OCR
RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced Subsidiary GCE

SCIENCE 2842

Science and Human Activity

Wednesday **12 JANUARY 2005** Morning 1 hour

Candidates answer on the question paper.
Additional materials:
Electronic calculator

Candidate Name	Centre Number	Candidate Number

TIME 1 hour

INSTRUCTIONS TO CANDIDATES

- Write your name in the space above.
- Write your Centre number and Candidate number in the boxes above.
- Answer **all** the questions.
- Write your answers in the spaces provided on the question paper.
- Read each question carefully to make sure you know what you have to do before starting your answer.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [ ] at the end of each question or part question.
- You will be awarded marks for the quality of written communication where this is indicated in the question.
- 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	10	
2	13	
3	12	
4	17	
5	8	
TOTAL	60	

This question paper consists of 11 printed pages and 1 blank page.

Registered Charity Number: 1066969
[Turn over

Answer **all** the questions.

1 Costa Rica, a Central American country close to the equator, has several 'cloud forests'. An important feature of the environment in these forests is that the base of the clouds is below the tops of the trees.

However, recent research has shown that the height of the cloud base seems to be rising, probably due to climate change. This may cause damage to the forest.

This question is about the processes which result in the formation of these low clouds from water vapour in the atmosphere.

(a) Name **two** natural environmental processes which produce water vapour.

1 .....

2 ..... [2]

(b) Air is forced to rise when it meets high ground. This can cause water vapour in the air to condense.

(i) State **one** other reason why air rises in equatorial regions.

.....

..... [1]

(ii) State the reason that condensation occurs as air rises.

..... [1]

(iii) Explain what happens to molecules of water vapour when the process of condensation occurs.

.....

..... [2]

(c) Suggest **two** possible climatic changes which could result in the cloud level becoming higher.

1 .....

2 ..... [2]

(d) Describe how **one** environmental factor, other than climate, has caused damage to trees in the past fifty years.

.....

.....

.....

..... [2]

[Total: 10]

2 Bromomethane, CH_3Br, has been used for many years as a pesticide to kill insects which attack crops.

However, it is due to be banned from the end of 2005 because of the effect it has on ozone in the stratosphere.

This question is about bromomethane and possible replacement treatments for crops.

(a) Bromomethane can be broken down by the action of sunlight.

The equation for the reaction is:

$$CH_3Br \longrightarrow CH_3\bullet + Br\bullet$$

(i) Using substances from this equation as examples, explain the terms

molecule .....

.....

radical .....

..... [3]

(ii) Suggest why this process occurs in the presence of sunlight.

.....

..... [1]

(b) The bromine atoms produced from the breakdown of bromomethane can act as a catalyst to break down ozone, O_3 into dioxygen, O_2.

(i) Explain the meaning of the term *catalyst*.

.....

..... [2]

(ii) Why is the destruction of ozone in the stratosphere a cause for concern?

.....

..... [1]

(c) Groundnut (peanut) crops are often infested by insects. One possible alternative to the use of bromomethane is to expose groundnuts to low frequency electromagnetic waves. This kills the insects by heating the water in their bodies but does not affect the crop.

(i) Explain what is meant by the term *electromagnetic wave*. You may find it helpful to draw a diagram.

.....

..... [2]

(ii) The water heats up because the energy of the electromagnetic wave is converted into kinetic energy of the water molecules.

This increased kinetic energy causes atoms in the molecules to vibrate more.

State **two** other ways in which molecules may possess increased kinetic energy.

1 .....

2 ..... [2]

(iii) Suggest why exposure to low frequency electromagnetic waves is unlikely to be as useful in treating a crop of strawberries.

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.....

..... [2]

[Total: 13]

[Turn over

3 Satellites in orbit around the Earth sometimes need to be moved into higher orbits, further away from the Earth.

This requires energy that is normally provided by fuel carried on board the satellite.

(a) State the overall energy transfer which occurs when a satellite is moved into a higher orbit.

from ..... to ..... [2]

(b) The work done to move an object such as a satellite against a force is given by the equation

$$\text{work} = \text{force} \times \text{distance}$$

Calculate the distance moved by an object if 3.0×10^8 J of work is done to move it against a force of 1.5×10^5 N. Show your working.

answer ..... m [2]

(c) A new method for moving satellites to higher orbits is being investigated. It relies on the idea that a current-carrying conductor in a magnetic field experiences a force.

A diagram of the suggested arrangement is shown in Fig. 3.1 (not to scale).

