Rewarding Learning

Centre Number

71	

Candidate Number

ADVANCED
General Certificate of Education
January 2013

Biology

Assessment Unit A2 1

assessing

Physiology and Ecosystems

[AB211]

AB211

FRIDAY 11 JANUARY, AFTERNOON

TIME

2 hours.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
Write your answers in the spaces provided in this question paper.
There is an extra lined page at the end of the paper if required.
Answer **all nine** questions.
You are provided with **Photograph 1.4** for use with Question 4 in this paper.
Do not write your answer on this photograph.

INFORMATION FOR CANDIDATES

The total mark for this paper is 90.
Section A carries 72 marks. Section B carries 18 marks.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
You are reminded of the need for good English and clear presentation in your answers. Use accurate scientific terminology in all answers.
You should spend approximately **25 minutes** on Section B.
You are expected to answer Section B in continuous prose.
Quality of written communication will be assessed in **Section B** and awarded a maximum of 2 marks.

For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
6	
7	
8	
9	
Total Marks	

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Section A

Examiner Only	
Marks	Remark

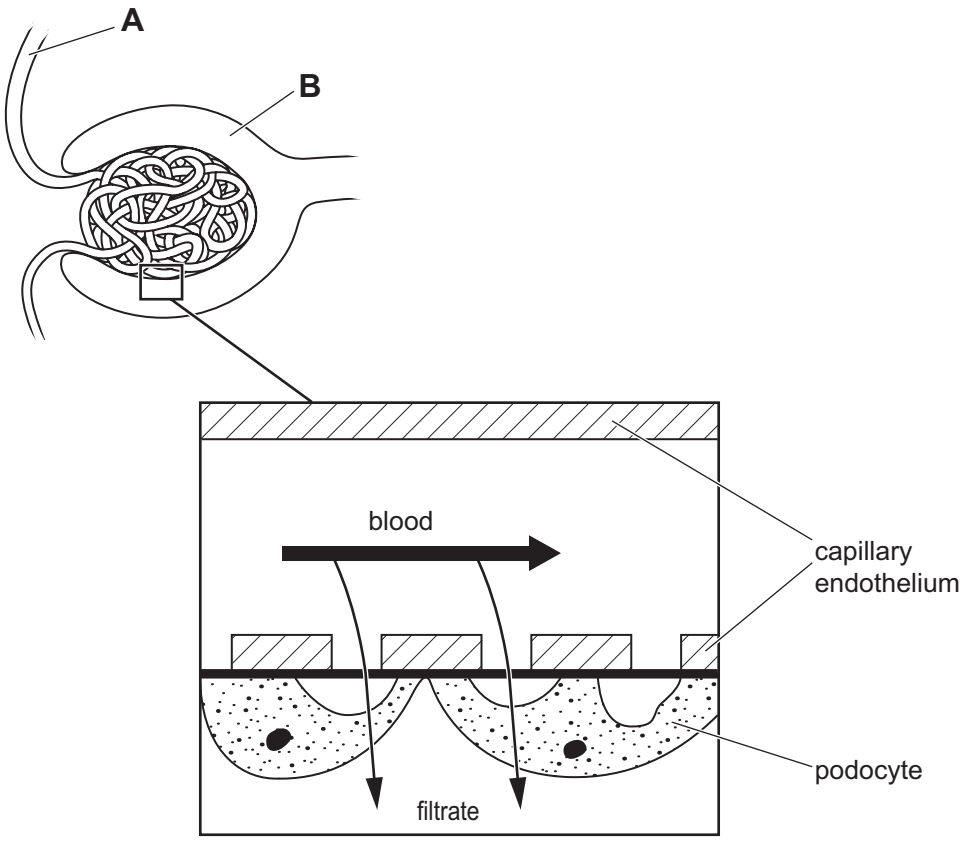
1 Read the following passage about the control of flowering in plants and write the most appropriate word(s) in the blank spaces to complete the account.

The pigment _____ is found in the leaves of flowering plants and occurs in two interchangeable forms. In daylight, the _____ form is rapidly changed to the _____ form. Short day plants will flower when the period of _____ reaches or exceeds a minimum length.

