

FOR OFFICIAL USE

Centre No.	Subject No. 1280	H	Paper No.	Group No.	Marker's No.
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Total

[CO43/SQP018]

**Higher
Geology**
Specimen Question Paper

Time: 3 hours

**NATIONAL
QUALIFICATIONS**

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

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Candidate number

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Number of seat

- 1 You should attempt **all** of the questions.
- 2 All answers should be written in the spaces provided in this answer book and should be written clearly and legibly in ink.
- 3 The marks allocated to each question or part of a question are shown at the end of each question or part of a question.
- 4 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.
- 5 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

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

Marks

1. Use the information in Table Q1 to allow you to answer the questions which follow.

Table Q1

<i>Element</i>	<i>Symbol and charge</i>	<i>Ionic radius (picometres)</i>
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)

(iii) Explain why there is complete solid solution between albite ($\text{NaAlSi}_3\text{O}_8$) and anorthite ($\text{CaAl}_2\text{Si}_2\text{O}_8$), while there is a very limited solid solution between anorthite and orthoclase (KAlSi_3O_8).

.....

Marks

(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: $\text{CaMgFe}^{2+}\text{Mn}(\text{CO}_3)_2$. 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. Table Q2 gives details of the chemistry of igneous rocks.

Table Q2

Oxide (weight %)	Rock A	Rock B	Rock C	Rock D
SiO ₂	70.4	54.9	50.0	40.2
Al ₂ O ₃	14.4	17.7	15.7	0.8
Fe ₂ O 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 ₂ O	3.2	3.7	2.7	0.3
K ₂ O	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 SiO₂.
- B There is no quartz in Rock D because all of the SiO₂ 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)

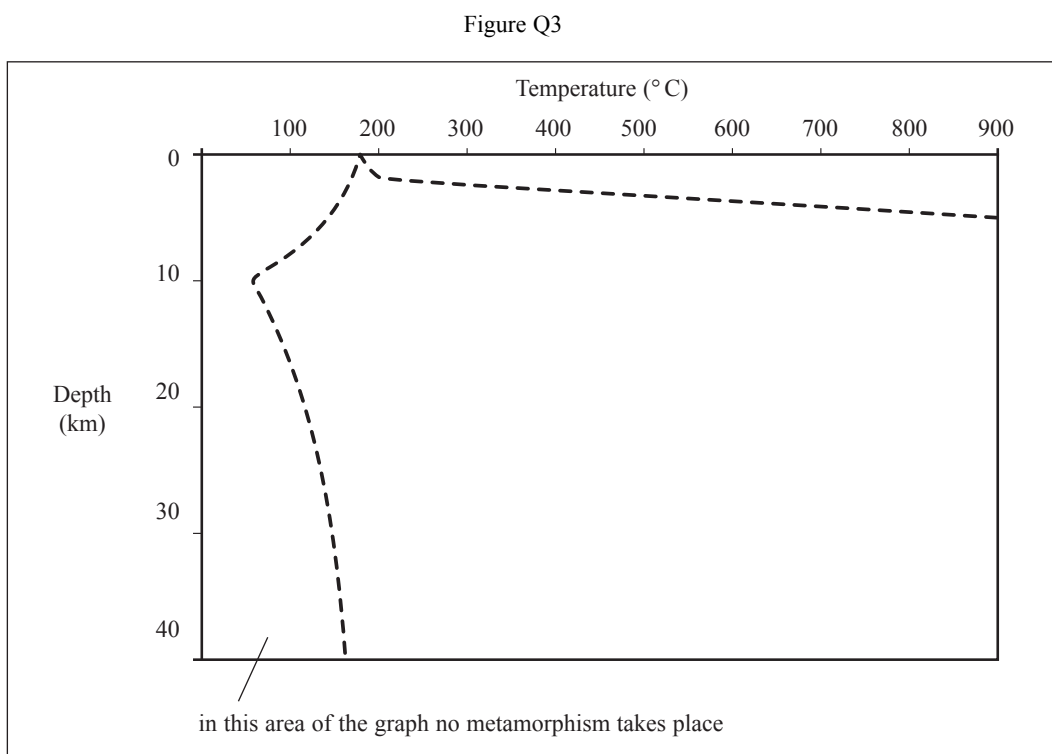
(ii) Describe one way in which granite magma may be formed.

