OCR
RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
Advanced Subsidiary GCE

SCIENCE 2841

Science and the Natural Environment

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	9	
2	11	
3	12	
4	12	
5	16	
TOTAL	60	

This question paper consists of 12 printed pages.

Registered Charity Number: 1066969
[Turn over

Answer **all** the questions.

1 Fig. 1.1 contains data about primary productivity in a number of biomes.

Primary productivity is a measure of the productivity of plants.

biome	mean annual primary productivity / g m^{-2}	mean annual rainfall / mm
tropical deciduous forest	1600	900
temperate deciduous forest	1200	1000
temperate grassland	600	400
desert	90	100

Fig. 1.1

(a) Plants form the first trophic level of an ecosystem.

Name the type of organism that forms

(i) the second trophic level

..... [1]

(ii) the third trophic level.

..... [1]

(b) State **two** reasons why plant productivity depends on the amount of rainfall.

.....

.....

..... [2]

(c) Name **one** factor, other than rainfall, on which productivity depends.

..... [1]

(d) Fig. 1.1 shows that the primary productivity of the tropical forest is greater than that of the temperate forest, even though annual rainfall is less in the tropical forest. Explain why.

.....

.....

..... [2]

(e) What is the meaning of the term *biome*?

.....

.....

..... [2]

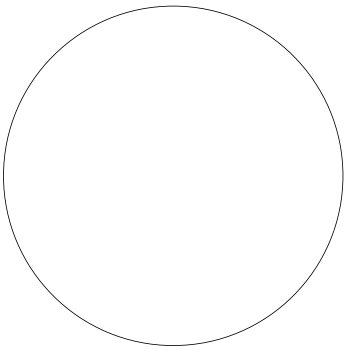
[Total: 9]

2 The pig-tailed macaque is a monkey that inhabits the tropical rain forests in Malaysia and Sumatra. The diet of the pig-tailed macaque is summarised in Fig. 2.1.

food	percentage of diet by mass
fruits and seeds	76
leaves and flowers	8
small animals	16

Fig. 2.1

(a) Sketch and label a pie-chart to show the percentage of the three different types of food in the diet of the pig-tailed macaque.



[1]

(b) Food provides an organism with energy.

State how energy is stored in food and give **one** example.

.....

..... [2]

(c) Name the process that releases energy in the cells of an organism.

..... [1]

(d) **(i)** Explain why it is important for an organism to balance its energy input and its energy output.

.....

.....

..... [2]

(ii) A pig-tailed macaque does not build a nest for its young. Instead, a parent carries its young while searching for food. Carrying the young requires energy, but the strategy reduces the parent's overall energy output. Suggest why.

.....

.....

..... [2]

(e) (i) Fig. 2.2 shows the structure of a tropical rain forest.

Label the layers of the forest.

An image has been removed due to third party copyright restrictions

Details:

An image showing the structure of a tropical rain forest

Fig. 2.2 [2]

(ii) A pig-tailed macaque has strong fingers and long limbs.

Describe one way in which these features are an adaptation to life among the trees in a tropical rain forest.

.....

..... [1]

[Total: 11]

3 Fig. 3.1 shows a simple, general model for the cycling of a nutrient element in an ecosystem. The labelled arrows indicate processes that transfer the nutrient. The boxes indicate reservoirs that store the nutrient.

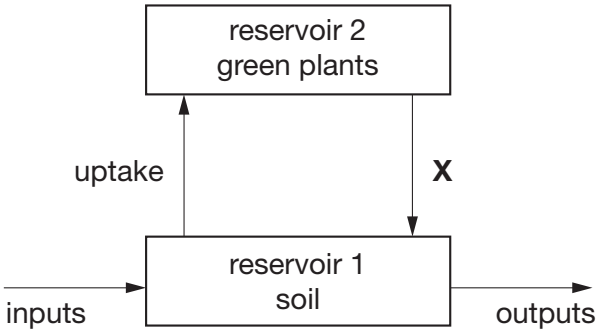


Fig. 3.1

(a) With reference to Fig. 3.1, give

(i) **one** example of an input process

..... [1]

(ii) **one** example of an output process

..... [1]

(iii) the name of the process labelled **X**

..... [1]

(iv) **one other** example of a reservoir.

