Rewarding Learning

ADVANCED

General Certificate of Education

2015

Centre Number

Candidate Number

Biology

Assessment Unit A2 1

assessing

Physiology and Ecosystems

ML

[AB211]

THURSDAY 21 MAY, AFTERNOON

TIME

2 hours, plus your additional time allowance.

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 answers 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 **(a)** The following account is about the adverse impact of human activity on the environment.
Write the most appropriate word(s) in the blank spaces to complete the account.

The depletion of the ozone layer has resulted in increased penetration of UV light, causing an increased risk of skin cancer and _____ . Acid rain also harms the atmosphere. It results from the combustion of fossil fuels as a consequence of _____ reacting with water. [2]

(b) State **one** strategy used to reduce ozone depletion and acid rain:

- Ozone depletion

_____

_____

_____

- Acid rain

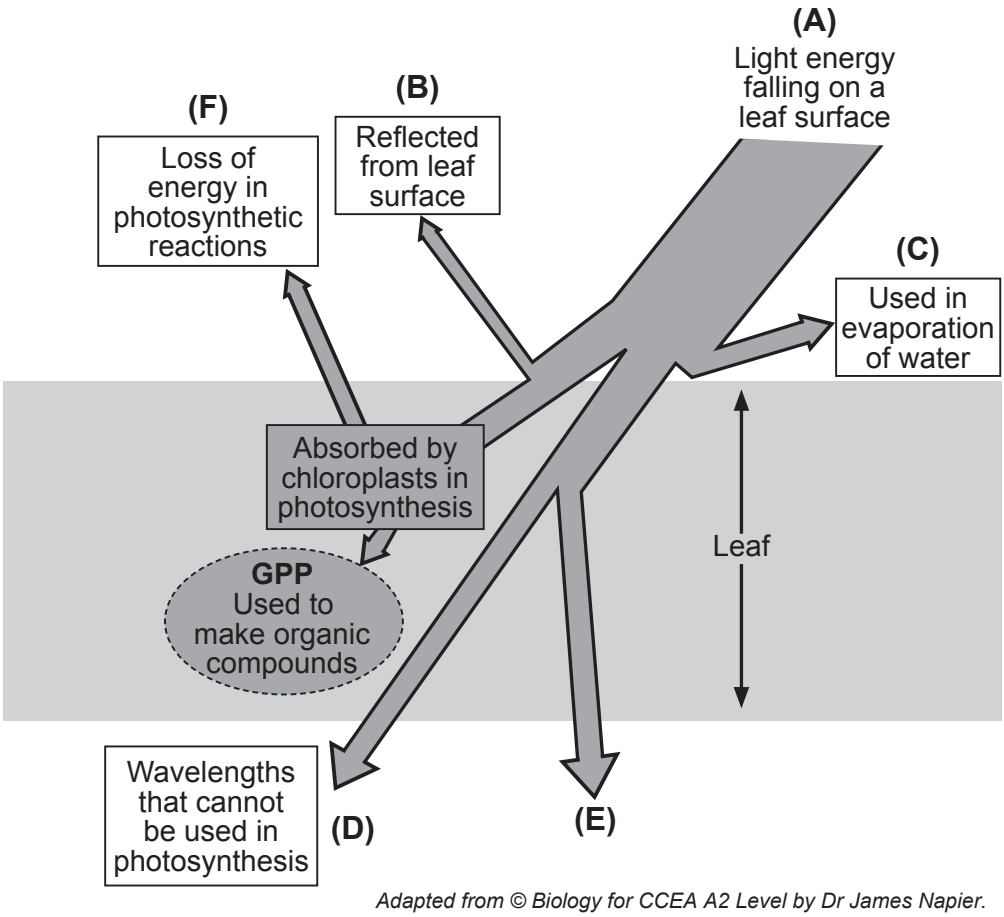
_____

_____

_____ [2]

Examiner Only	
Marks	Remark

2 **(a)** The diagram below summarises the fate of light energy falling on a crop leaf.



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(i) Suggest what is represented by the arrow **E**.