[3]

2 The diagram below shows the site of ultrafiltration in a kidney.

Examiner Only	
Marks	Remark



(a) (i) Identify structures **A** and **B** shown on the diagram.

A _____

B _____ [2]

(ii) On the diagram, label and name the structure which is the effective filter in ultrafiltration. [1]

(b) The table below shows the value of water potential components in both the blood plasma and the renal filtrate (in the nephron) at the site of ultrafiltration. The pressure potential, ψ_p, is a measure of hydrostatic pressure. All units are in kPa.

Blood plasma	Renal filtrate
$\psi_s = -3.5$ $\psi_p = 6.5$	$\psi_s = -0.5$ $\psi_p = 1.2$
$\psi_{plasma} =$	$\psi_{filtrate} =$

Using the information provided, calculate the net filtration force. (Show your working out.)

Net filtration force _____ kPa [2]

(c) In healthy individuals, protein does not normally appear in the urine. One indicator of high blood pressure is the presence of protein in the urine. Explain the presence of protein in the urine in someone with high blood pressure.

_____

_____ [1]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

3 Many human activities harm the environment. However, there is increasing awareness of the harm we cause. Legislation and the promotion of environmentally-friendly activities are approaches taken by governments to help protect the environment.

(a) The European Nitrates Directive aims to reduce nitrate enrichment of our waterways. One aspect of the Directive is to restrict the application of some forms of fertiliser on agricultural land during the winter months.

Suggest how this reduces nitrate enrichment of waterways.

[2]

(b) Many governments promote the use of managed reed bed systems. Reed beds of the common reed (*Phragmites australis*) can help reduce organic waste in waterways by breaking down organic compounds and then utilising the breakdown products for growth.

An important adaptation in *Phragmites* is that oxygen can be transferred from the leaves, through the stem and into the roots. Diffusion of oxygen out of the roots creates an oxygen-rich environment in the area immediately surrounding the roots. Consequentially oxygen gradients are created over very short distances resulting in localised aerobic and anaerobic conditions – conditions that favour highly diverse microbial populations.

Investigations have shown that constructed reed bed systems are very effective small-scale biofilters (filters of biological materials), particularly in reducing nitrate levels.

(i) With reference to the nitrogen cycle, explain why localised gradients in oxygen levels are important in the breakdown and removal of organic waste.

[3]

(ii) Explain the significance of the reeds "utilising the breakdown products for growth" in their role as a biofilter.

_____

_____ [1]

(iii) Suggest **two** reasons why many governments promote the use of managed reed bed systems as a means of reducing organic waste in rural areas.

1. _____

_____

2. _____

_____ [2]

(c) Legislation is also in place to reduce ozone depletion of the atmosphere. Ozone gas forms a layer in the stratosphere that protects against the harmful effects of ultraviolet radiation.

Explain **one** way in which ozone depletion can harm humans.

_____

_____ [1]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

4 (a) **Photograph 1.4** shows a section through part of the wall of a mammalian eye.

(i) Identify layer **X** that lies immediately below the photoreceptor cells.

_____ [1]

(ii) Identify the dark circular structures in the layers labelled **Y**.

_____ [1]

(iii) The mammalian retina is described as being 'inverted'. Using **photograph 1.4**, suggest why the mammalian retina is described as being inverted and suggest a possible disadvantage of this.

