. **1**
- Marine rocks are covered by deltaic then terrestrial sediments as the delta builds up. **1**
- The delta sinks, marine sedimentation begins again so the same sequence is repeated. **1**

(Maximum marks 4)

9. (*a*)
- Diagenesis is a group of processes by which soft sediment is converted to hard rock. **1**
- The sediment is buried and compacted. **1**
- This helps grains to stick together (eg there may be grain-contact solution). **1**
- Cement (eg calcite, quartz, iron oxide) which holds the grains together **1**
- is deposited by percolating water. **1**

(Maximum marks 3)

(*b*)
- Plants which grow in anaerobic swampy conditions do not decay completely on death **1**
- so their remains form peat. **1**
- The peat is buried and compressed. **1**
- Increased compression and heating drives off increasing amounts of water and other volatiles **1**
- so the carbon percentage of the coal increases. **1**
- This gives a sequence of increasing rank (peat to anthracite). **1**

(Maximum marks 5)

(*c*) • Evaporites are formed by the evaporation of sea water in hot climates.
• The salts precipitate in order of increasing solubility—
• calcium carbonate ⟶ calcium sulphate ⟶ sodium chloride ⟶
• potassium and magnesium salts. **2**
• Thick sequences are formed in subsiding basins regularly fed with fresh supplies of sea water. **1**
(Maximum marks 3)

(*d*) • Placers are sands and gravels rich in ore minerals. **1**
• The ore minerals are dense and tough. **1**
• Examples of ore minerals are cassiterite, gold, magnetite, chromite. **1**
• Formed on beaches and in river beds. **1**
• Drawing or further description to be given. **1**
(Maximum marks 4)

10. (*a*) No more than 4 marks of the 7 should be attributed to one type of margin.
Constructive margin:
• Partial melting of peridotite
• gives basaltic magma. **2**
• Gabbro forms in magma chambers under the ridge. **1**
• Tension forms fissures which allow intrusion of multiple dykes. **1**
• Sea bed, effusive fissure eruptions form pillow lavas. **1**

Destructive margin:
• Andesitic magma is formed by the partial melting of the subducted slab, and
• by fractionation of basaltic magmas formed by partial wet melting of the peridotite wedge above the subjected slab. **2**
The andesite magma
• rises to form diorite intrusions and
• explosive central vent volcanoes. **2**
Granite is formed
• by fractionation of andesitic magmas and
• by partial melting of diorite and crust. **2**
(Maximum marks 7)

(*b*) • Apparent polar wander curves show the positions of the palaeomagnetic pole at different times relative to continents.
• Since the pole has not moved the continents must have moved. **2**
• When continents are joined they have the same apparent polar wander curves.
• When continents separate or collide, the apparent polar wander curves diverge or converge. **2**
• The divergence or convergence of the curves gives the time of separation or collision. **1**
(Maximum marks 4)

(*c*) • The British area is made up of terranes moved and jostled into their present positions by plate movements.
• Plate collision closed the Iapetus Ocean and caused the Caledonian Orogeny.
• Mountain building was accompanied by regional metamorphism and by the intrusion of granites.
• Areas such as the Lake District are the remains of ancient volcanic island arcs. **3**
• Britain drifted north through various climatic zones from the southern hemisphere. (Eg Carboniferous coals were formed when Britain was on the equator; Permian rocks were formed when Britain lay in the position of the Sahara Desert.) **1**
(Maximum marks 4)

Section C

11. Mudcracks (1 mark) Initially, small cracks were formed by drying and contraction of the mud. (1 mark) Later, further drying formed the large cracks which cut across the small cracks. (1 mark)

12. (*a*) C

(*b*) (i) Any reasonable answer would be acceptable. (Eg, The rocks may be poorly exposed so it may not be possible to see matching rocks or structures on opposite sides of the fault. The rocks may be massive so there may be no matching layers on opposite sides of the fault. It may not be possible to detect oblique movement on the fault.)

(ii) Movement on F1: The rocks on the west of the fault have been moved vertically downwards.
Movement on F2: The rocks on the west of the fault have been moved vertically upwards.

