

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced Subsidiary GCE

SCIENCE

Science and the Natural Environment

2841

Friday

10 JUNE 2005

Morning

1 hour

Candidates answer on the question paper.

Additional materials:

Electronic calculator

Candidate Name	Centre Number	Candidate Number												
	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <td style="width: 15px; height: 15px;"></td> <td style="width: 15px; height: 15px;"></td> <td style="width: 15px; height: 15px;"></td> <td style="width: 15px; height: 15px;"></td> <td style="width: 15px; height: 15px;"></td> <td style="width: 15px; height: 15px;"></td> </tr> </table>							<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <td style="width: 15px; height: 15px;"></td> <td style="width: 15px; height: 15px;"></td> <td style="width: 15px; height: 15px;"></td> <td style="width: 15px; height: 15px;"></td> <td style="width: 15px; height: 15px;"></td> <td style="width: 15px; height: 15px;"></td> </tr> </table>						

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	13	
2	13	
3	13	
4	8	
5	13	
TOTAL	60	

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

Answer **all** the questions.

- 1 The forest floor is the bottom layer of a tropical rain forest. It consists of the surface layer of soil, a root mat formed from the roots of the larger trees and, lying on this, dead plant and animal material. This dead material is broken down quickly to release nutrients. These are efficiently taken up by the root mat, and retained in it and other parts of the trees. Only small quantities of nutrients are lost from the forest.

- (a) Name **one** layer formed by the branches of the larger trees in a tropical rain forest.

..... [1]

- (b) (i) What general term is used to describe the type of organism that breaks down dead plant and animal material, releasing nutrients from it?

..... [1]

- (ii) Describe how the root mat takes up nutrients.

.....

 [2]

- (c) Fig. 1.1 contains data from experiments carried out to measure how efficiently nutrients are taken up by a root mat from a tropical rain forest floor. The nutrient element studied in this case was nitrogen. Solutions, containing known quantities of the isotope nitrogen-15, were sprayed onto five sites of equal area. The quantity of nitrogen-15 leached from each site was measured. This was then expressed as a percentage of the nitrogen-15 that was sprayed on at the start.

site	percentage of nitrogen-15 leached
A	0.0005
B	0.0065
C	0.0070
D	0.0110
E	0.0025

Fig. 1.1

- (i) Calculate an average value for the percentage of nitrogen-15 leached from the forest floor. Show your working.

percentage leached = % [2]

- (ii) Other measurements showed that the root mat retained, on average, 26.4% of the nitrogen-15 that was sprayed onto the forest floor.
How many times more nitrogen-15 is retained by the root mat than is leached from the forest?

answer = [1]

- (iii) Leaching causes an output of nutrients from an ecosystem.
State **one** example of a process that provides an **input** of nutrients to an ecosystem.

..... [1]

- (d) Nitrogen-15 is non-radioactive. It can be detected using a mass spectrometer. The samples that were analysed for nitrogen-15 also contained nitrogen-14, the isotope that accounts for almost 100% of naturally-occurring nitrogen.

- (i) In what way do the isotopes, nitrogen-14 and nitrogen-15, differ?

.....
..... [2]

- (ii) Isotopes are converted into positive ions in a mass spectrometer.
Describe how a mass spectrometer separates the ions of two isotopes.

.....
.....
.....
.....
.....
..... [3]

[Total: 13]

- 2 Most of the organisms that live on the floor of the deep ocean grow very slowly. In 1975, a mud sample collected from one deep ocean site was found to contain specimens of *Tindaria callistiformis*, a species of deep sea clam. The age of the clam shells was estimated from the amount of radium-228 in them. Radium is built into the shells as they grow. The shells were found to be about 100 years old.

(a) Radium-228 is radioactive. Its half-life is 6.7 years.

(i) What is the meaning of the term *half-life*?

.....
..... [2]

(ii) Radium is also built into shells in the form of the isotope, radium-224, which has a half-life of 3.6 days. Measuring how much radium-224 is left in a 100 year old shell would lead to an inaccurate estimate of its age. Explain why.

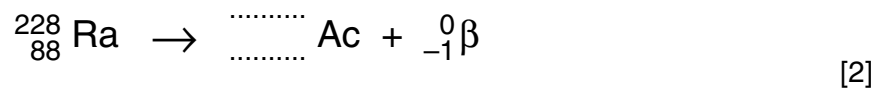
.....
..... [1]

(b) Radium-228 decays by emission of β^- radiation.

(i) Describe what happens to a nucleus when a β^- particle is emitted.

.....
.....
..... [2]

(ii) Complete the equation below for the decay of radium-228.



(c) Complete the table below to show properties of α , β and γ radiation.

property	α radiation	β radiation	γ radiation
charge		negative	
penetrating power	low		
ionising power			low

[3]

Ionising radiation can be detected using a Geiger-Muller tube.
In order to be detected, the radiation must do two things:

- penetrate through a window in the end of the tube
- ionise atoms of gas contained inside the tube.