_____ [1]

(ii) Using the letters given, devise a formula to show the amount of light energy falling on the leaf surface that represents Gross Primary Production (GPP).

GPP = _____ [1]

(iii) Suggest **one** way that farmers can maximise the amount of light energy falling on the leaves of a crop in a field.

_____

_____ [1]

(b) Many crops are grown as a monoculture.

Examiner Only	
Marks	Remark

(i) Explain precisely what is meant by the term monoculture.

_____

_____

_____ [1]

(ii) Explain how monocultures can harm:

- soil quality

_____

_____

_____

- animal biodiversity

_____

_____

_____ [2]

Examiner Only	
Marks	Remark

3 **(a)** An investigation was carried out in a laboratory. This was to determine the photoperiod necessary to promote flowering in a species of plant. The results are shown in the table below.

Length of continuous dark period/hours	Length of continuous light period/hours	Flowering outcome
16	8	no flowering
14	10	no flowering
12	12	no flowering
10	14	flowering
8	16	flowering

(i) What is the evidence that this species is a long-day plant?

_____

_____

_____ [1]

(ii) Suggest why the investigation was carried out in a laboratory rather than field (outdoor) conditions.

_____

_____

_____ [1]

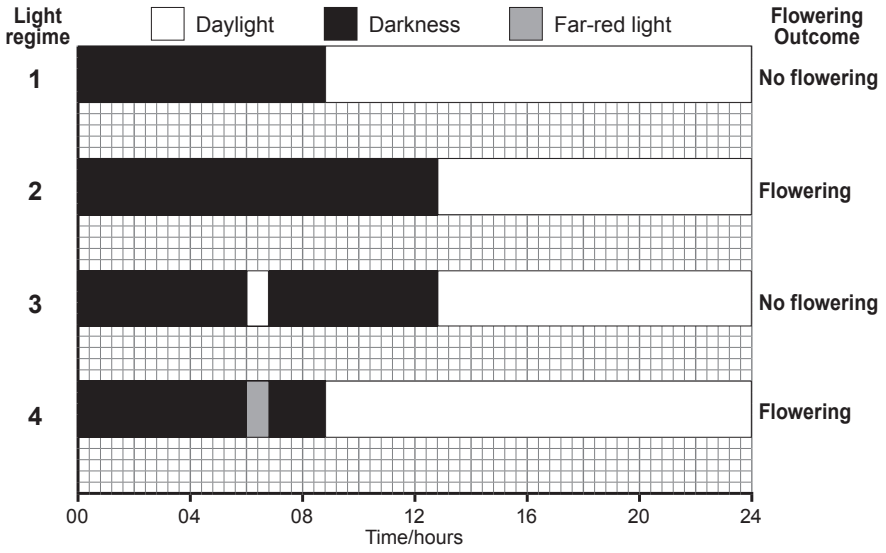
(iii) Describe how this investigation could be extended to give a more precise value for the photoperiod required to promote flowering.

_____

_____

_____ [1]

(b) The diagram below shows the effect of different light regimes on a short-day plant.



(i) In terms of phytochrome conversions, explain why the plant does **not** flower in light regime 3.

_____

_____

_____

_____

_____

_____ [2]

(ii) Explain why flowering does occur in light regime 4, yet not in light regime 1.

_____

_____

_____

_____

_____

_____

_____

_____

_____ [3]

Examiner Only	
Marks	Remark

(c) The human eye is normally able to distinguish different colours. However, in one form of red-green colour blindness, individuals are unable to distinguish between red and green colours.

With regard to the function of the retina, suggest the biological basis of this type of colour blindness.

_____

_____

_____ [1]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

4 **(a)** **Photograph 1.4** is an electron micrograph of a section through the wall of a proximal convoluted tubule in the kidney.

(i) Identify the structures labelled **A** and **B**.

A _____

B _____ [2]

(ii) Explain precisely the role of the structures labelled **A** in the proximal convoluted tubule.

_____

_____

_____

_____

_____ [2]

(b) **(i)** Name the type of epithelial cells shown in the electron micrograph.

