Surname		Other Names	
Centre Number			Candidate Number				
Candidate Signature									

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General Certificate of Education
June 2004
Advanced Subsidiary Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

ENVIRONMENTAL SCIENCE ESC1
Unit 1 Energy, Atmosphere and Hydrosphere

Thursday 10 June 2004 Afternoon Session

No additional materials are required.
You may use a calculator.

Time allowed: 1 hour

Instructions

- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided. All working must be shown.
- Do all rough work in this book. Cross through any work you do not want marked.

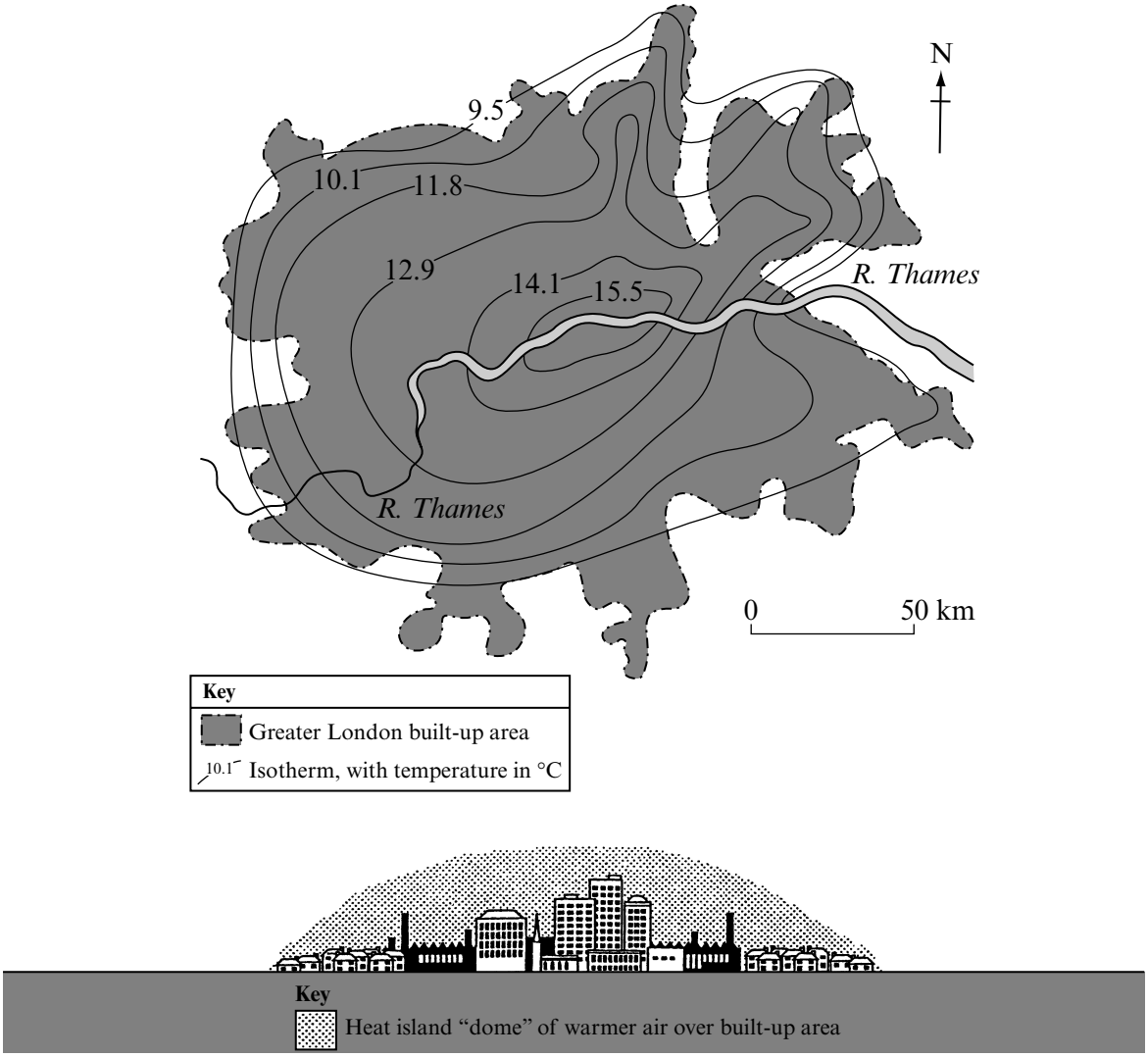
Information

- The maximum mark for this paper is 60.
- Mark allocations are shown in brackets.
- You will be assessed on your ability to use an appropriate form and style of writing, to organise relevant information clearly and coherently, and to use specialist vocabulary, where appropriate.
- The degree of legibility of your handwriting and the level of accuracy of your spelling, punctuation and grammar will also be taken into account.

For Examiner's Use			
Number	Mark	Number	Mark
1			
2			
3			
4			
5			
6			
7			
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

Answer **all** questions in the spaces provided.

1 The presence of a large urban area often alters the local climate. The diagrams show some of the features of an urban heat island.



Source: J. GILLETT AND M. GILLETT, *Pollution* (Hodder and Stoughton) 1999.

