OCR
RECOGNISING ACHIEVEMENT

ADVANCED GCE **2846/01**

SCIENCE

Science and Global Processes

FRIDAY 13 JUNE 2008 Afternoon

Time: 1 hour

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

Additional materials (required):
Electronic calculator

CUP/T50295

Candidate Forename		Candidate Surname	
Centre Number		Candidate Number	

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 **60**.
- You may use an electronic calculator.
- You are advised to show all the steps in any calculations.

FOR EXAMINER'S USE		
Qu.	**Max.**	**Mark**
1	**16**	
2	**11**	
3	**15**	
4	**18**	
TOTAL	**60**	

This document consists of **12** printed pages and **4** blank pages.

[Turn over

Answer **all** the questions.

1 This question is about evidence for layers of the Earth and for tectonic plate movement.

(a) Seismic data provides evidence that the Earth has a layered structure.

Fig. 1.1a represents the layers, and Fig. 1.1b shows seismic waves arriving at a boundary between the lithosphere and the asthenosphere. Waves travel more slowly in the asthenosphere than in the lithosphere.

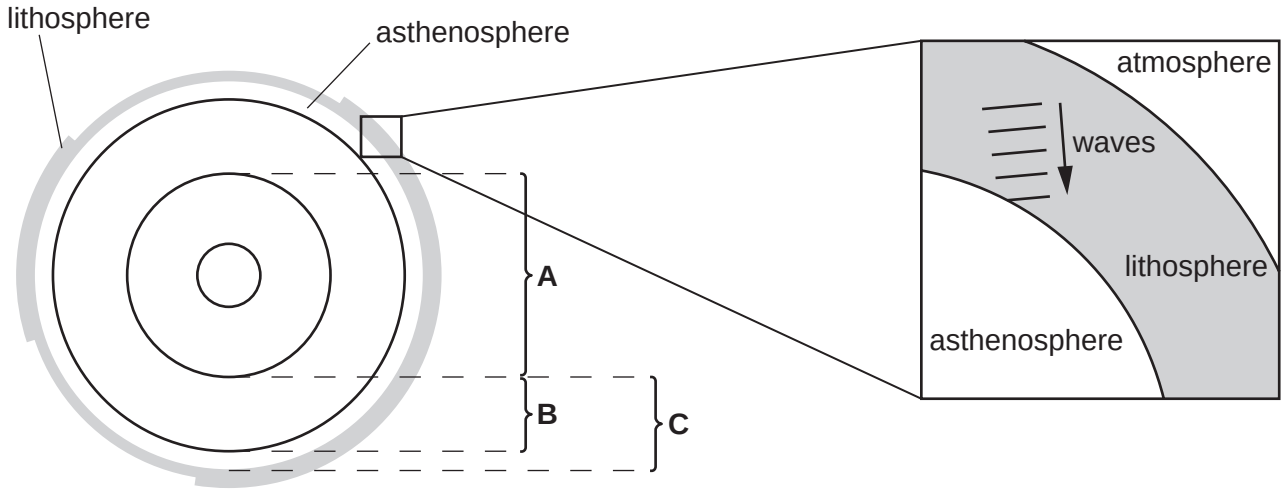

Fig. 1.1a **Fig. 1.1b**

(i) Name the parts

A .....

B .....

C .....[3]

(ii) Reflection and refraction of waves at boundaries cause the pathways of seismic shock waves to change.

Add wave patterns to Fig. 1.1b to show reflection and refraction after waves reach the boundary between the lithosphere and the asthenosphere. [3]

(iii) Seismic shock waves from an earthquake in Japan are detected in Scotland.

On Fig. 1.2, add a typical seismometer trace produced in Scotland that shows the start of the earthquake.

[1]

Fig. 1.2

(iv) Suggest two reasons why detection continues for much longer than the duration of the earthquake itself.

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.....[2]

(v) State one piece of evidence from seismic wave observations for the existence of layers of the Earth.

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.....[1]

(vi) The asthenosphere lies just below the lithosphere. It is a layer of material that was discovered by the study of seismic waves.

Explain how the observed nature of the asthenosphere provides support for plate tectonic theory.

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.....[2]

(b) Fig. 1.3 shows a pattern of magnetism of rocks in part of the seabed of the Pacific Ocean. The rocks have bands of alternating magnetic polarity.

