OCR
RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced Subsidiary GCE

SCIENCE 2841

Science and the Natural Environment

Thursday **12 JANUARY 2006** 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 and 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	15	
2	15	
3	15	
4	15	
TOTAL	60	

This question paper consists of 10 printed pages and 2 blank pages.

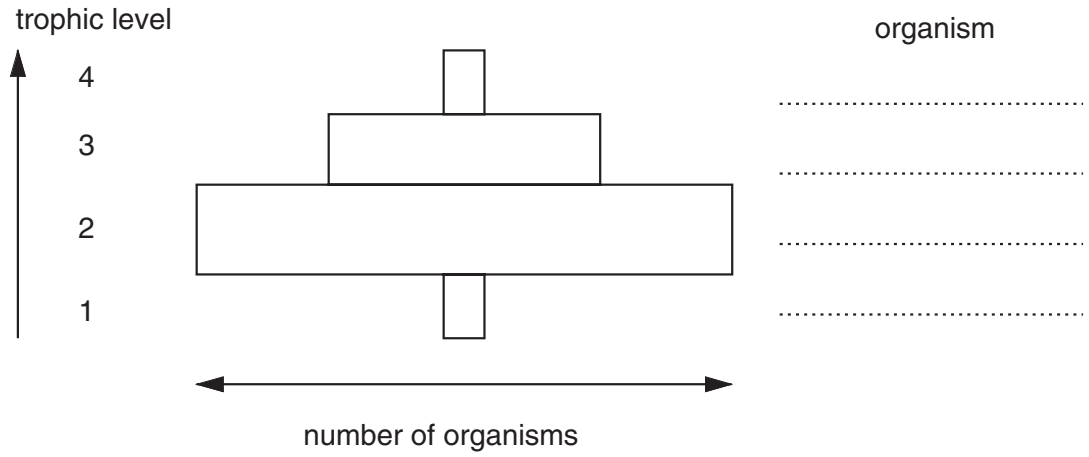
Registered Charity Number: 1066969
[Turn over

Answer **all** the questions.

1 Read the information in the box below about Great Tits and how they rear their chicks.

> New oak leaves are eaten by caterpillars which are only present for 2–3 weeks while the leaves are young. The same caterpillars are the major source of food for the chicks of the Great Tit. During this time, the adult birds bring one caterpillar every few minutes to their young in the nest. Great Tits and their chicks are themselves eaten by predatory birds.

(a) Fig. 1.1 shows a pyramid of numbers of organisms for the food chain described in the box.



(not to scale)

Fig. 1.1

(i) Label each trophic level in Fig. 1.1 with the name of the appropriate organism from the food chain described in the box. [2]

(ii) Name the trophic levels shown in Fig. 1.1.

level 1 is …… level 2 is ……

level 3 is …… level 4 is …… [2]

(b) Explain the meanings of the terms *population* and *community*.
Give examples from the information in the box.

population.....

.....

.....

community.....

.....

.....[4]

Read the information in the box below. It takes the story of Great Tits and their chicks a stage further.

> A study of trees in Wytham Wood near Oxford has shown that spring is arriving earlier. One indication of this is that oak trees now come into leaf 3 weeks earlier than they did 50 years ago. As a result, the caterpillars that eat the young leaves are now present at the earlier time. The study has also shown that Great Tits have adapted to the earlier spring by breeding earlier in the year.

(c) **(i)** The passage below, about adaptation, contains gaps.
Complete the passage using the words that follow.
Use each word only once or not at all.

cumulative	**generations**	**grow**	**individuals**	**offspring**
population	**random**	**reproduce**	**selection**	**survival**

Adaptation can take place when …… are present with a characteristic that gives them an increased chance of …… .
When they …… , the characteristic can be passed on to their …… . The process can go on through successive …… . Gradually, an increasing proportion of the …… will possess this advantageous characteristic. This process is called …… natural …… . [4]

(ii) Great Tits have adapted to the earlier arrival of spring by breeding earlier.
Suggest how this happened.

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.....[3]

[Total: 15]

[Turn over

2 Where do the oceans come from? One theory is that some of the water in the oceans was brought to Earth by comets. Comets consist of a mixture of ice and dust. But it is unlikely that all of Earth's water came from comets because comet water and ocean water are different. There is twice as much deuterium in comet water as there is in ocean water. Deuterium is a heavy isotope of hydrogen.

(a) Explain the meaning of the term *isotopes*.

.....

.....