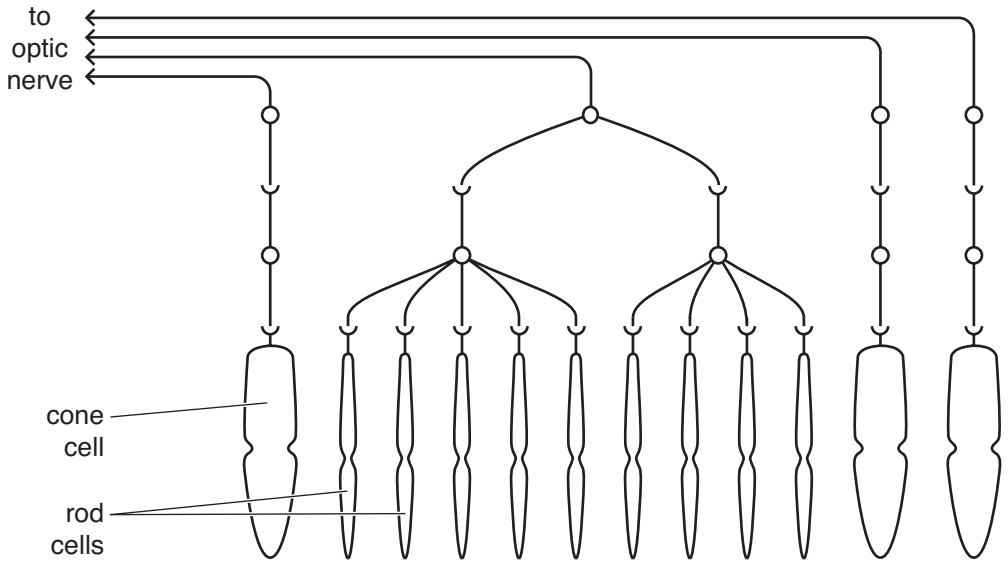
_____

_____

_____

_____ [2]

(b) Mammalian photoreceptor cells (rods and cones) and their associated neurones are represented in the diagram below.



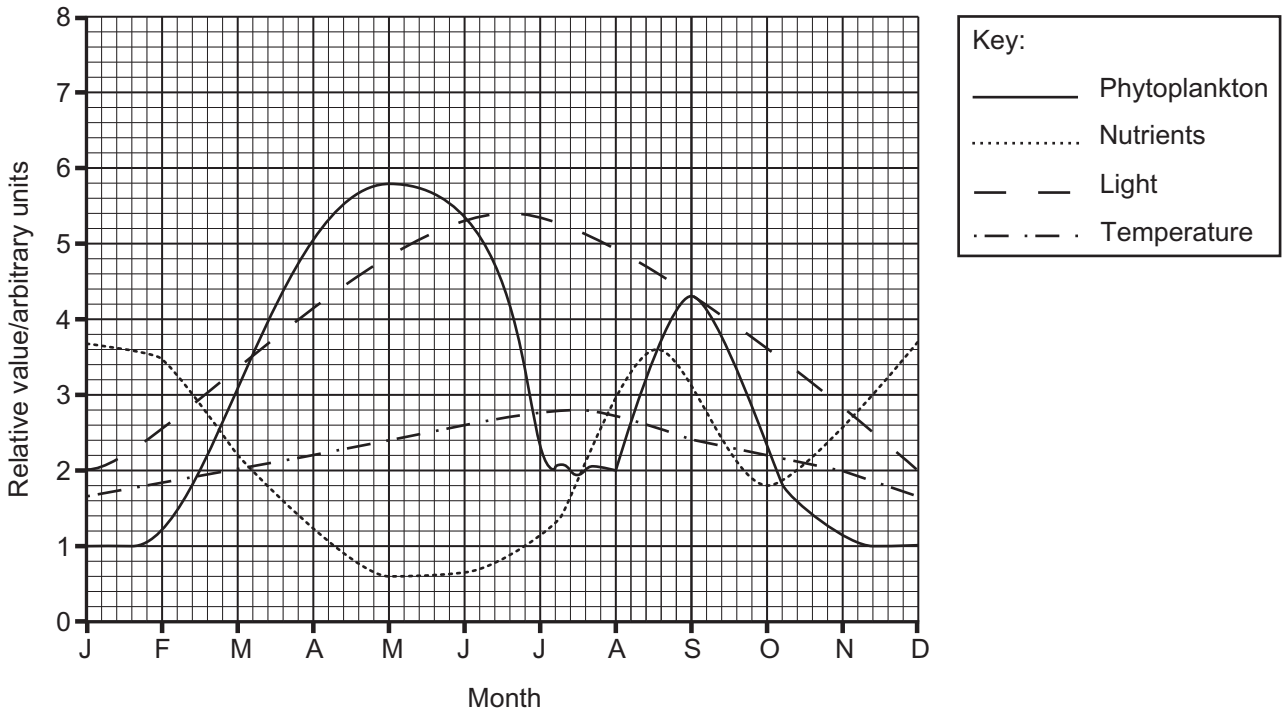
The diagram shows that the rods and cones differ in the structural arrangement with their associated neurones. Describe and explain the significance of this to human vision.