_____ [1]

(ii) Write down **two** differences in structure between the endothelium lining the glomerular capillaries and the epithelium in **Photograph 1.4**.

1. _____

_____

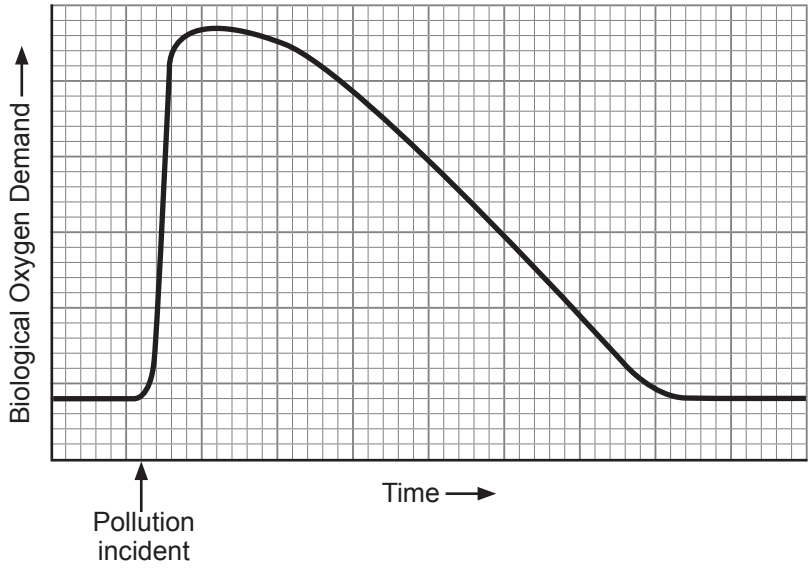
2. _____

_____ [2]

Examiner Only	
Marks	Remark

5 In order to promote environmental conservation, human activity needs to be managed and monitored. There are many aspects to this, including reducing pollution levels and conserving existing habitats.

(a) The graph below shows how an incident of slurry pollution in a small lake affected the Biological Oxygen Demand (BOD) over a period of time.



(i) Explain the immediate effect of the slurry pollution on BOD in the lake.

_____

_____

_____

_____

_____

_____

_____

_____ [3]

Examiner Only	
Marks	Remark

(ii) Artificial fertiliser entering waterways also affects BOD, although the sequence of events and the timescale are different. Write down **one** similarity and **two** differences between the effects of artificial fertiliser and slurry on BOD in waterways.

Similarity _____

_____

_____

Differences _____

_____

_____

_____

_____

_____ [3]

(b) Indicator species can be used to monitor pollution levels in waterways. A number of different species of aquatic invertebrates (e.g. bloodworms and stoneflies) can be used for this purpose.

Suggest **two** advantages of using invertebrates, which occupy lower trophic levels in the aquatic food web, as indicator species, rather than top predator fish such as pike.

1. _____

_____

2. _____

_____ [2]

Examiner Only	
Marks	Remark

(c) It is also important to monitor and conserve woodland. The photograph below shows a section of woodland that has been coppiced.

Source: Chief Examiner

Using your knowledge and the information provided:

(i) Describe the process of coppicing and its effect on trees.

_____

_____

_____

_____

_____ [2]

(ii) Describe and explain **one** way in which coppicing can promote biodiversity.

_____

_____

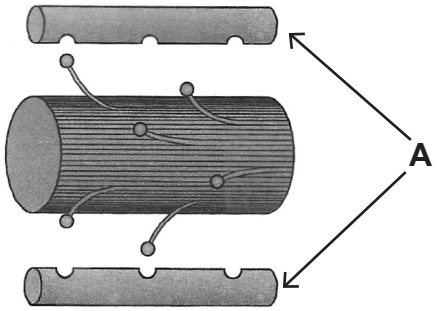
_____

_____

_____ [2]

Examiner Only	
Marks	Remark

6 **(a)** The main proteins involved in skeletal muscle contraction are represented in the diagram below.