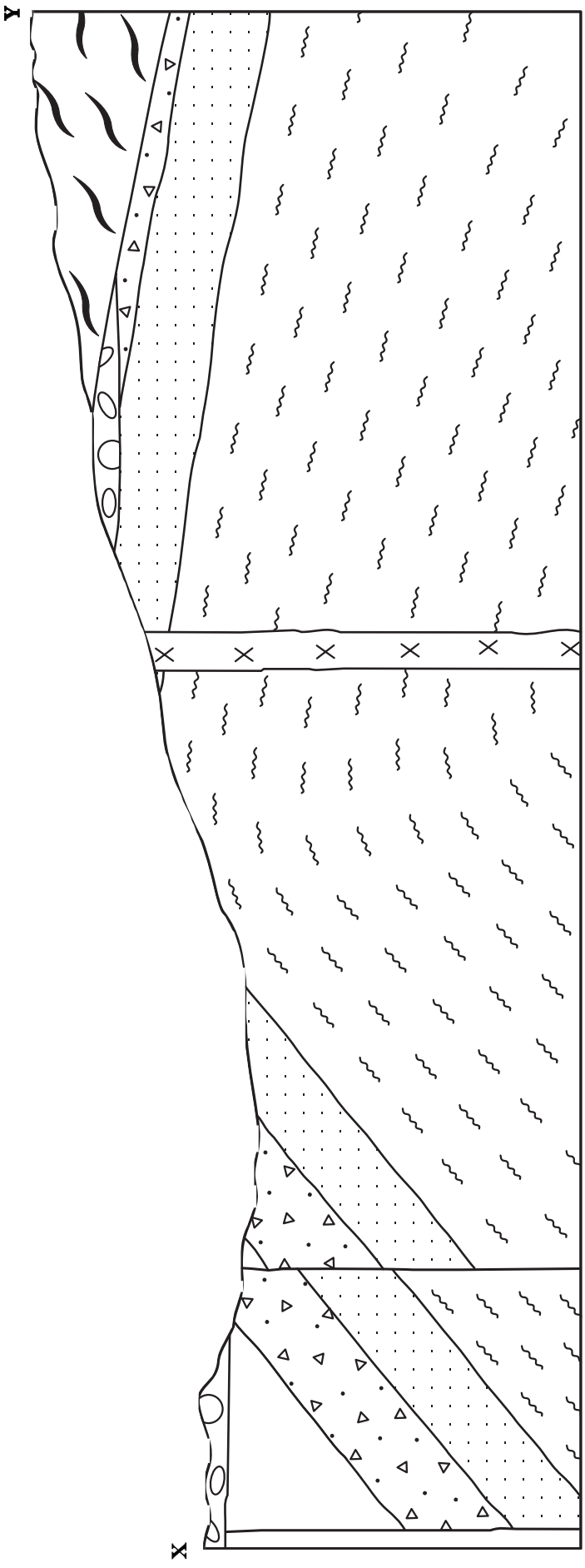
(*c*) (i) Name of mineral A: microcline
Name of mineral B: quartz
Name of mineral C: garnet
Name of mineral D: muscovite

(ii) Name of Rock P: granite
Name of Rock Q: schist

(iii) A

12. (continued)