[4]

Examiner Only

Marks	Remark

5 **(a)** Phytoplankton is the general name given to the microscopic protoctists that photosynthesise in the upper, light-rich layers of lakes. The graph below shows the relationships between light, temperature, nutrients and the growth of phytoplankton in an Irish lake throughout a year.



(i) Using the information in the graph, explain why the population of phytoplankton increases in early spring (February–April).

_____

_____

_____

_____

_____ [2]

(ii) Suggest why there is a second peak of phytoplankton numbers in late summer (August–September).

_____

_____

_____

_____

_____ [2]

Examiner Only	
Marks	Remark

(iii) Phytoplankton are consumed by zooplankton (microscopic heterotrophic protoctists). Suggest how the numbers of zooplankton in this lake would change throughout the year. Explain your answer.

[3]

(iv) Phytoplankton could be described as being r-selected. Identify **one** piece of evidence in the graph for this statement.

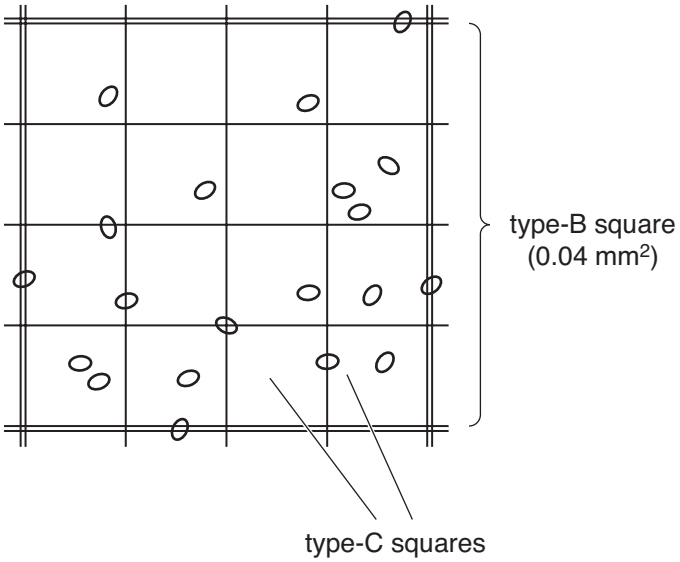
[1]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

(b) Phytoplankton numbers can be estimated using a haemocytometer.

The diagram below represents a type-B square from a haemocytometer slide. The distance between the surface of the type-B square and the overlying coverslip is 0.1 mm.



(i) Suggest why type-B squares, rather than type-C squares, are used to estimate the number of phytoplankton in the sample used.

_____

_____ [1]

(ii) Count the number of phytoplankton in the type-B square shown.

_____ [1]

(iii) Using your answer from **(ii)** above, calculate the number of phytoplankton per mm^3. (Show your working.)

Answer _____ cells mm^{-3} [2]

(c) To ensure validity, it is important that appropriate sampling procedures are in place during sampling of the phytoplankton in the lake and also when adding the phytoplankton to the haemocytometer.

Examiner Only	
Marks	Remark

(i) Suggest **one** variable that should be controlled when sampling the phytoplankton in the lake.

_____

_____ [1]

(ii) Suggest **one** precaution that should be undertaken when adding the phytoplankton to the haemocytometer.

_____

_____ [1]

Examiner Only	
Marks	Remark

6 Hedgerows in Northern Ireland show considerable regional diversity.

In Fermanagh, hedges are commonly associated with water-filled ditches and frequently border semi-natural vegetation such as rough pasture or meadow. In intensively-farmed East Down, hedgerows less frequently have ditches and they often border large fields commonly used for silage, crop or livestock farming. In addition, East Down hedges tend to be much more frequently trimmed than Fermanagh hedges.

In an investigation of the biodiversity of hedgerows, 25 Fermanagh and 25 East Down hedgerows were sampled at the same time of year. The number of plant species in 30 metre lengths of hedge was determined for each hedgerow. Flowering plants, and the moisture-requiring ferns and mosses, were only recorded as far out from the hedgerow as the extent of the lateral growth of the woody species.

The table below shows the average number of species recorded in Fermanagh and East Down hedgerows.