.....

(1)

3. (a) Figure Q3 shows the temperature and pressure conditions under which metamorphic rocks form.

Marks



(i) On Figure Q3, 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 Figure Q3, 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)

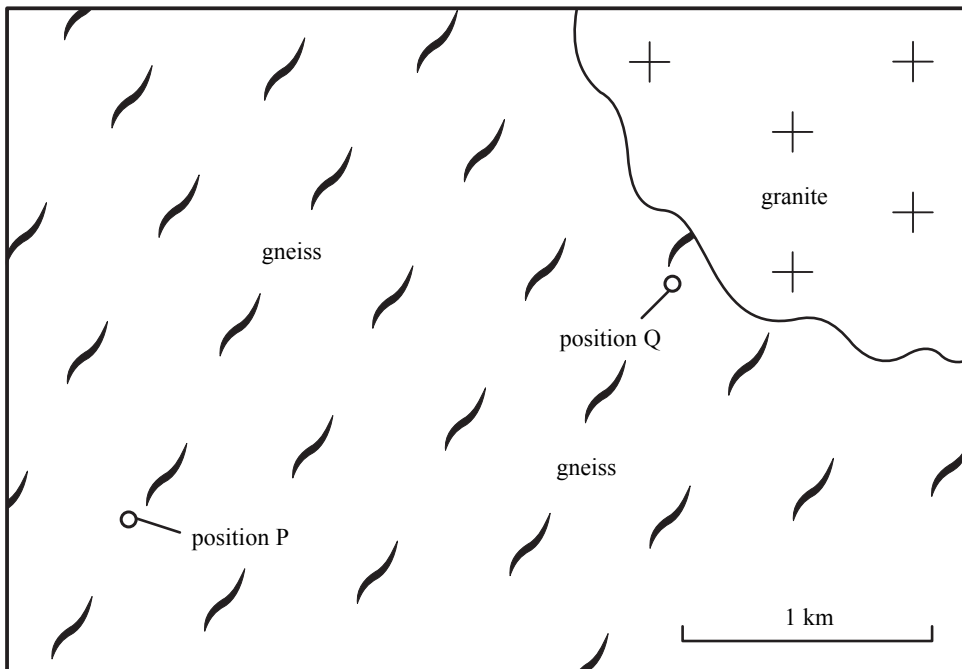
Marks

4. Potassium-40 (^{40}K) decays to argon (Ar) with a half-life of 11 900 million years. Figure Q4(1) shows the decay curve for ^{40}K .

Figure Q4(1)



Figure Q4(2)



(a) A crystal of muscovite taken from position Q in Figure Q4(2) has a $^{40}\text{K}/\text{Ar}$ ratio of 15/1.

Marks

(i) From the graph Figure Q4(1), 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 in Figure Q4(2) 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)

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.