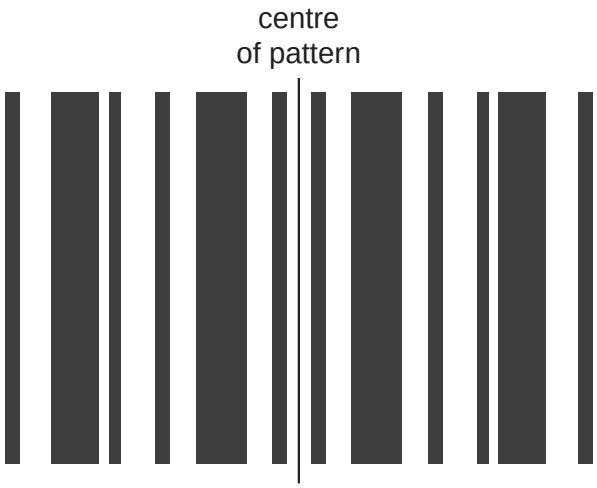

Fig. 1.3

(i) Explain how Fig. 1.3 provides evidence that the sea floor has spread from the centre of the pattern.

.....

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.....[3]

(ii) State how this evidence provides support for plate tectonic theory.

.....

.....[1]

[Total: 16]

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2 The table shows information about properties of four materials.

property / material	melting point / K	electrical conductivity / Ω^{-1} m^{-1}	thermal conductivity / W m^{-1} K^{-1}
copper	1358	Very high	High
diamond	3820	Very low	Very high
sodium chloride	801	Very low when dry, conducts when molten	Low
dodecane (hydrocarbon, $C_{12}H_{26}$)	265	Very low	Very low

(a) The materials in the table above have different structures. Write the name of the correct material next to its structure.

type of structure	**name of material**
molecular	.....
giant molecular	.....
ionic	.....
metallic	..... [3]

(b) Explain, in terms of its structure, why copper has high electrical conductivity.

.....

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.....[2]

(c) Use the information in the table to compare the properties of diamond and dodecane. Explain the differences that exist.

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.....[6]

[Total: 11]

3 An asteroid 1.0×10^6 m from the Moon's surface is falling vertically towards it at a velocity of 2.0×10^4 ms^{-1}. The asteroid has a mass of 4.0×10^{10} kg.

You can assume that the asteroid has a constant acceleration of 1.6 ms^{-2} until it hits the Moon's surface.

Select from these equations for the calculations below.

$v = s \div t$ $\quad$ $v = u + at$ $\quad$ $E_k = \frac{1}{2}mv^2$ $\quad$ $F = ma$

$v^2 = u^2 + 2as$ $\quad$ $p = mv$ $\quad$ $g = F \div m$

v is speed or velocity
s is distance or displacement
t is time
a is acceleration
E_k is kinetic energy
F is force
m is mass
p is momentum
g is gravitational field strength
u is the initial speed or velocity

Write your answers in standard form and with units. In each case, state the equation used.

(a) Calculate the force acting on the asteroid when at a distance of 1.0×10^6 m from the Moon's surface.

equation used

force = ... unit .....[4]

(b) **(i)** Show that the velocity with which the asteroid hits the Moon's surface is 2.0×10^4 ms^{-1}, to two significant figures.

equation used

[3]

(ii) Comment on the change in velocity during this fall.

.....

.....[1]

(c) (i) Calculate the kinetic energy of the asteroid just before it hits the Moon's surface.

equation used

kinetic energy = ... unit .....[4]

(ii) Explain what happens to this kinetic energy during and after impact.

.....

.....

.....[3]

[Total: 15]

4 This question is about water, its structure and properties, and the effects of these on climate. The density of water is maximum at 4 °C.

(a) Fig. 4.1 shows the variation of temperature with depth in a tropical ocean.

