

**ADVANCED GCE  
 GEOLOGY**

Petrology

**MONDAY 9 JUNE 2008**

**2835**

Morning  
 Time: 1 hour 30 minutes

Candidates answer on the question paper  
**Additional materials (enclosed):** None

**Additional materials (required):**  
 Electronic calculator  
 Ruler (cm/mm)



Candidate  
 Forename

Candidate  
 Surname

Centre  
 Number

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Candidate  
 Number

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**INSTRUCTIONS TO CANDIDATES**

- Write your name in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use blue or black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Write your answer to each question in the space provided.

**INFORMATION FOR CANDIDATES**

- The number of marks for each question is given in brackets [ ] at the end of each question or part question.
- The total number of marks for this paper is **90**.
- You will be awarded marks for the quality of written communication where this is indicated in the question.
- Some questions in this paper are synoptic in nature. In your answers to these questions you are encouraged to show your knowledge and understanding of different areas of Geology and apply these and the geological skills you have learned, to the situations in the questions.

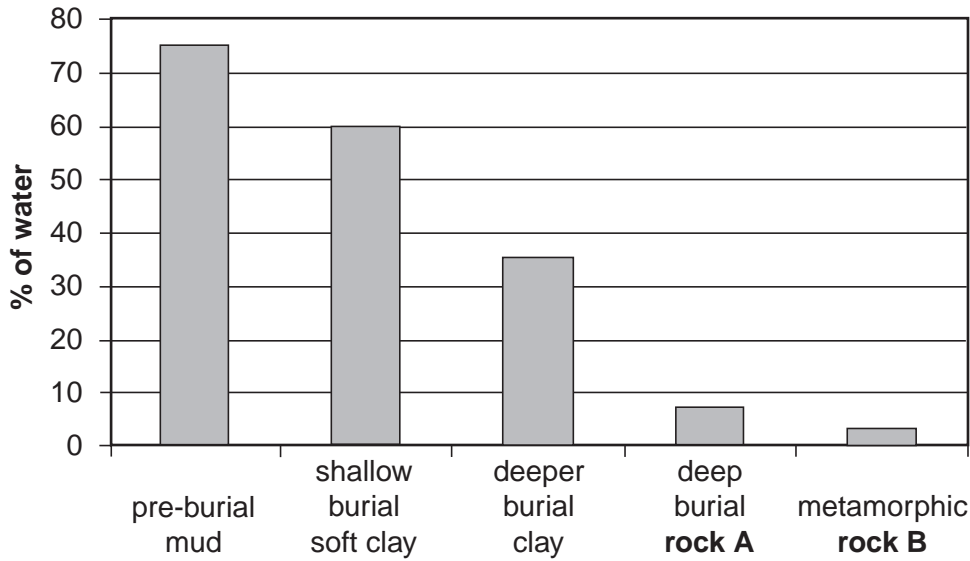
**FOR EXAMINER'S USE**

Qu.	Max	Mark
1	19	
2	19	
3	14	
4	13	
5	25	
<b>TOTAL</b>	<b>90</b>	

This document consists of **15** printed pages and **1** blank page.

Answer **all** the questions.

1 The data below shows the effects of pressure on mud as it undergoes burial.



(a) (i) Name rocks **A** and **B**.

rock **A** .....

rock **B** ..... [2]

(ii) Describe the process of lithification that causes the reduction in water content.

.....  
 .....  
 .....  
 ..... [2]

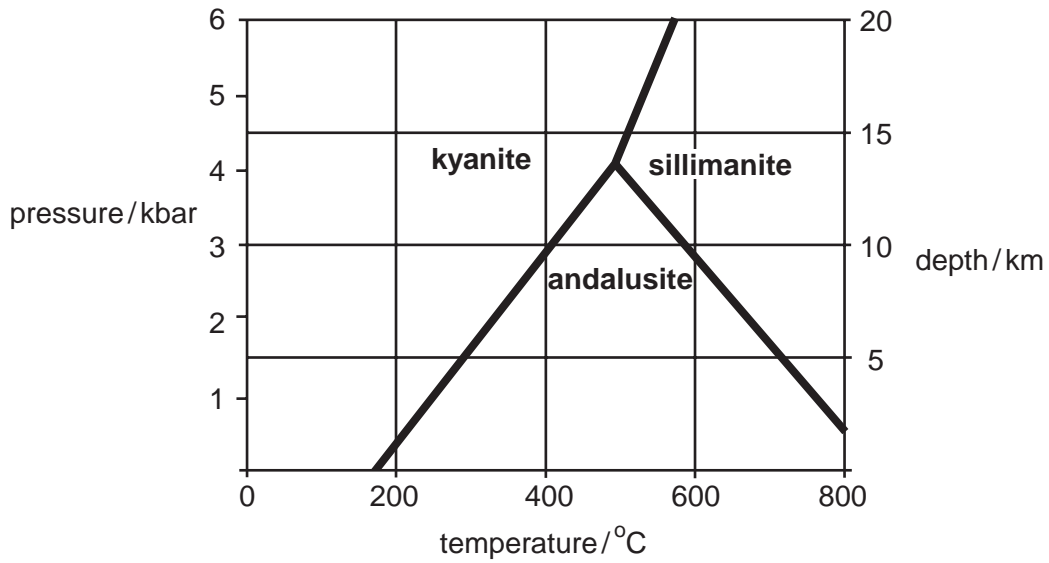
(iii) State the additional factor needed for the formation of rock **B**.