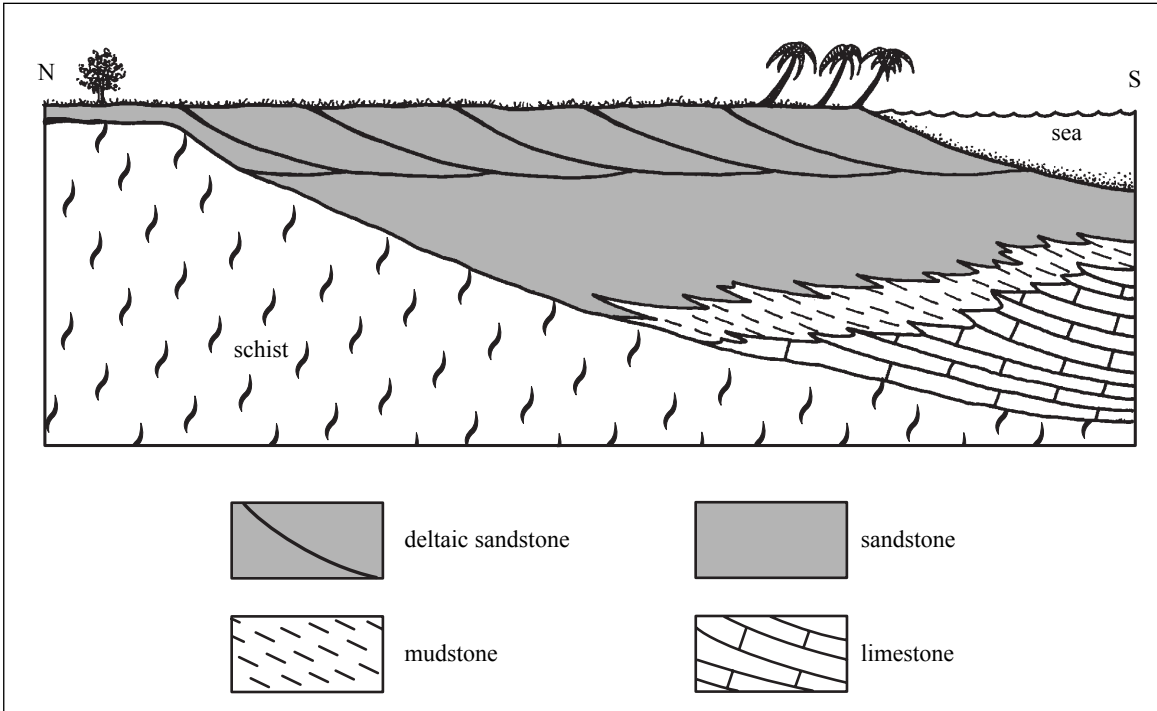
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(1)

Marks

(c)

Figure Q5



(i) Which **two** statements correctly describe relationships shown on the diagram Figure Q5?

- 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)

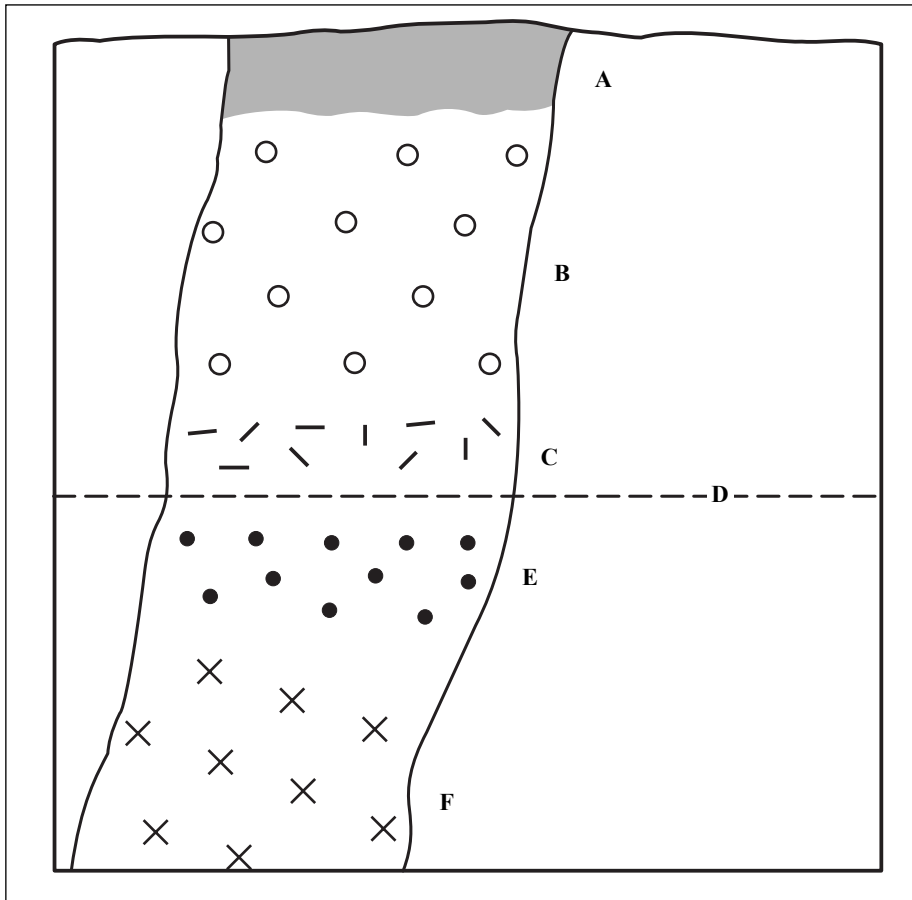
(ii) On the diagram Figure Q5, draw lines to divide the rocks by age rather than by type. The rocks between any pair of lines should be of approximately the same age.