Geiger-Muller tubes are designed to have window thicknesses and gas pressures appropriate to the type of ionising radiation that is to be detected.

(d) Suggest why the following design features are necessary to give accurate measurements.

(i) The thinnest windows are used in Geiger-Muller tubes designed to measure α radiation.

.....
..... [1]

(ii) The highest gas pressures are used in Geiger-Muller tubes designed to measure γ radiation.

.....
..... [1]

(e) Name **one** other method of detecting ionising radiation.

..... [1]

[Total: 13]

3 Leaves contain a number of pigments. They absorb electromagnetic radiation to provide the energy required in photosynthesis.

(a) In which organelles of plant cells are the pigments contained?

..... [1]

(b) The pigments are involved in the light dependent stage of photosynthesis.
Write a **word equation** for the process that takes place in the **light dependent** stage of photosynthesis.

[3]

Three types of pigment present in leaves are: chlorophyll *a*, chlorophyll *b* and carotenes. Fig. 3.1 shows the absorption spectra of these pigments.

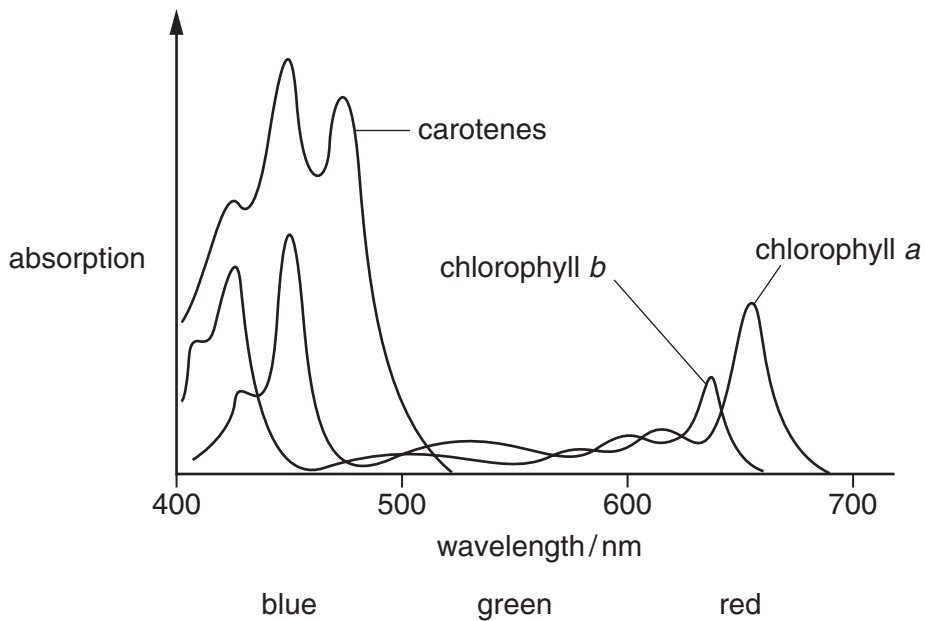


Fig. 3.1

(c) Write down the wavelength values of the **two** highest peaks in the absorption spectrum of **chlorophyll a**.

1

2 [2]

(d) (i) Explain why a beam of visible light changes from white to coloured when it passes through a pigment.

.....

.....

..... [2]

(ii) Use Fig. 3.1 to explain why leaves appear green.

.....

..... [1]

(iii) In autumn, chlorophylls in leaves break down.
Using the information in Fig. 3.1 about absorption of particular colours, suggest why leaves often turn red in autumn.

.....

.....

..... [2]

(e) State **two** effects, other than absorption, that can occur when a beam of electromagnetic radiation comes into contact with a material.

1

2 [2]

[Total: 13]

4 Images of the Earth can be obtained by remote sensing satellites. An image consists of an array of pixels, and a satellite carries an array of sensors.

(a) What is the meaning of the term *array of pixels*?

.....
.....
..... [2]

(b) What is the relationship between

(i) a pixel in an image and a sensor on a satellite;

.....
..... [1]

(ii) the grey scale of a pixel and the radiation received by a sensor?

.....
..... [1]

Fig. 4.1 shows illustrations of how Antarctica and the surrounding sea appear in two remotely sensed images.

In Image A, visible light is detected.

In Image B, thermal infrared radiation is detected.