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(i) Identify protein **A**.

_____ [1]

(ii) Explain the process of muscle contraction in a myofibril following nervous stimulation.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

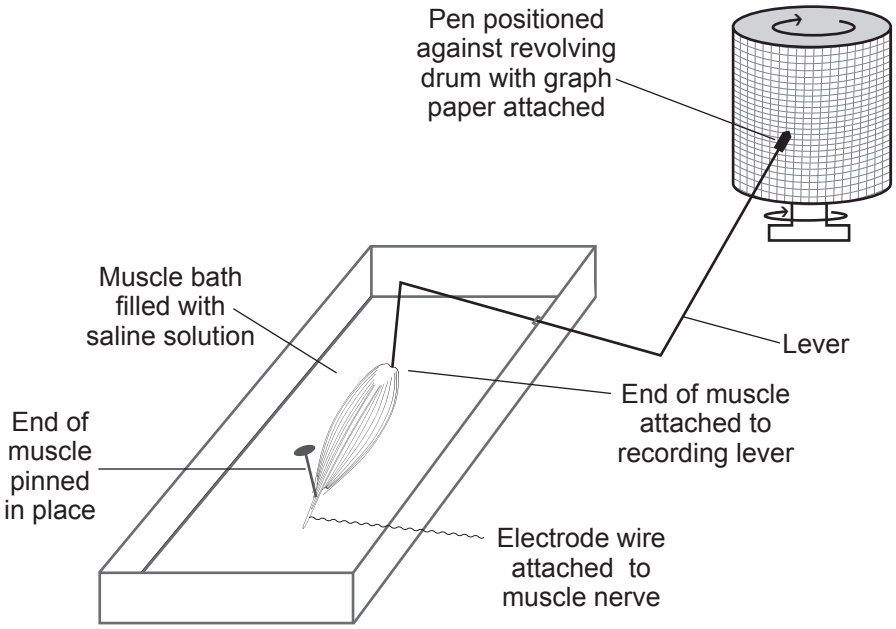
_____

_____ [4]

Examiner Only	
Marks	Remark

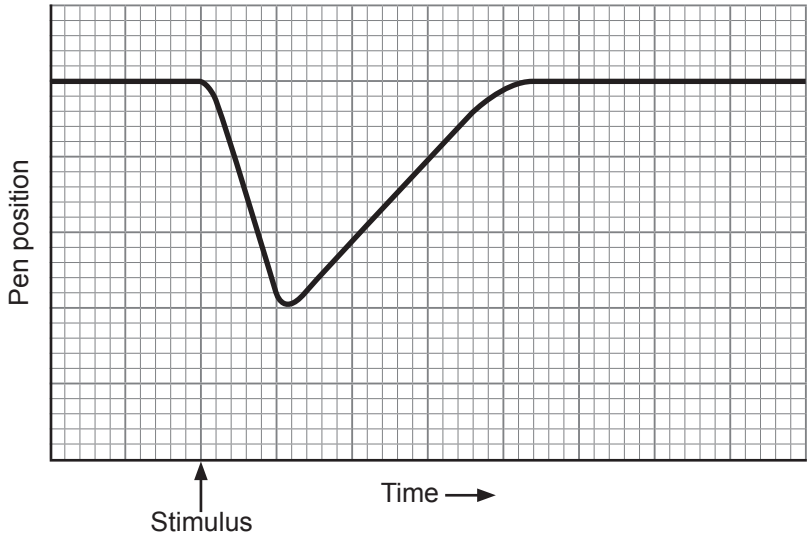
(b) An experiment was carried out to investigate muscle contraction in skeletal muscle. This type of investigation uses muscles obtained from freshly killed animals. The experimental set-up is shown in diagram **A**.

Diagram A



If a single electrical stimulus is applied to the muscle (by the electrode wire), the following trace (graph line) is produced on the graph paper on the revolving drum.