	Average number of plant species in 30 m of hedge	
Plant species	**Fermanagh**	**East Down**
Woody species	8	3
Flowering plants	15	5
Ferns and mosses	8	4

(a) Suggest an explanation for the increased species-richness in Fermanagh hedges.

[4]

Examiner Only

Marks	Remark

(b) The species diversity of the Fermanagh and East Down hedgerows could have been compared using Simpson's Index which would give a single statistical indicator for each of the two areas.

(i) Suggest **one** reason why Simpson's Index was not used to compare the two areas.

_____

_____ [1]

(ii) Suggest **one** way in which Simpson's index would be a more effective measure of diversity than the data that was gathered to compare diversity in the East Down and Fermanagh hedgerows.

_____

_____ [1]

(c) Hedgerows are not climatic climax communities. Give **one** reason why.

_____

_____ [1]

(d) Removing hedgerows to create larger fields for intensive agricultural use can contribute to soil erosion. Suggest **two** reasons for this.

1. _____

_____

2. _____

_____ [2]

Examiner Only	
Marks	Remark

7 The immune system has evolved to protect against disease-causing microorganisms. However, there is a fine balance between defending against foreign pathogens and causing harm to the body's own cells.

(a) Type 1 diabetes is an autoimmune condition, caused by the body's immune system, which damages its own insulin-producing cells in the pancreas. The consequence is that insulin can no longer be produced in sufficient quantity to control blood sugar levels.

Onset of diabetes in patients appears to involve both genetic predisposition and environmental factors. Research suggests that a significant environmental trigger is infection with a virus such as chickenpox or rubella in the months before the onset of diabetes.

(i) Suggest how infection with a virus can act as an environmental trigger.

_____

_____ [1]

(ii) Explain why Type 1 diabetes is a cell-mediated response and not an antibody-mediated immune response.

_____

_____

_____

_____ [2]

(iii) Describe the process of cell-mediated immunity.

_____

_____

_____

_____

_____

_____

_____

_____

_____ [4]

(b) Another adverse immune response is caused by rhesus incompatibility between mother and foetus during pregnancy. Sarah is rhesus negative and is married to Paul. The table below shows the rhesus status of their four children.

Child	Age	Rhesus status
Mary	6	negative
Sean	4	positive
Bill	3	negative
Aoife	1	positive

In terms of rhesus incompatibility, explain why Sarah's pregnancies required careful monitoring. Your answer should explain which child, or children, were at particular risk and state one thing that would have been done to reduce the risk.