.....[2]

(b) The symbol for deuterium is $^{2}_{1}H$. The symbol for 'normal' hydrogen is $^{1}_{1}H$.

(i) What is the atomic number of deuterium? ..... [1]

(ii) What is the number of neutrons in a deuterium atom? ..... [1]

(c) Draw a labelled diagram to illustrate a simple model of the structure of a deuterium atom.

[3]

(d) The relative amounts of deuterium and 'normal' hydrogen in a sample of water can be found using a mass spectrometer. In this instrument, positively charged ions of different masses are deflected to different extents.

(i) Describe how positive ions are produced in a mass spectrometer.

.....

.....

.....[2]

(ii) How is the beam of positive ions deflected in a mass spectrometer?

.....

.....[1]

(iii) Describe how the information from a mass spectrometer can be used to determine the relative amounts of two isotopes in a sample.

.....

.....

.....[2]

(e) The structure of an atom cannot be seen directly. Models of atomic structure have been developed from indirect evidence.

Describe briefly **one** such piece of indirect evidence.

.....

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.....[3]

[Total: 15]

3 A new method is being used for the treatment of sewage from villages. It uses a 'rotating biological contactor'. Material in the sewage is broken down by bacteria into less harmful products which can be safely released into a stream or the sea.

(a) Bacterial cells are prokaryotic cells. Animal and plant cells are eukaryotic cells.
State two differences between a prokaryotic cell and a eukaryotic cell.

1 .....

.....

2 .....

....[2]

(b) All types of cell possess a plasma membrane.
Fig. 3.1 shows the fluid-mosaic model of a plasma membrane.

A diagram has been removed due to third party copyright restrictions

Details: A diagram of the fluid-mosaic model of a plasma membrane

Fig. 3.1

(i) Label the diagram in Fig. 3.1. [4]

(ii) Some products of sewage treatment pass through the bacterial plasma membrane.
Using the fluid-mosaic model, describe two ways in which substances can pass through a plasma membrane.

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.....[2]

(c) Fig . 3.2 shows a simplified cross-section of a rotating biological contactor. The contactor contains slowly rotating discs. These are colonised by bacteria.

A diagram has been removed due to third party copy-right restrictions

Details: A diagram showing a simplified cross-section of a rotating biological contactor containing slowly rotating discs

Fig . 3.2

(i) Some of the bacter ia used in this method of sewage treatment respire aerobically; others respire anaerobically. Suggest how the design of a rotating biological contactor allows both aerobic and anaerobic bacteria to act on the sewage.

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.....[2]

(ii) The breakdo wn of material by bacteria in sewage treatment is similar to the breakdown of biomass by bacteria on a forest floor.
State two products of this bacter ial action.

1 ....

2 .....[2]

(d) Se wage treatment may involve a further stage in which the liquid product is exposed to ultraviolet radiation. This destroys a large proportion of the bacteria that are otherwise released from the treatment process.

(i) How does the frequency of ultraviolet radiation compare to that of visible light?

..... [1]

(ii) Suggest wh y ultraviolet radiation is capable of destroying bacteria.

.....

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.....[2]

[Total: 15]

4 From about 1850, telegraphic signals could be transmitted between continents by means of cables laid under the sea. This development became possible following the discovery of a material called gutta-percha. This material provided a waterproof and electrically-insulating coating for the cables. Gutta-percha is made from a milky fluid extracted from the Isonandra Gutta tree that grows in the tropical rain forest of Malaysia.

(a) (i) About 4 kg of gutta-percha can be extracted before an Isonandra Gutta tree is destroyed.
1 km of undersea cable used about 60 kg of gutta-percha.
How many Isonandra Gutta trees were used to make 1 km of undersea cable?

.....[1]

(ii) By 1900, about 400 000 km of cable had been laid under the sea.
On average, how many Isonandra Gutta trees were used, per year, to make undersea cables between 1850 and 1900?

.....

.....[2]

(iii) Suggest **one disadvantage** of using gutta-percha to make undersea cables.

.....

.....[1]

(b) An Isonandra Gutta tree is one of the taller trees in the tropical rain forest. Its height allows the tree to obtain more of the sunlight available to the forest.
State **two** ways, other than this, in which trees are adapted to conditions in a tropical rain forest.

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.....[2]

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

Describe how the different types of tree in a tropical rain forest give rise to the structure of the forest.

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.....[7]

Quality of Written Communication [2]

[Total: 15]

END OF QUESTION PAPER

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