Image A

Image B

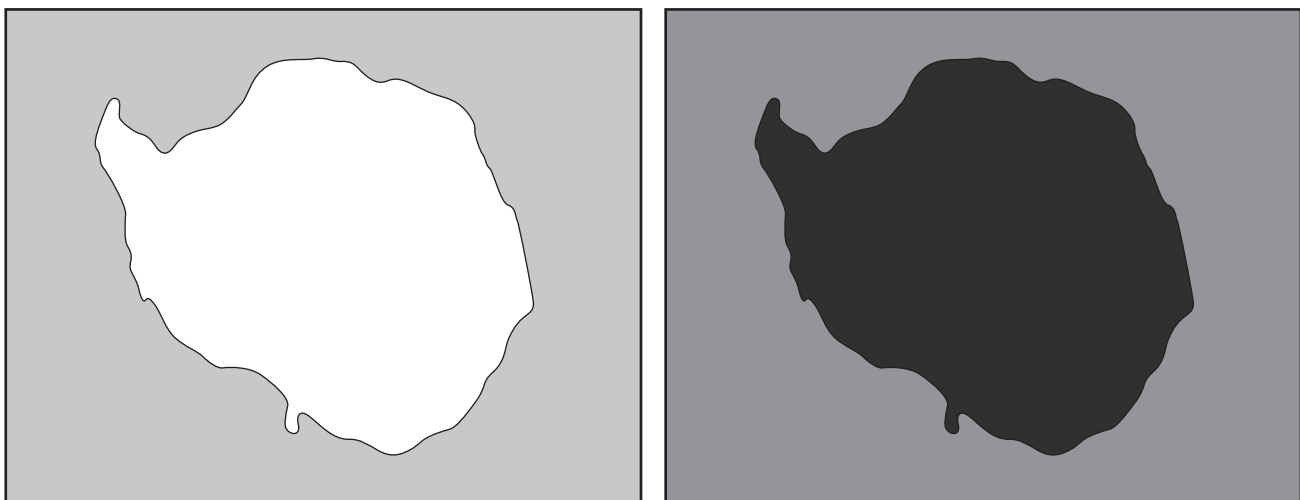


Fig. 4.1

(c) Explain why Antarctica appears black in the thermal infrared image.

.....
..... [1]

(d) Images can be combined to give a false colour composite image.

(i) What is the meaning of the term *false colour composite*?

.....
.....
..... [2]

(ii) A false colour composite image was made using Image **A** and Image **B**.
The visible light in Image **A** was assigned to the colour blue.
The thermal infrared radiation in Image **B** was assigned to the colour red.

Complete the labels in Fig. 4.2 with the colours that would be shown in the false colour composite image.

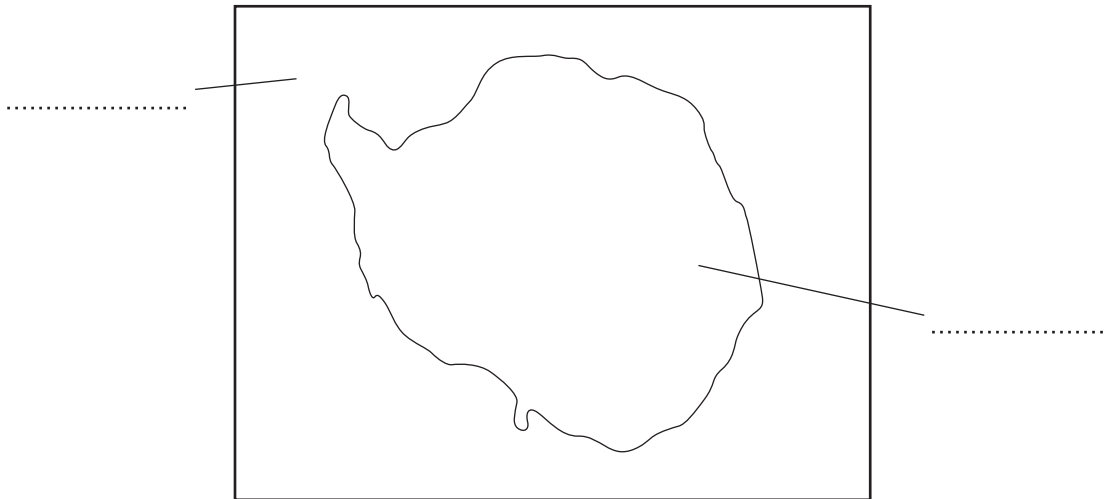


Fig. 4.2

[1]

[Total: 8]

5 The cell is the basic unit of life. Some organisms consist simply of single cells. Larger plants and animals consist of large numbers of cells. In these multicellular organisms, cells are organised into a hierarchy of tissues, organs and systems.

(a) Explain, using a named example of a system, how cells, tissues, organs and systems are related.

.....
.....
.....
.....
..... [4]

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

Plant cells and animal cells contain organelles.
Describe the structures and roles of **two** organelles that are present in **both** animal and plant cells.

.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
..... [7]

Quality of Written Communication [2]

[Total: 13]

END OF QUESTION PAPER

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (OCR) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

OCR is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.