(a) Give **two** features of a city which cause an urban heat island to form.

1. .....

2. .....

(2 marks)

(b) Explain how an urban heat island may affect the following.

(i) Wind flow

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(2 marks)

(ii) Rainfall

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(2 marks)

(iii) Intensity of sunlight

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.....

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(2 marks)

8

TURN OVER FOR THE NEXT QUESTION

2 Before water can be used it must be treated to remove contaminants.

(a) Name and describe a process which is used to remove:

(i) large floating objects, such as branches and plastic bags;

process .....

description .....

.....

(2 marks)

(ii) suspended colloidal particles, such as clay;

process .....

description .....

.....

(2 marks)

(iii) bacteria.

process .....

description .....

.....

(2 marks)

(b) Explain why such processes are usually more important when treating river water than when treating reservoir water.

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(2 marks)

8

3 Fossil fuels provide most of the energy used in industrial societies.

(a) Outline the processes which occurred during the formation of **all** fossil fuels from dead organic matter.

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(3 marks)

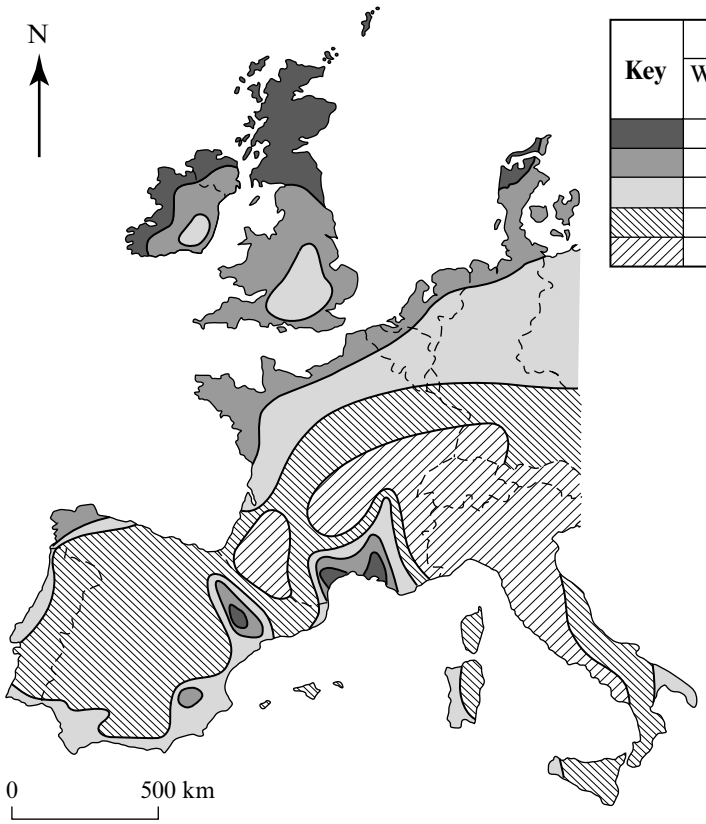
(b) Complete the table to show whether the given features are an advantage or disadvantage. Include brief explanations for your choices.