..... [1]

(b) Nutrient levels in ecosystems are normally held in a steady state.

(i) Explain, in terms of Fig. 3.1, the meaning of the term *steady state*.

.....

.....

..... [2]

(ii) Name the mechanism that keeps an ecosystem in a steady state.

..... [2]

(c) Selenium is a nutrient element. The human diet can be deficient in selenium when food is grown on soil that has a low selenium content. Adding selenium compounds to the soil does not help because the selenium becomes strongly bound to organic matter in the soil. A more effective approach is to spray crops, such as cabbages, with a solution of a selenium compound.

(i) Explain how spraying crops provides a different pathway for selenium from that shown in Fig. 3.1.

.....

.....

..... [2]

(ii) Bread is the main source of selenium in the UK diet. The wheat for bread flour used to be grown on the N. American prairies. It was replaced by wheat grown in Europe. Since then, selenium levels in the UK population have fallen.

Suggest an explanation for the fall in selenium levels.

.....

.....

..... [2]

[Total: 12]

4 'Big cats' are found in many regions of the world. It is thought that, about 2 million years ago, they all had one common ancestor species. Natural selection led to populations with different characteristics, for example, nocturnal or day hunter, fast or strong. These populations then evolved further into the different species of 'big cat' known today.

(a) What is the meaning of the term *natural selection*?

.....

.....

.....

..... [3]

Lions, leopards and cheetahs have different habitats within the same ecosystem: the wooded grasslands of central Africa. Fig. 4.1 contains information about how these big cats hunt and feed.

species	day or night hunter	method of catching prey	feeding habit
lion	day hunter	knocks prey down using its weight	ground feeder
leopard	nocturnal	stalks prey that is often heavier than itself	drags prey up a tree
cheetah	day hunter	trips up prey while running	ground feeder

Fig. 4.1

(b) Use the information in Fig. 4.1 to suggest **two** characteristics that have been important in the evolution of leopards.

.....

.....

..... [2]

(c) What is the meaning of the term *habitat*?

.....

.....

..... [2]

(d) The term 'niche' is sometimes defined as 'the role of a species in its community'. Which species of big cat occupies the niche of 'grassland hunter of small, fast antelopes'?

..... [1]

(e) A pride (a social grouping) of 8 lions hunts and kills a wildebeest. The edible material of the prey has a total energy content of about 1 000 000 kJ.

(i) Resting requires less energy than any other activity.

A resting lion requires about 1200 kJ per hour.

Calculate the minimum energy required, **per day**, by the pride of lions.

Show your working.

energy required per day = ... kJ [2]

(ii) Explain why the pride is able to rest for no more than 4 days before having to resume hunting.

.....

.....

..... [2]

[Total: 12]

5 In its early stages, the universe consisted of hydrogen atoms. Some regions of the universe then collapsed in on themselves, creating stars, and generating high pressures and high temperatures. Under these conditions, nuclear fusion takes place. At first, helium atoms were made from hydrogen atoms. Later, heavier atoms were formed. For example, oxygen atoms were made from helium atoms and carbon atoms.

(a) What is the meaning of the term *nuclear fusion*?

.....

.....

..... [2]

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

Describe how different atomic nuclei differ in their structure.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [6]

Quality of Written Communication [2]

(c) In the universe at the present time, the space between the stars also contains molecules, such as water molecules. These are produced when heavier atoms, released from stars that have exploded, come into contact with hydrogen atoms. In the case of water molecules, oxygen atoms combine with the hydrogen atoms.

Water molecules can be detected because they emit electromagnetic radiation at a precise frequency of 22 235 MHz, in the microwave region of the spectrum.

(i) Name the region of the spectrum that lies on the **lower** frequency side of microwaves.

..... [1]

(ii) Explain why **wavelengths** in this region are **longer** than those of microwaves.

.....

.....

..... [2]

(iii) What is the meaning of the letter, M, in the units MHz?

..... [1]

(iv) Write the value of the frequency, 22 235 MHz, in Hz in standard form.

frequency = ... Hz [2]

[Total: 16]

END OF QUESTION PAPER