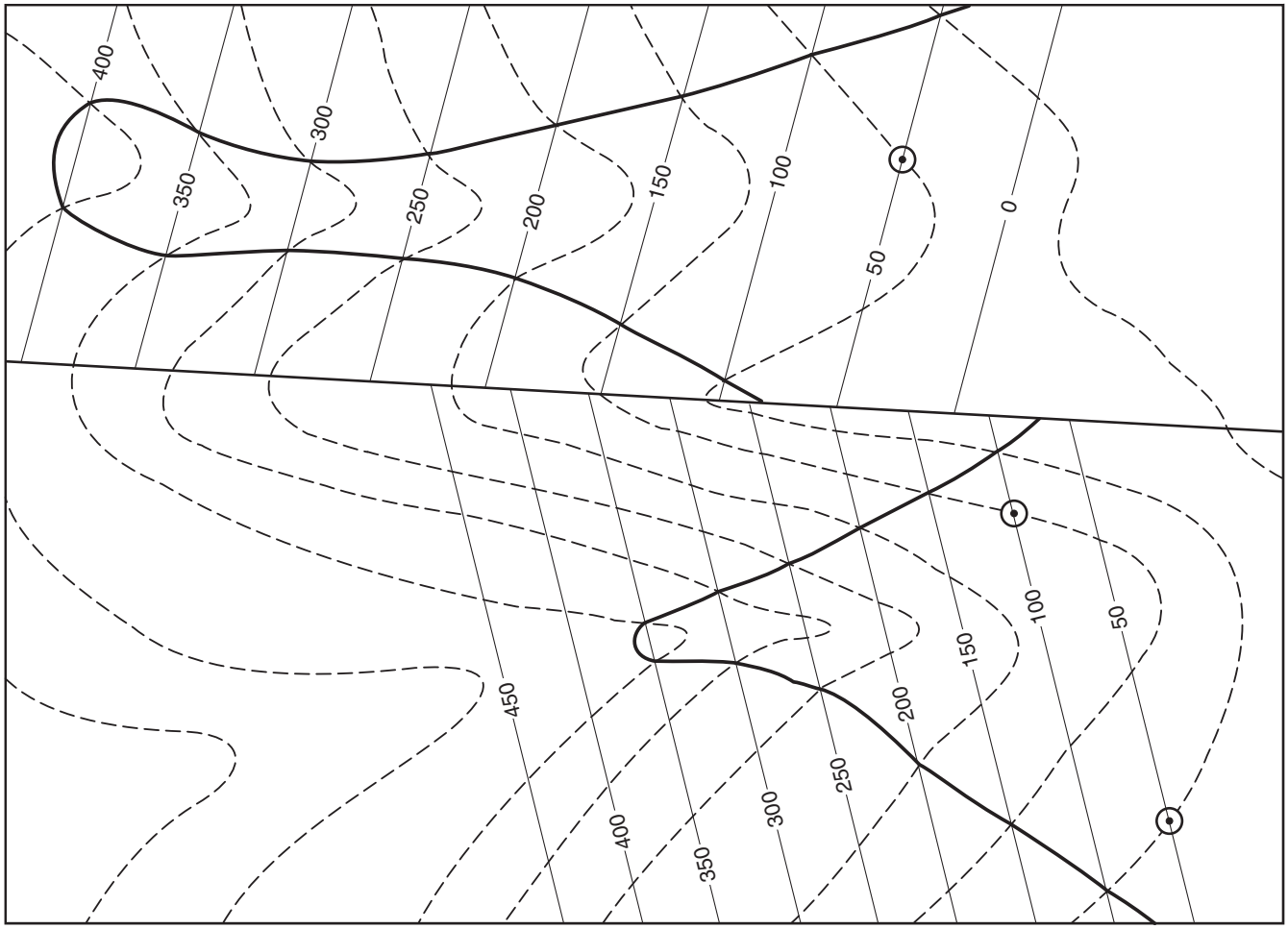
(*d*)



12. (continued)

(*e*) The sequence of events is briefly as follows: Formation of schist. Schist unconformably overlain by sandstone, greywacke, mudstone. Movements on faults F1 and F2. (Relative ages of faults not known.) Conglomerate deposited above unconformity. Intrusion of dolerite dyke. Intrusion of felsite dyke. Thrusting of gneiss over dolerite and all older rocks. (Relative ages of felsite and thrust not known.) Within gneiss, granite intruded and partly metamorphosed. Rock R intruded. (Relative ages of Rock R and rocks under thrust not known.)

13. (*a*) (i) On map.



Key

50 Structure contour with height in metres

13. (*a*) (continued)

(ii) Dip 14°, (1 mark) in a direction slightly north of east (1 mark). The exact angle of dip is 14·04° so take 12–16° .

(iii) On map.

(*b*) (i) On map.

(ii) Dip 9°, (1 mark) in a direction slightly south of east (1 mark). The exact angle of dip is 9·46° so take 7–11°.

(iii) On map.

(*c*) 1. The rocks have been moved up on the south side of the fault. (Or down on the north side.)

2. The rocks have been more steeply tilted on the south side of the fault. (Or less steeply tilted on the north side.)

3. The rocks have been twisted so the rocks north and south of the fault no longer strike in the same direction.

Total marks: 95 marks

[*END OF MARKING INSTRUCTIONS*]