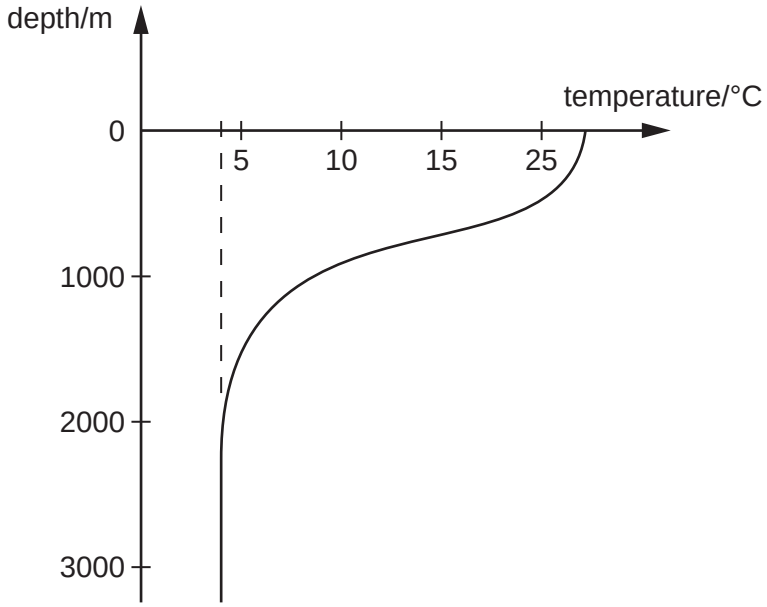

Fig. 4.1

(i) Describe and explain the shape of the graph in Fig. 4.1

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.....[4]

(ii) State why water at the surface of a tropical ocean is likely to have higher salinity than that of the deep water.

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.....[1]

(b) Fig. 4.2 shows part of the ocean circulation in the North Atlantic.

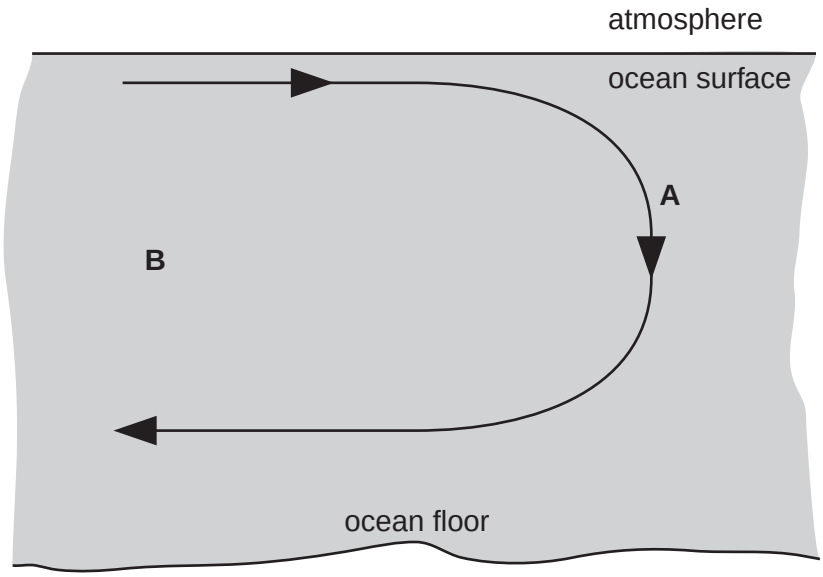

Fig. 4.2

(i) Explain why the water at point **A** is sinking.

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.....[2]

(ii) Explain why the surface current and deep current do not mix at point **B**.

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.....[1]

(c) Water is a very unusual material. For example, the solid is less dense than the liquid, so ice floats.

How do the intermolecular distances in ice and liquid water differ?

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.....[1]

(d) Fig. 4.3 shows a water molecule.

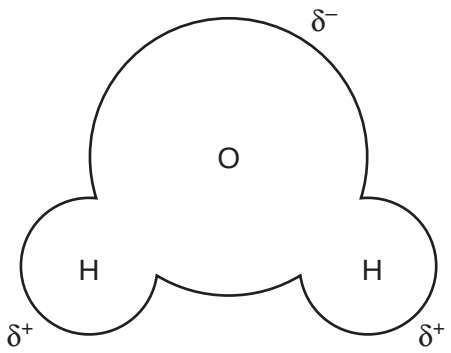

Fig. 4.3

(i) Explain why a water molecule has a permanent dipole.

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.....[2]

(ii) Explain how a hydrogen bond forms in water.

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.....[2]

(e) The high specific heat capacity of water is related to its hydrogen bonds.

(i) The hydrogen bond is weak but nevertheless energy is required to break the bonds. There are fewer hydrogen bonds at higher temperature.

Use this information to explain why water can store larger quantities of additional energy than almost all other liquids, for the same temperature rise.

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.....[2]

(ii) Explain the effect of this high specific heat capacity on the climate of an oceanic region such as the British Isles.

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.....[3]

[Total: 18]

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