Fossil fuel	Feature	Advantage or disadvantage?	Explanation
Crude oil	Low reservoir rock permeability		
Crude oil	Low viscosity	Advantage	Increases flow rate during extraction
Crude oil	Low reservoir rock porosity		
Coal	High carbon content		
Coal	Hard overburden rock	Disadvantage	Removal is difficult and expensive
Natural gas	High sulphur content		

(4 marks)

7

4 The potential for using wind power is affected by wind strength and its reliability. The map shows the wind speed and power at different locations.



Key	Open plain		Coast	
	Wind speed ms^{-1}	Power wm^{-2}	Wind speed ms^{-1}	Power wm^{-2}
	>7.5	>500	>8.5	>700
	7.0	400	7.5	500
	6.0	250	6.5	325
	5.0	150	5.5	200
	<4.5	<100	<5.0	<150

The shaded regions show average wind speed and the power each would produce if wind turbines were placed on the land at an optimum density.

(a) Suggest **three** reasons why the windiest areas are not always chosen for the location of wind farms.

1. .....

.....

2. .....

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3. .....

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(3 marks)

(b) The formula shows the maximum amount of energy which could be harnessed by an aerogenerator.

$$\mathbf{E} = \frac{\mathbf{mv^2}}{\mathbf{2}}$$

where
E = kinetic energy available. Units = j
m = mass of air flowing over blades. Units = kg
v = wind velocity. Units = ms^{-1}

Use the formula to calculate the amount of energy available to an aerogenerator when 400 kg of air flows over its blades at a velocity of 7 ms^{-1}.

Show your working.

Answer ..... j
(1 mark)

(c) Outline **two** reasons why it may be difficult to replace fossil fuels with wind power.

1. .....

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2. .....

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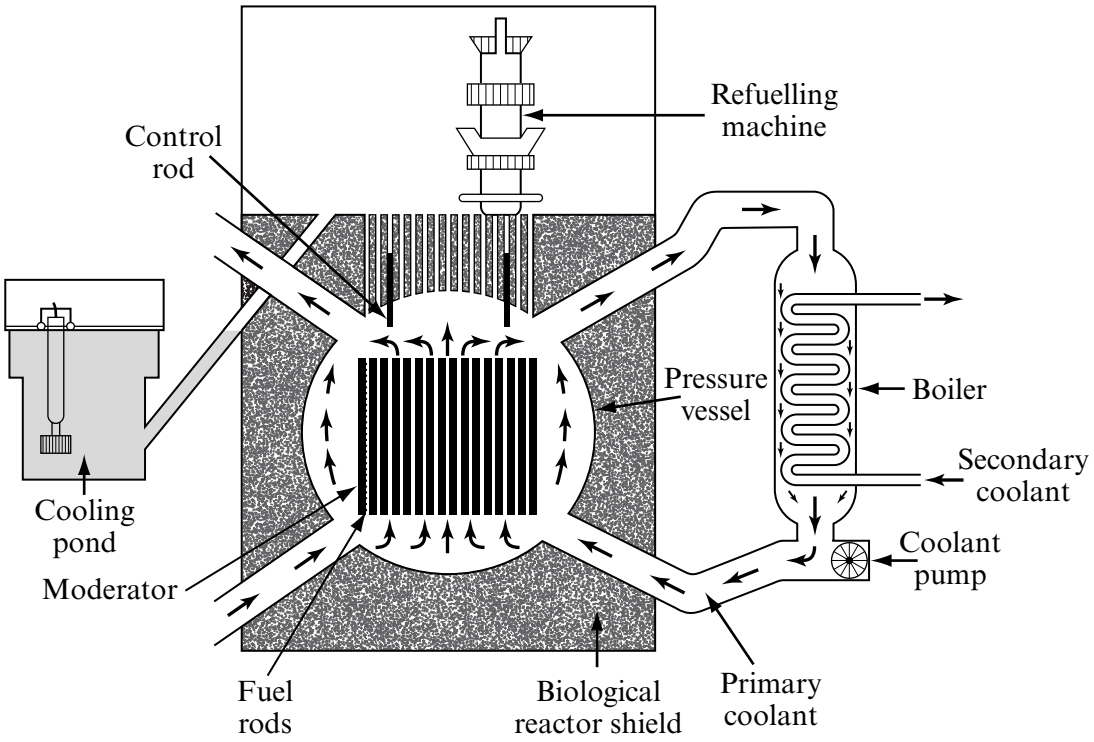
(2 marks)