_____

_____

_____

_____

_____

_____

_____

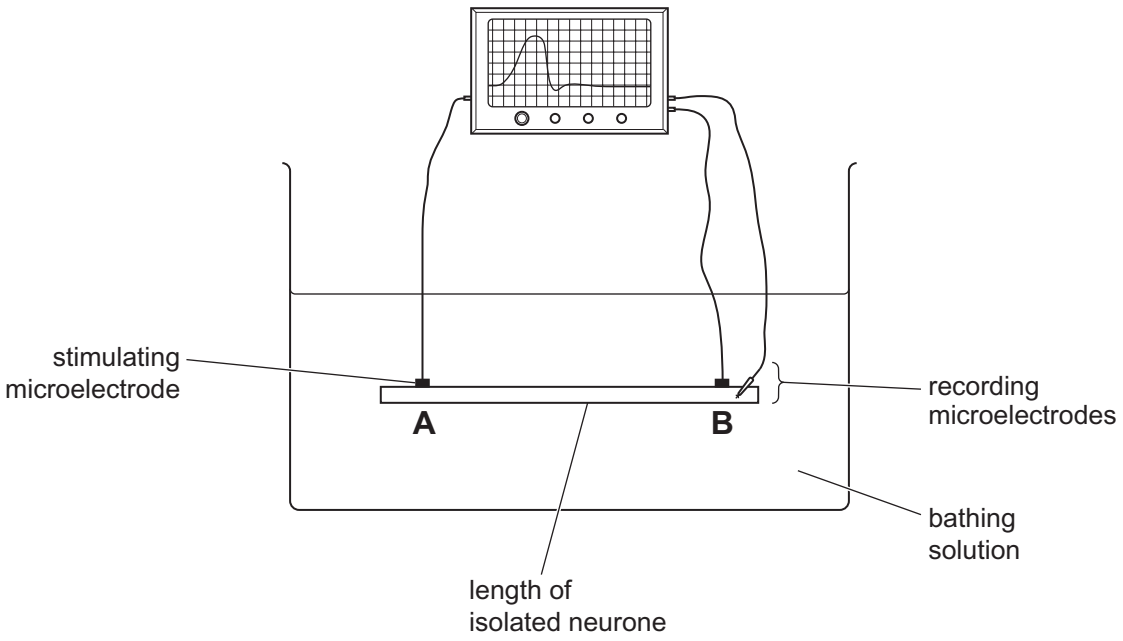
_____

_____ [4]

Examiner Only	
Marks	Remark

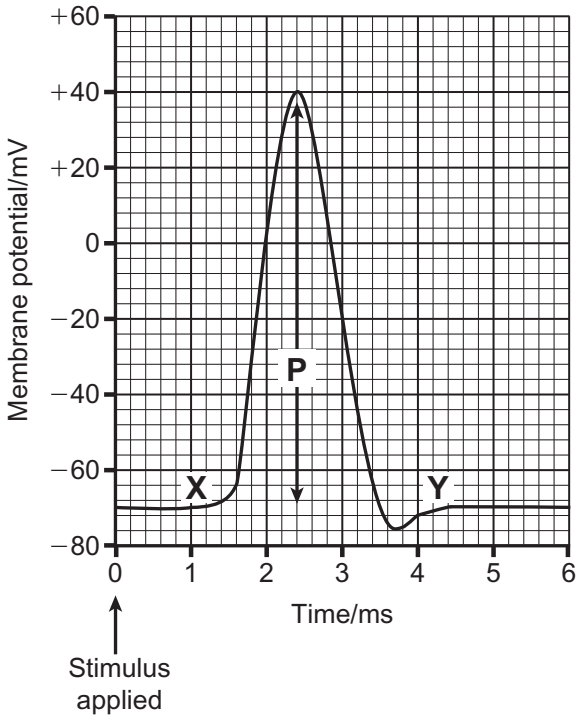
Examiner Only	
Marks	Remark

8 **(a)** An investigation was carried out to investigate the effect of electrical stimulation on isolated neurones. This type of investigation uses neurones obtained from freshly killed animals. The experimental set-up is shown in the diagram below.



In the investigation the neurone was stimulated via a microelectrode at **A**, where depolarisation of the neurone was initiated. At **B**, a pair of microelectrodes, one external and one internal, record the potential difference as an impulse passes.

The graph below shows the potential difference detected by the microelectrodes at **B**, following stimulation by the microelectrode at **A**.



(i) State the name of the change in the potential difference shown as **P** on the graph.

_____ [1]

(ii) Describe and explain the sequence of events between **X** and **Y** following stimulation.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____ [4]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

(b) The set-up in the investigation described in part **(a)** could also be used to investigate the speed of nervous conduction along a neurone.

Using the set-up described, devise a plan for an investigation to compare the speed of nervous conduction between myelinated and non-myelinated neurones.

Your answer should indicate the variable(s) that you will need to control to ensure that valid results are obtained. You do not need to describe how the neurones are obtained.

[4]

(c) Experiments of the type described in this question can raise ethical concerns. Suggest **one** ethical concern which may be expressed. Justify the use of such experiments.

[3]

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(Questions continue overleaf)

Section B

Examiner Only	
Marks	Remark

Quality of written communication is awarded a maximum of 2 marks in this section.

9 **(a)** Give an account of the efficiency of light absorption by plants and the subsequent transfer of energy within food chains. [10]

(b) Discuss how farmers are able to maximise the productivity of plants and animals. [6]

Quality of written communication [2]

(a) Give an account of the efficiency of light absorption by plants and the subsequent transfer of energy within food chains.

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

(b) Discuss how farmers are able to maximise the productivity of plants and animals.

Examiner Only	
Marks	Remark

Extra lined page

Examiner Only	
Marks	Remark

THIS IS THE END OF THE QUESTION PAPER

113608

GCE Biology Advanced (A2)
Assessment Unit A2 1: Physiology and Ecosystems
January 2013

Photograph 1.4
(for use with Question 4)