(2)

Marks

6. The diagram Figure Q6 shows a copper ore body which has been subjected to secondary enrichment.

Figure Q6



- (a) From the diagram Figure Q6, 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.

<i>Feature</i>	<i>Letter</i>
(i) Ore which has not been affected by any process of secondary enrichment	_____
(ii) A high concentration of insoluble iron oxides	_____
(iii) Oxidised ores such as malachite	_____
(iv) A copper concentration of 0%	_____
(v) A high concentration of sulphides produces the richest copper ore	_____
(vi) The water table	_____

(3)

Marks

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

.....

.....

.....

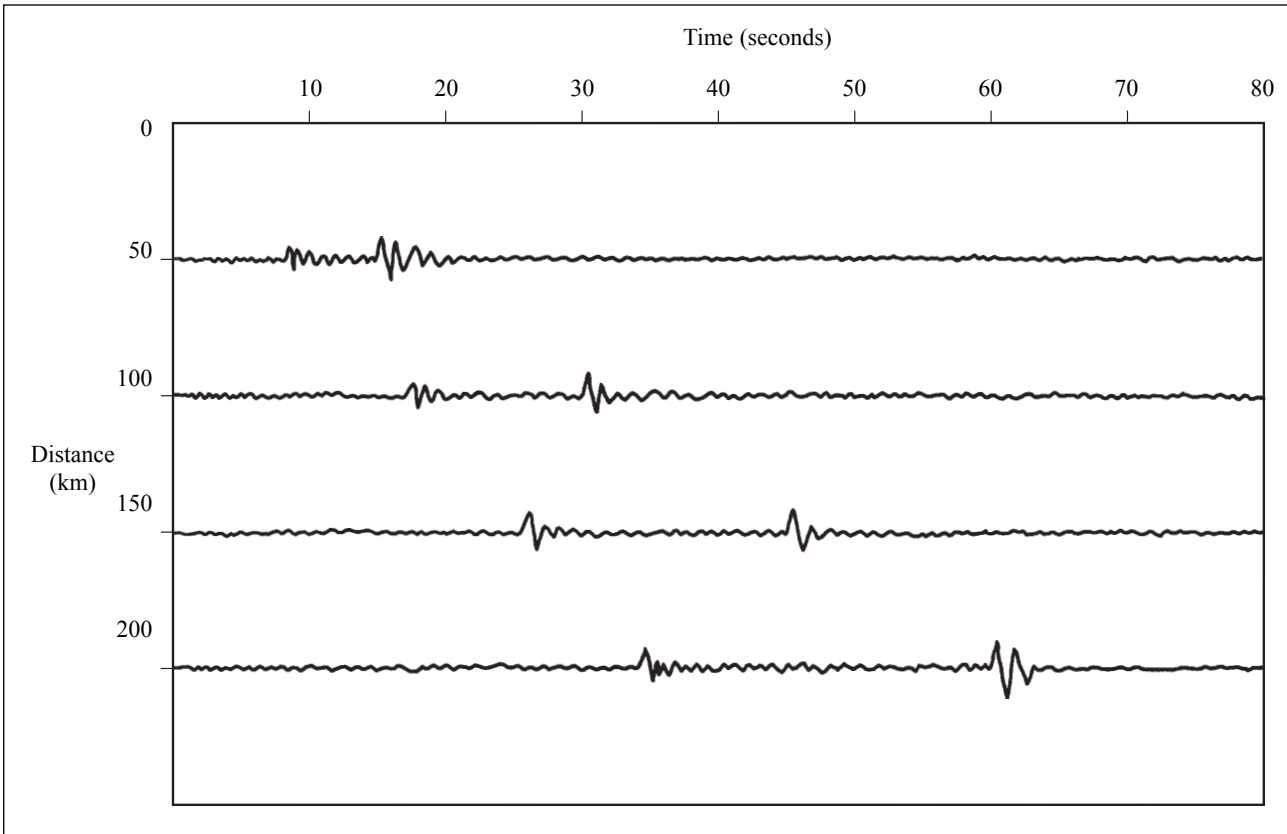
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(2)