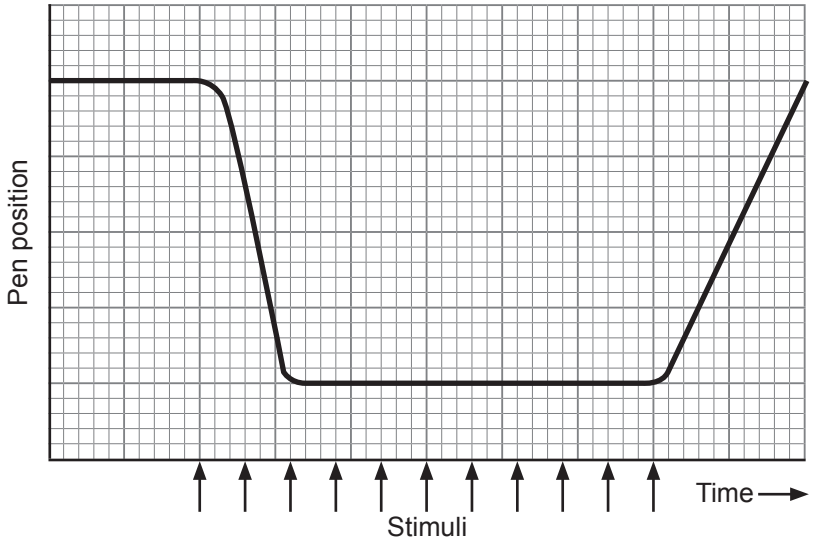
Diagram B



(i) On diagram **B** above, mark with an **X**, a part of the trace that represents muscle contraction. [1]

Examiner Only	
Marks	Remark

The diagram below represents the trace from a muscle that was stimulated repeatedly over a period of time, with very short intervals between successive stimuli.



(ii) Identify **two** differences between the muscle response to repeated stimuli and a single stimulus.

1. _____

_____

2. _____

_____ [2]

(iii) Suggest **one** example of human activity that would involve this type of contraction.

_____

_____ [1]

(c) When using the experimental set-up shown in diagram **A** to compare different types of contraction in muscle, it is important to make sure that variables are controlled as far as possible. Describe **two** variables that need to be controlled in this investigation to make sure the results are valid.

1. _____

_____

2. _____

_____ [2]

Examiner Only	
Marks	Remark

7 Shingles is a medical condition that is most common in older people, or people with weakened immune systems (e.g. transplant patients and patients undergoing chemotherapy).

The *varicella zoster* virus that causes shingles is the same virus that causes chickenpox. Following an initial chickenpox infection, most of the *varicella zoster* viruses are destroyed by the immune system, but some may remain dormant within nervous tissue for many years. Shingles is a consequence of the reactivation of the virus, which then migrates out of nervous tissue into body fluids to cause the characteristic 'shingles rash' in the surrounding skin.

In September 2013, people who were 70 years old became eligible for shingles vaccination as part of NHS policy.

(a) Explain precisely why transplant patients have an increased risk of suffering from shingles.

_____

_____

_____ [1]

(b) While the vaccination programme for shingles costs the NHS many millions of pounds to implement, it is suggested that a similar amount of money will be saved once the vaccination programme is fully in place. Suggest **one** way in which the vaccination programme outlined above helps save NHS spending.

_____

_____

_____ [1]

Examiner Only	
Marks	Remark

(c) The vaccine contains 'live' attenuated (weakened) *varicella zoster* virus. In many people there is a significant immune response very soon after immunisation, with both antibody-mediated and cell-mediated responses taking place.

(i) Suggest why the immune response to the shingles vaccine may be more rapid than for most other vaccinations with 'live' virus.

_____

_____

_____

_____

_____

_____ [2]

(ii) Using the information provided, explain fully why the immune response following activation involves both cell-mediated and antibody-mediated responses.