..... [1]

(b) Explain the relationship of diagenesis and metamorphism to temperature and pressure.

.....  
 .....  
 .....  
 ..... [2]

(c) The graph below shows the pressure and temperature conditions under which each of the different minerals andalusite, kyanite and sillimanite is stable.



(i) The minerals andalusite, kyanite and sillimanite all have the same chemical formula  $Al_2SiO_5$  but different crystal structures. Give the term used to describe this phenomenon.

..... [1]

(ii) Name the parent mineral from which the minerals andalusite, kyanite and sillimanite may form.

..... [1]

(iii) If andalusite, kyanite and sillimanite are all at equilibrium in the same rock, state the temperature and pressure under which the metamorphism of the rock occurred.

temperature ..... pressure ..... [1]

(d) (i) **On the graph**, draw a line, starting from the origin, representing a temperature gradient of  $35^\circ C/km$ . [1]

(ii) Use the graph to identify the minerals that are likely to form where the temperature gradient is  $35^\circ C/km$ .

..... [1]

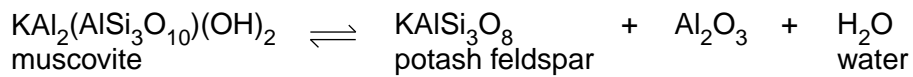
(iii) Name the likely rock types in which the minerals you have identified on the graph will be found. Explain your answer.

rock types ..... and .....

explanation .....

..... [2]

(e) One of the chemical reactions that occurs during metamorphism is shown below.



Describe and explain why this is not usually a reversible reaction.

.....

.....

.....

..... [2]

(f) (i) Name a rock produced by dynamic metamorphism.

..... [1]

(ii) Explain how dynamic metamorphism produces this rock.

.....

.....

.....

..... [2]

[Total: 19]

2 Descriptions of three sedimentary rocks are given in the table below.

	description
<b>rock C</b>	<ul style="list-style-type: none"> <li>• sub angular, poorly sorted grains 1 to 2 mm in size</li> <li>• red or brown colour</li> <li>• contains potash feldspar (28%), quartz and rock fragments</li> </ul>
<b>rock D</b>	<ul style="list-style-type: none"> <li>• white colour</li> <li>• fine, powdery rock</li> <li>• composed of calcite from coccoliths</li> </ul>
<b>rock E</b>	<ul style="list-style-type: none"> <li>• low density</li> <li>• black colour with shiny layers and dull layers</li> <li>• made of carbon with some plant debris</li> </ul>

(a) (i) Identify the three sedimentary rocks.

**C** .....

**D** .....

**E** .....

[3]

(ii) Describe the likely environment in which rock **C** was deposited.

.....  
 .....  
 .....  
 ..... [2]

(iii) Describe the likely environment in which rock **E** was deposited.

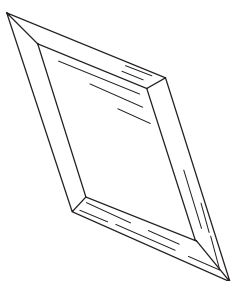
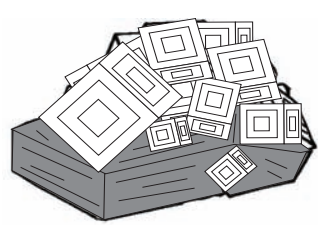
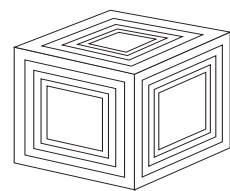
.....  
 .....  
 .....  
 ..... [2]

(b) Show how you would distinguish between crystals of the minerals quartz and calcite using labelled diagrams.

quartz	calcite
--------	---------

[2]

(c) The table below shows two minerals and their diagnostic properties.

 crystal x1	 crystals x1	 crystal x10
<b>F</b> hardness 2 clear white colour	<b>G</b> hardness 2.5 colourless or white when pure	

Identify the two minerals.