Marks

7. The diagram Figure Q7 shows a series of seismograms obtained at different distances from an earthquake focus.

Figure Q7



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

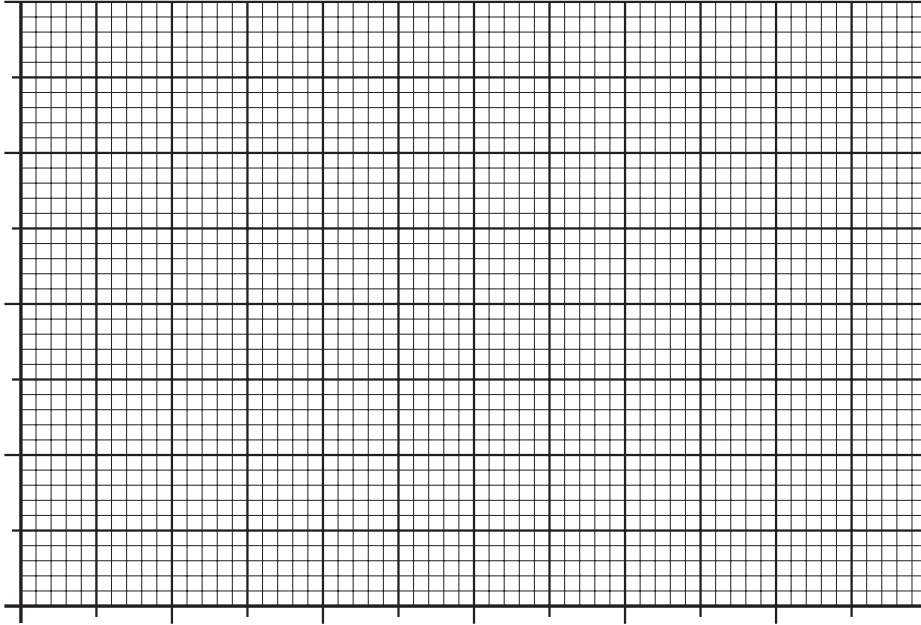
Speed of P waves: _____

Speed of S waves: _____

(2)

Marks

- (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 B

This section consists of three questions, only ONE of which should be attempted. Twenty 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.

Marks

8.	Write an essay on aspects of fossils and stratigraphy. Give details as follows:	
(a)	The evolution of <i>Micraster</i> .	5
(b)	The characteristics of zone fossils.	5
(c)	Problems which arise when correlating sedimentary sequences in different areas.	5
(d)	The formation of cyclothems.	5
		(20)
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.	5
(b)	The formation of coal.	6
(c)	The formation of evaporites.	4
(d)	The formation and characteristics of placer deposits.	5
		(20)
10.	Write an essay on aspects of plate tectonics. Give details as follows:	
(a)	Igneous processes at constructive and destructive margins.	10
(b)	How study of apparent polar wander curves contributes to our knowledge and understanding of continental drift.	5
(c)	How study of plate tectonics has contributed to our understanding of the geological history of the British area.	5
		(20)

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 Photograph Q11 and describe how these features were formed.

Diagrams should be used where necessary.