6

TURN OVER FOR THE NEXT QUESTION

5 The diagram shows the main features of a nuclear power station.



(a) Complete the table of purposes or principles of operation.

Part of power station	Purpose	Principle of operation
Moderator		Moderator slows neutrons by absorbing energy on impact
Secondary coolant	Provide kinetic energy to turn turbines	
Biological reactor shield		Thick layer of concrete absorbs radiation
Cooling pond		Water absorbs heat and radiation
Control rod	Control power output of reactor	

(5 marks)

(b) Compare nuclear power stations with coal-fired power stations in terms of the:

(i) energy density of the fuel;

.....

.....

(1 mark)

(ii) quantities of wastes produced.

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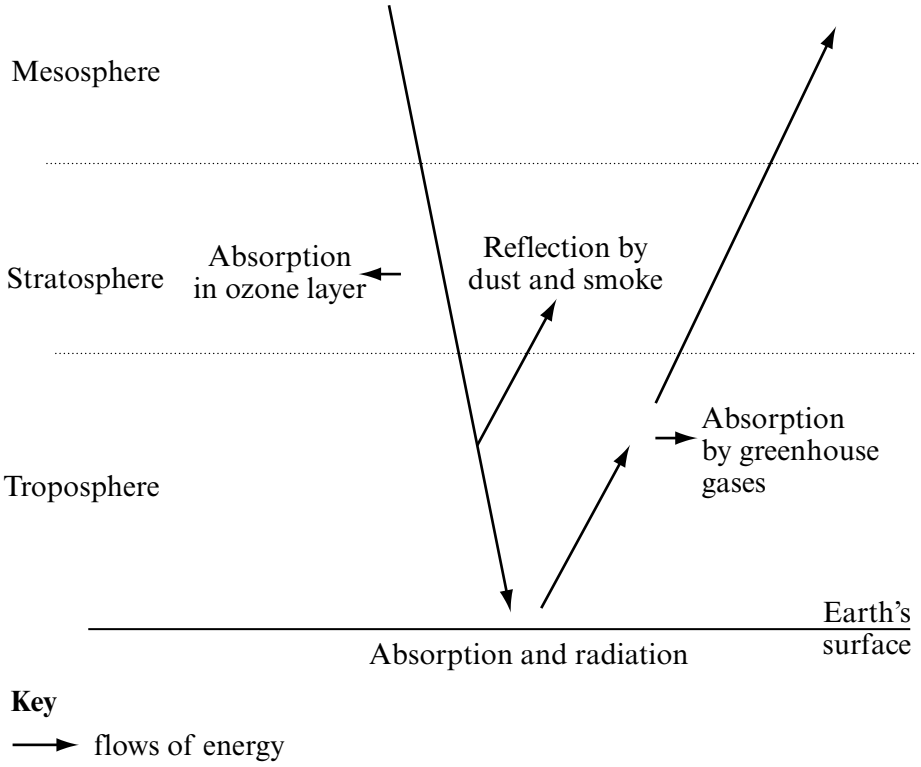
(1 mark)

7

TURN OVER FOR THE NEXT QUESTION

6 The diagram shows the structure of the atmosphere and some processes involving energy.



(a) Describe the main types of electromagnetic radiation involved in the following processes shown on the diagram.