**F** .....

**G** .....

[2]

(d) (i) Minerals **F** and **G** form in evaporite sequences. Describe with the aid of a labelled diagram how these minerals form in a marine barred basin.

.....  
.....  
.....  
..... [4]

(ii) Describe how evaporite sequences form in cycles of sedimentation.

.....  
.....  
.....  
..... [2]

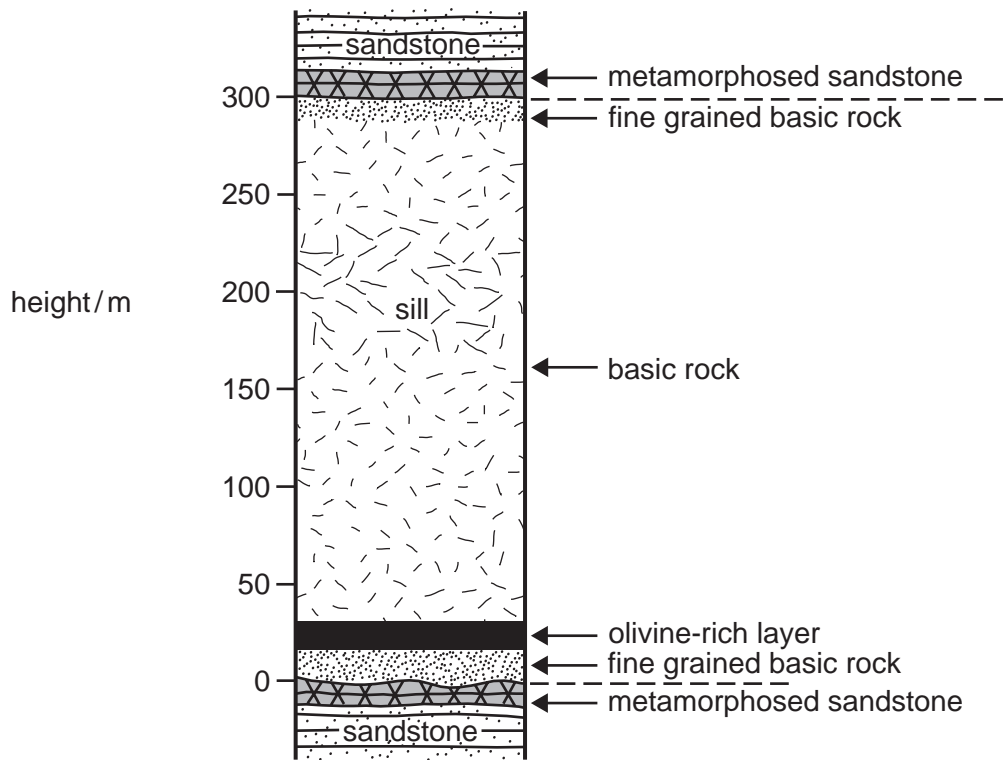
(iii) Describe how evaporite deposits can be used to interpret climatic conditions.

.....  
.....  
.....  
..... [2]

[Total: 19]

[Turn over

3 The diagram below shows a cross section through a large basic sill intruded into sandstones.



(a) (i) Identify the part of the sill that crystallised last. Give a reason for your answer.

crystallised last ..... m

reason .....

..... [2]

(ii) Explain how the olivine-rich layer 25 m above the base of the sill formed.

.....  
 .....  
 .....  
 ..... [2]

(iii) Suggest rock names for the fine grained basic rock at the top and base of the sill and for the rest of the sill.

fine grained rock ..... rest of sill ..... [2]

(iv) Identify the rock that will be found in the areas of metamorphosed sandstone.

..... [1]



(b) The table below shows the chemical composition by percentage of selected oxides from three different parts of the sill.

oxide %	fine grained layers	olivine-rich layer	150 m above base
SiO <sub>2</sub>	51.8	48.3	52.3
Al <sub>2</sub> O <sub>3</sub>	15.3	9.3	16.5
FeO	9.3	11.5	8.7
MgO	7.5	17.5	5.4
CaO	9.7	7.0	9.7
NaO	2.3	2.0	2.3
K <sub>2</sub> O	0.8	0.4	1.0

(i) Using the table, explain why the percentage of iron oxide and magnesium oxide changes through the sill.