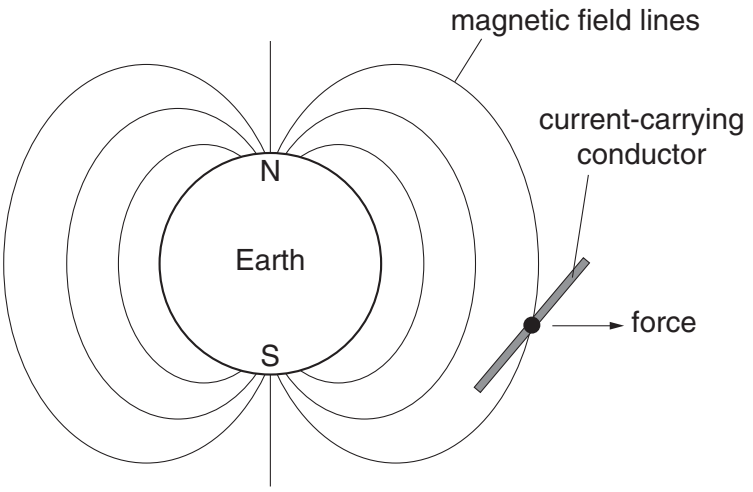

Fig. 3.1

(i) According to the diagram, where is the Earth's magnetic field strongest? Explain your answer.

.....

..... [2]

(ii) An electric current passes through the conductor. What is the meaning of the term *electric current*?

.....

..... [1]

(d) One of the problems which will need to be solved is that of power loss in the conductor.

The relationship between power loss, current and resistance is:

$$\text{power loss} = \text{current}^2 \times \text{resistance}$$

(i) Use this relationship to calculate the power loss if a current of 0.02 A passes through a resistance of 200 Ω. Show your working and remember to state the units in your answer.

answer ..... units ..... [3]

(ii) Power loss can be reduced by selecting a material with a suitable resistivity. Use the table below to select a suitable material for a conducting wire which could be placed in orbit and used in the manner outlined above. Explain your choice.

material	resistivity / $10^{-8}\,\Omega$m	density / kg m^{-3}
copper	1.7	8920
graphite	800	2267
iron	9.7	7874
aluminium	2.7	2700

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..... [2]

[Total: 12]

4 One of the problems caused by acid deposition has been its effect on stonework, particularly limestone (calcium carbonate).

Rain water containing acidic substances attacks the stonework.

(a) Acidic substances present in rain water could include sulphuric acid, H_2SO_4, sulphurous acid, H_2SO_3, and nitric acid, HNO_3.

(i) Give the formula of the ion that is present in solutions of **all** these acids.

..... [1]

(ii) Sulphuric acid is described as a strong acid whereas sulphurous acid is described as a weak acid. Explain the difference between a *strong acid* and a *weak acid*.

.....

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..... [2]

(b) Pollutant gases dissolve in rain water to make it acidic.

(i) Name **two** pollutant gases that could cause rain water to become acidic.

1 .....

2 ..... [2]

(ii) Explain how **one** of these pollutant gases is formed.

.....

.....

..... [2]

(c) Limestone (calcium carbonate) is an ionic solid. When it is attacked by sulphuric acid, it produces calcium sulphate which forms an ionic solution in water.

Describe, in terms of the arrangement of ions, **one** difference between the structure of an ionic solid and an ionic solution.

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..... [2]

(d) In this question, two marks are available for the quality of written communication.

Attack by acid on calcium carbonate is an example of a chemical reaction. The rate of a chemical reaction depends on a number of factors. Describe and explain how temperature and concentration of reactants affect the rate of a chemical reaction.

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..... [6]

Quality of Written Communication [2]

[Total: 17]

5 In recent years, many industrial processes have been made environmentally friendly. For example, enzymes are now being used to perform reactions which were previously carried out using conventional chemistry.

(a) Complete the following paragraph about enzymes using the words in the list below. Each word may be used once or not at all.

inhibitors	**substrates**	**primary structure**
secondary structure	**tertiary structure**	**helix**
active site	**amino acids**	**proteins**

Enzymes belong to the class of biological molecules known

as …… .

These are built up from smaller sub-units called …… .

The sequence of these sub-units is known as the …… .

The overall complex three-dimensional shape of the enzyme molecule is known as

its …… and normally includes a cleft called

the …… .

Molecules called …… fit into this cleft and react to make

products.

[6]

(b) Give an example of an **industrial** process in which the use of enzymes has replaced the use of conventional chemistry.

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..... [1]

(c) Describe **one** advantage, other than cost, of using enzymes in industry compared to using conventional chemistry.

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..... [1]

[Total: 8]

END OF QUESTION PAPER

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