_____

_____

_____

_____

_____

_____

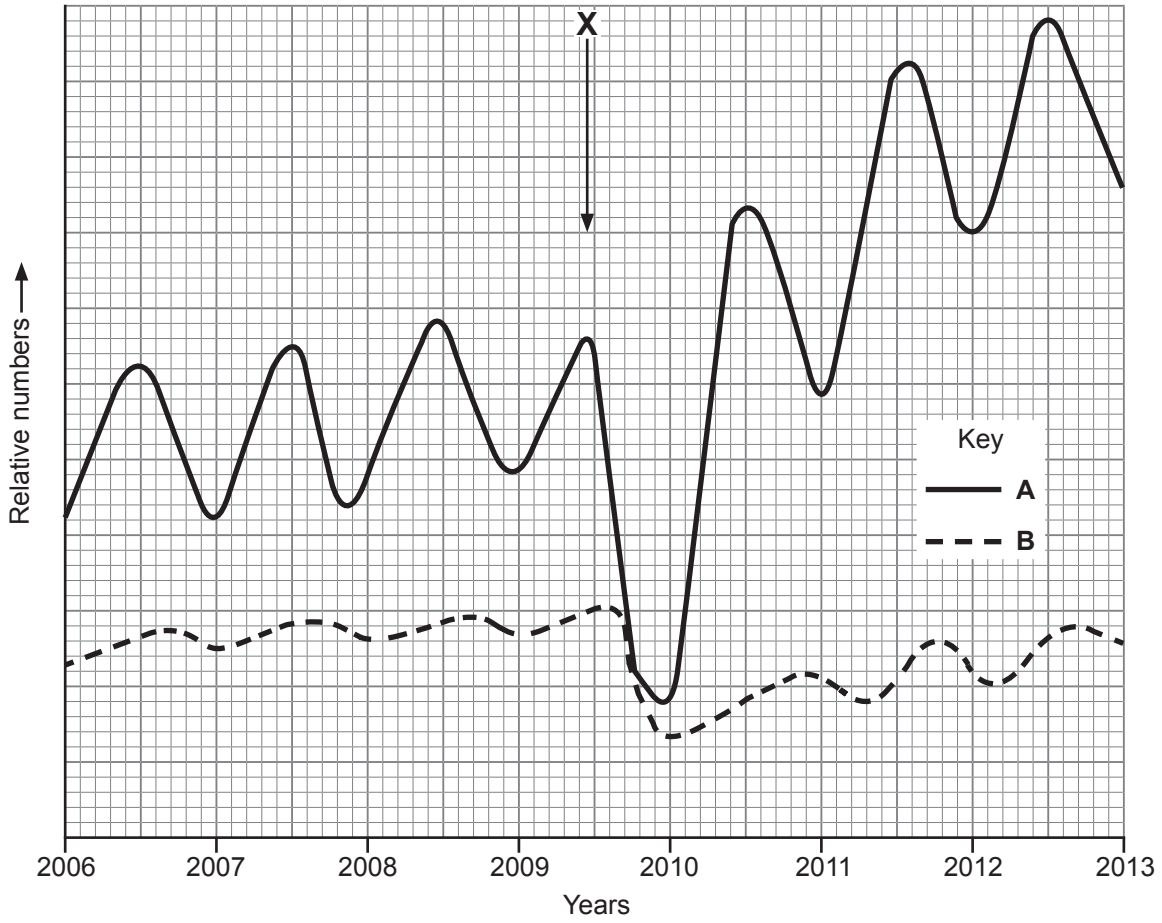
_____

_____

_____ [3]

Examiner Only	
Marks	Remark

8 **(a)** Relative changes over time in the numbers of a crop pest species **(A)** and its main predator species **(B)** in a field are shown in the graph below. Both species are very small insects. **X** shows the time at which a broad-spectrum insecticide (pesticide) was applied to the crop in this field.



(i) Give **one** piece of evidence from the graph that indicates that **A** is the pest (prey) and **B** is the predator.

_____

_____ [1]

Examiner Only	
Marks	Remark

(ii) Describe and explain the effect that the insecticide has on species **A**.

[4]

(b) Due to their small size, individual insects of species **A** usually only travel very short distances and spend most of their time on leaf surfaces, often with many insects feeding on the same leaf. The habitat of individual insects is usually restricted to a small number of adjacent crop plants.