.....  
 .....  
 .....  
 ..... [2]

(ii) Why does the silica percentage drop in the olivine-rich layer of the sill?

.....  
 ..... [1]

(iii) Explain why the composition would not vary in this way in a thin sill.

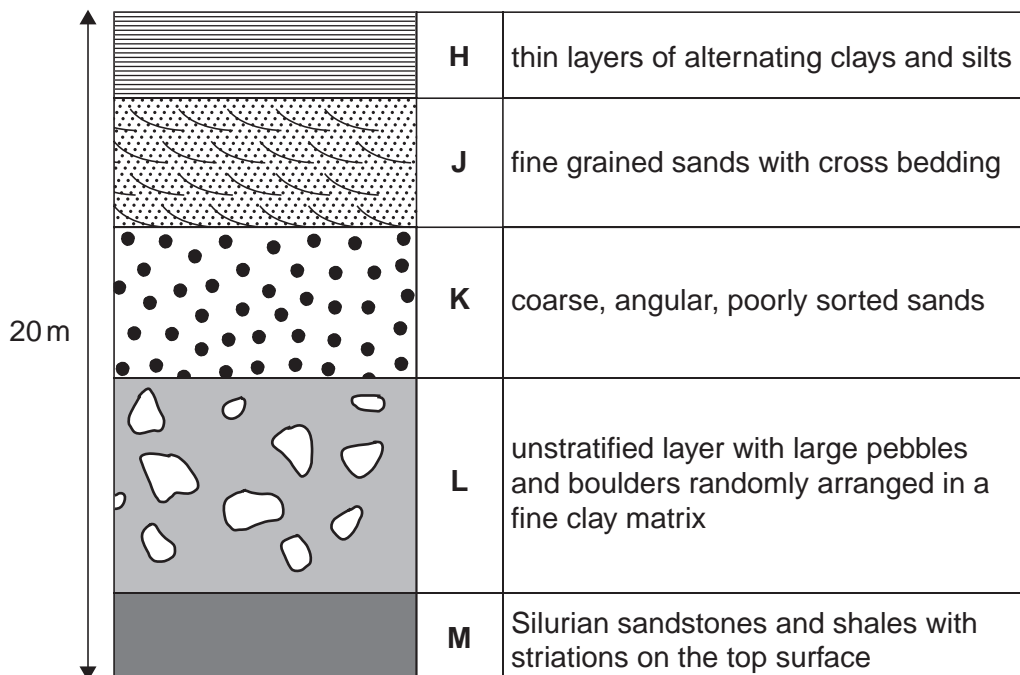
.....  
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(c) Describe how the composition of the plagioclase feldspars is likely to vary through the sill.

.....  
 .....  
 .....  
 ..... [2]

[Total: 14]

- 4 The diagram below shows a vertical sequence of beds that was identified when drilling a borehole to investigate the foundations for a dam. The beds (H, J, K and L) above the Silurian are all Pleistocene in age.



- (a) (i) Explain how the unstratified layer (L) was deposited.

.....  
 .....  
 .....  
 ..... [2]

- (ii) Describe the environment of deposition of the sand beds (J and K).

.....  
 .....  
 .....  
 ..... [2]

- (iii) Describe how the thin layers of alternating clays and silts (H) were formed.

.....  
 .....  
 .....  
 ..... [2]

- (iv) Name the correlation method for which these layers of clay and silt could be used. Explain how this method could be used for correlation.

correlation method .....

explanation .....

..... [2]

- (b) (i) Explain how the striations on the top of the Silurian beds formed.

..... [1]

- (ii) Pebbles and boulders from the unstratified layer (L) have been identified. The data is shown below.

type of rock	number of pebbles/boulders
sandstone	52
shale	33
limestone	9
granite	3
schist	2
gabbro	1

Explain how this range of rocks could all be found together within layer L.

..... [2]

- (c) Would the sequence of rocks shown in the borehole provide a suitable foundation rock for a dam? Give reasons for your answer.

..... [2]

[Total: 13]

5 In this question, two marks are available for the quality of written communication.

Answer **both** parts of the question.

(a) Describe the mineral composition and textures that occur in **acid** igneous rocks. Explain the origin of the acid igneous rocks at destructive plate boundaries. You may use diagrams to illustrate your answer.

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..... [11]

- (b) Explain the origin of **two** sedimentary structures that can be used as palaeocurrent indicators and **two different** sedimentary structures that can be used as way-up indicators. Use labelled diagrams in your answer.

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