Photograph Q11



(2)

Marks

12. Study the map Figure Q12 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) A large fault runs across an area of countryside cut by rivers. In the field, how would you find the amount of movement on the fault?

.....

(1)

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

.....

(1)

(iii) Describe the movements which have taken place on faults F1 and F2 on the map Figure Q12.

Movement on F1:

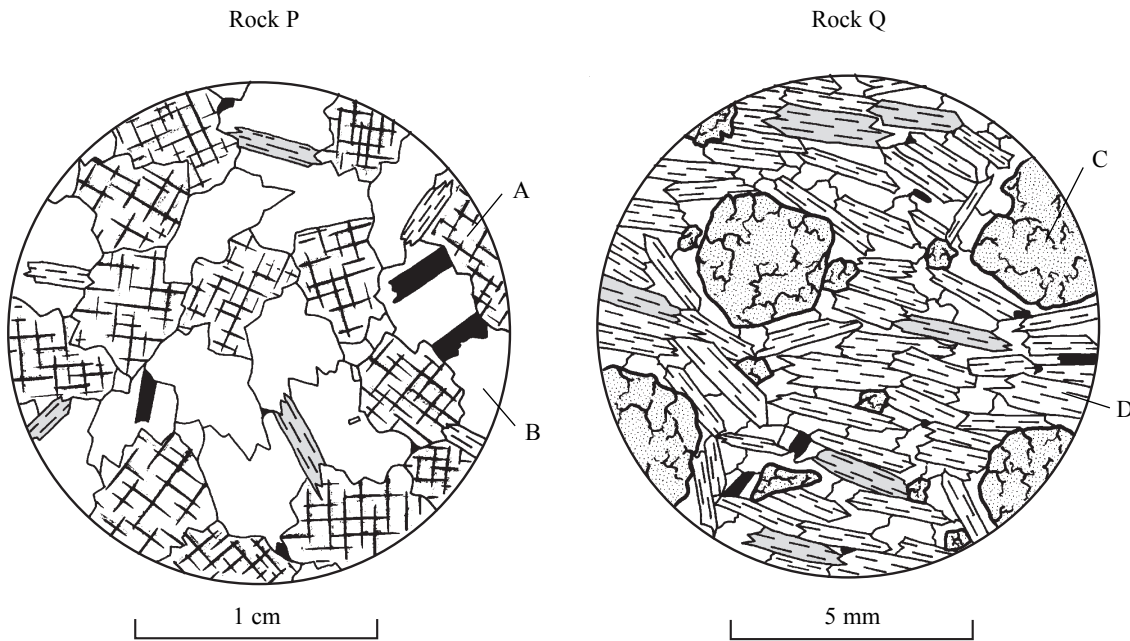
Movement on F2:

(2)

(c) Figure Q12(c) shows Rocks P and Q under the microscope.

Marks

Figure Q12(c)



(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 Figure Q12(d) (on the separate **worksheet**), draw a geological section between points X and Y on the map Figure Q12.

(4)