(i) Absorption in ozone layer

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(1 mark)

(ii) Absorption at Earth's surface

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(1 mark)

(iii) Radiation from Earth's surface

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(1 mark)

(b) Describe how human activities have reduced the amount of ozone in the stratosphere.

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(3 marks)

(c) Explain why this reduction in stratospheric ozone is harmful to life on Earth.

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(2 marks)

(d) Name the international agreement which aims to reduce this damage.

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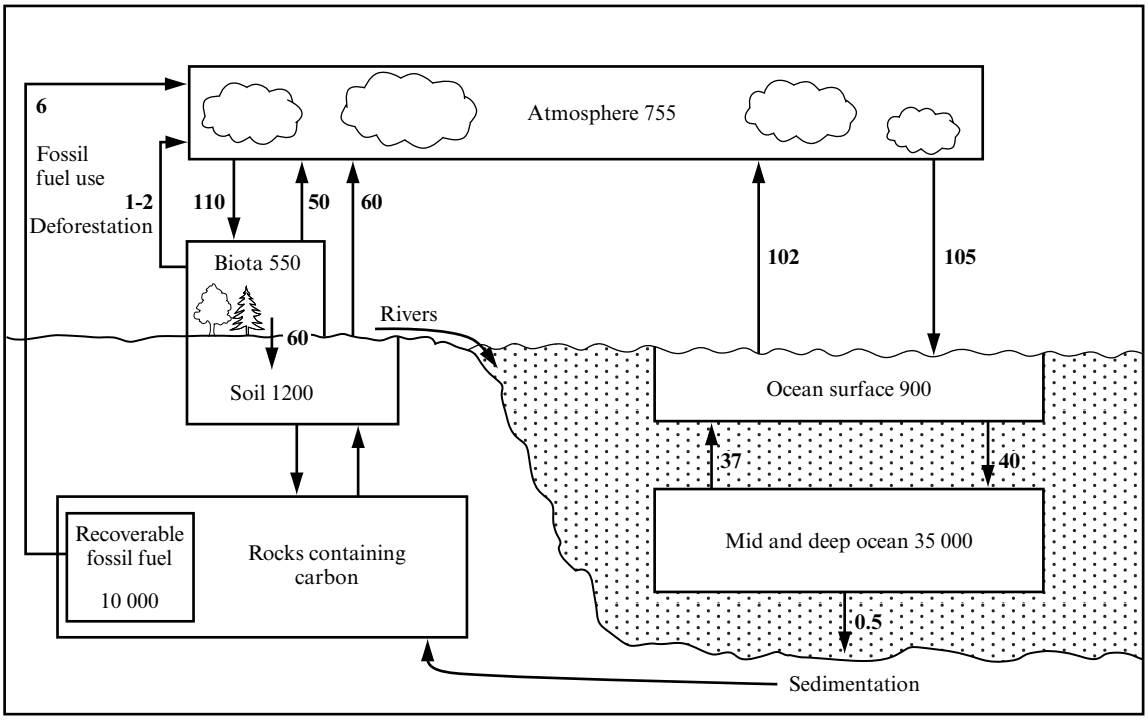
(1 mark)

9

TURN OVER FOR THE NEXT QUESTION

7 The diagram shows the major stores and flows in the carbon cycle.



Source: N. MIDDLETON, *The Global Casino* (Arnold) 1999

(a) Use the processes in the carbon cycle to explain what is meant by the term 'dynamic equilibrium'.

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(3 marks)

(b) (i) Use the data in the diagram to calculate the theoretical lifespan of recoverable fossil fuels if the consumption rate remains constant.

Show your working.

Answer ..... years
(1 mark)

(ii) Outline **two** reasons why fossil fuel use may stop before this time is reached.

1. .....

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2. .....

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(2 marks)

(c) Describe the ways in which human activities alter amounts of carbon present in the major carbon reservoirs and the rates at which it moves between reservoirs.

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QUESTION 7 CONTINUES ON THE NEXT PAGE

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(9 marks)

15

END OF QUESTIONS

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