Numbers of species **A** were estimated using a variation of the capture-recapture technique. Each month, 10 one metre square quadrats were placed randomly in the field and from each an initial (capture) sample was taken. Captured insects were marked and subsequently released back into the quadrat. Several days later, a second (recapture) sample was taken from within the same square metre.

(i) Suggest a suitable method for trapping the insects during the sampling process.

[1]

(ii) Using the information provided, suggest **one** reason why sampling was restricted to individual quadrats (rather than on a whole field basis).

[1]

Examiner Only	
Marks	Remark

(iii) During the sampling of one square metre at a particular time, the number of species **A** initially captured and marked was 242. When repeated several days later, 166 were captured, of which 84 had been marked.

Calculate the estimated population size of species **A** (in m^{-2}) in this quadrat at this particular time. (Show your working out.)

_____ m^{-2} [2]

(c) Using the information provided, draw and label a possible pyramid of numbers for the organisms described in parts **(a)** and **(b)**.

[2]

Examiner Only	
Marks	Remark

(d) Insects can also harm humans. African trypanosomiasis (sleeping sickness) is caused by a protoctistan parasite that is transmitted by female tsetse flies.

(i) Describe the characteristic features of protoctistans.

_____

_____

_____ [1]

For ecological and other reasons, governments discourage the sole use of pesticides and promote other strategies for reducing pest numbers. One such strategy is the use of sterile males. In many areas of Africa, sleeping sickness has been virtually eradicated due to the release into the wild of large numbers of male tsetse flies that have been sterilised by radiation.

(ii) Describe how the use of sterile male tsetse flies helps reduce the incidence of sleeping sickness.

_____

_____

_____

_____

_____

_____ [2]

(iii) Evaluation of the use of sterile male flies shows that it is more effective than using chemical pesticides in reducing the incidence of sleeping sickness.

Suggest **two** reasons why it is more effective than chemical pesticides.

1. _____

_____

2. _____

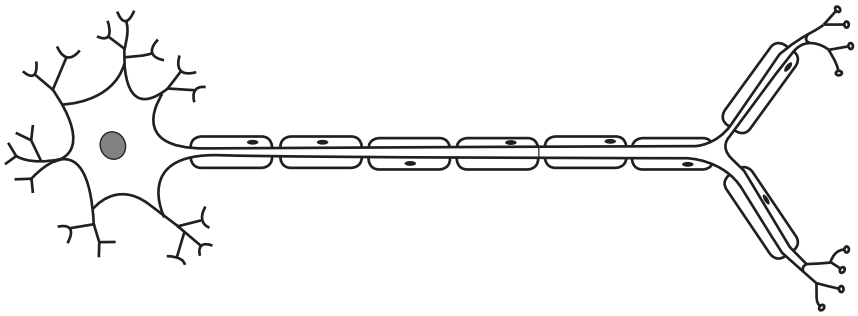
_____ [2]

Section B

Examiner Only	
Marks	Remark

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

9 Neurones are specialised cells, highly adapted for rapid nervous communication throughout the body. The diagram below represents a motor neurone.



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(a) Using the diagram and your knowledge, describe and explain how neurones are adapted for their function. Your answer should refer to how nerve impulses are initiated, propagated and passed on. [12]

(b) Nervous communication involves synaptic transmission. While they may limit the speed of nervous transmission, synapses have a necessary role in coordination and control. Outline why synapses are important. [4]

Quality of written communication [2]

(a) Using the diagram and your knowledge, describe and explain how neurones are adapted for their function. Your answer should refer to how nerve impulses are initiated, propagated and passed on.

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

(b) Nervous communication involves synaptic transmission. While they may limit the speed of nervous transmission, synapses have a necessary role in coordination and control. Outline why synapses are important.

Examiner Only	
Marks	Remark

Extra lined page

Examiner Only	
Marks	Remark

THIS IS THE END OF THE QUESTION PAPER

GCE Biology Advanced (A2)
Assessment Unit A2 1
Physiology and Ecosystems
2015

Photograph 1.4
(for use with Question 4)