Marks

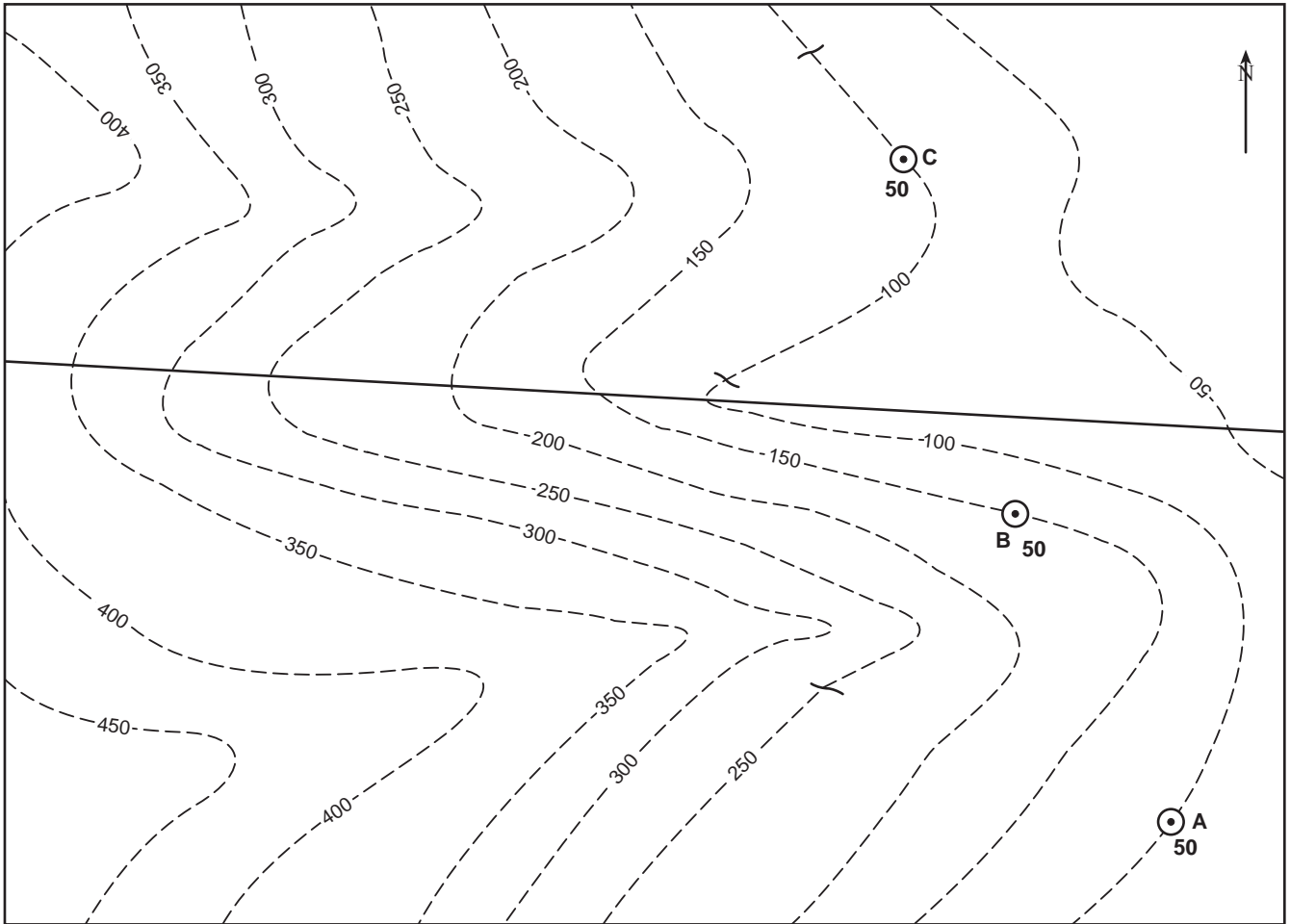
12. (continued)

(e) Describe the geological history of the area shown on the map Figure Q12.

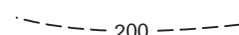


(6)

13.

Figure Q13



Key

		
200	outcrop of coal seam	A 50
surface contour with height in metres		borehole with depth to coal seam in metres

0 200 400 600 800
metres

(a) South of the fault on the map Figure Q13, 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.
- (ii) What is the angle and direction of dip of the seam south of the fault?

.....
Space for working

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

Candidates must not write in this margin

Marks	
(3)	
(2)	
(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)

[END OF QUESTION PAPER]

SPACE FOR ANSWERS OR FOR ROUGH WORK

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SPACE FOR ANSWERS OR FOR ROUGH WORK

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Total

[CO43/SQP018]

**Higher
Geology**

Time: 3 hours

**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

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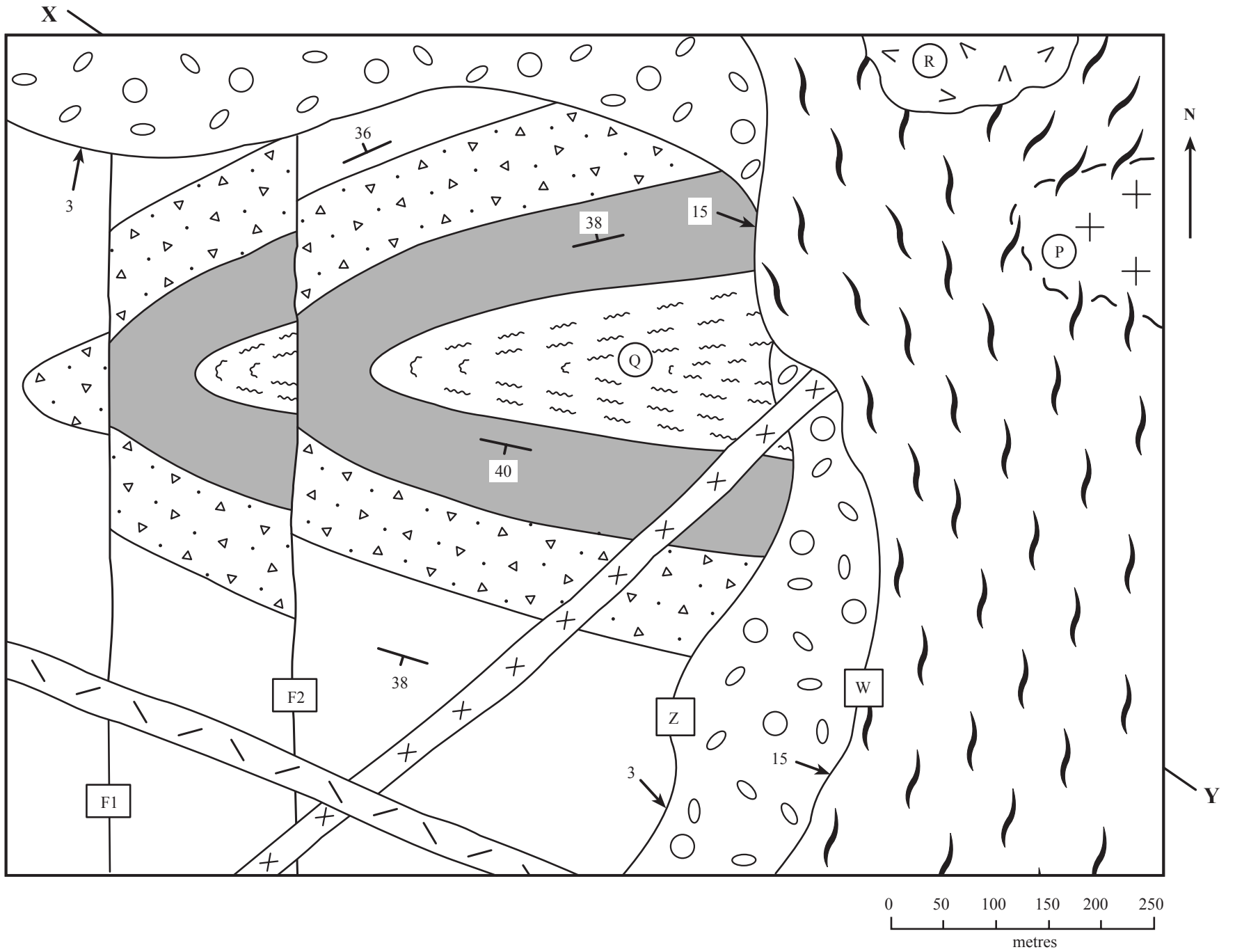
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Number of seat

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

Figure Q12



Key (Rocks not in order of age)









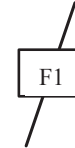
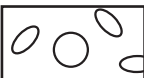
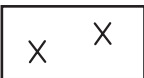


	gneiss		rock P		40 strike direction with direction and angle of dip
	rock Q		felsite		3 direction and angle of dip of Structures W and Z
	sandstone		mudstone		F1 fault
	conglomerate		dolerite		
	greywacke		rock R		

Figure Q12(d)

