Rewarding Learning

ADVANCED
General Certificate of Education
2024

Centre Number

Candidate Number

Biology

Assessment Unit A2 1

assessing

Physiology, Coordination and Control, and Ecosystems

[ABY11]

ABY11

TUESDAY 4 JUNE, MORNING

TIME

2 hours 15 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
You must answer the questions in the spaces provided.
Do not write outside the boxed area on each page or on blank pages.
Complete in black ink only. **Do not write with a gel pen.**
Answer **all nine** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 100.
Section A carries 82 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.

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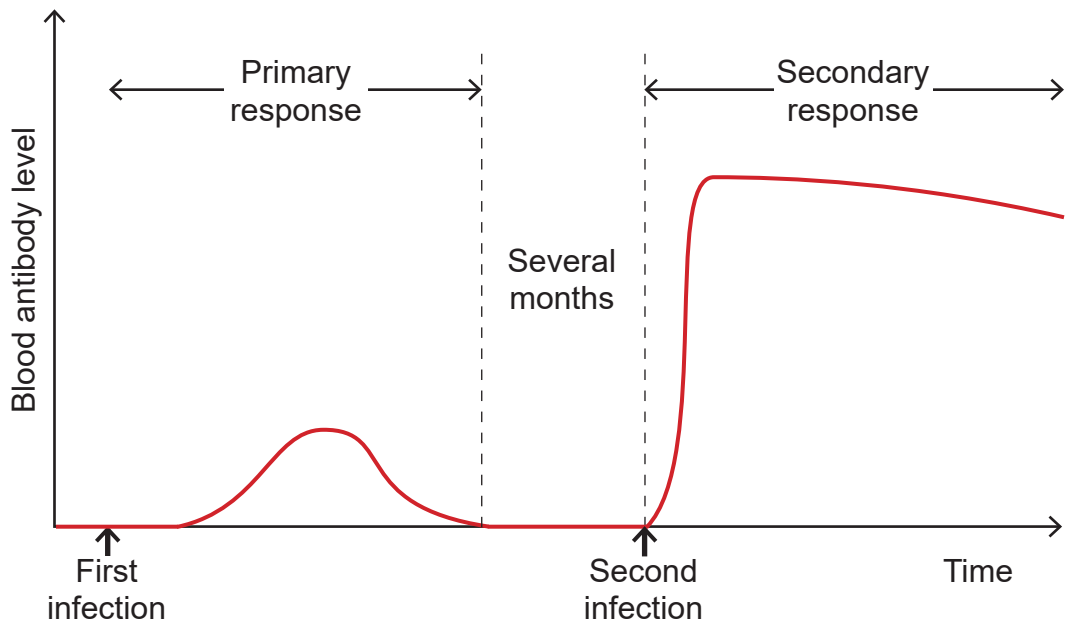
Section A

1 **(a)** The graph below shows the changes in blood antibody level in an individual over time. This individual was infected by the same type of bacterium on two separate occasions.



(i) Apart from a higher blood antibody level, describe **one** other way in which the secondary response differs from the primary response.

_____

_____ [1]

(ii) Complete the passage below describing antibody production.

There is a delay following initial infection as _____

cells need to be activated. Activation of these cells results in the production

of _____ cells which produce antibodies. [2]

(b) The formation of antigen-antibody complexes can cause bacterial cells to form clumps (agglutination).

Describe how phagocytosis leads to the destruction of these clumps of bacteria.

_____

_____

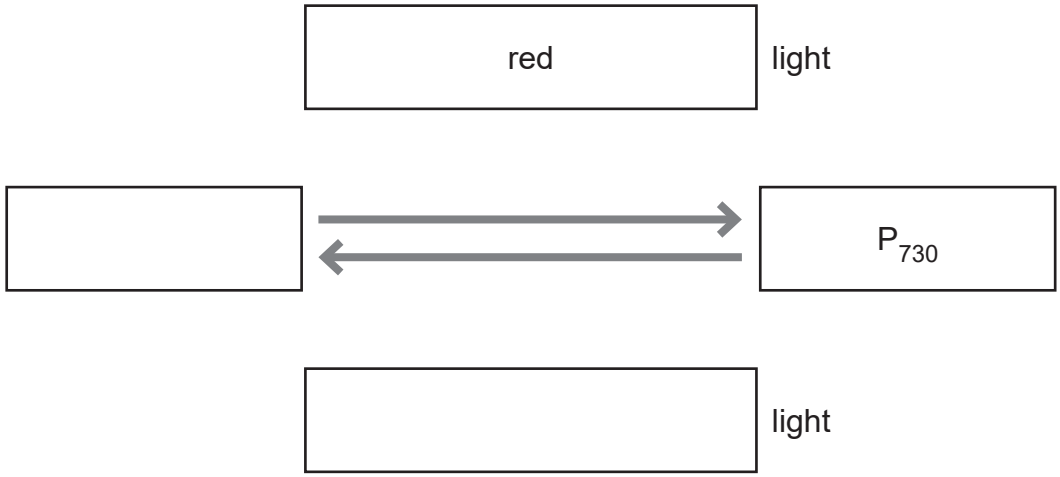
_____

_____

_____ [2]

2 **(a)** Phytochrome is a pigment involved in the control of flowering in many plants.

(i) Complete the diagram below using the most appropriate words or terms.



[2]

(ii) Define the term 'short-day plant'.

_____

_____

_____ [1]

The phytochrome system uses daylength to control flowering.

(iii) In terms of phytochrome, explain what initiates flowering in short-day plants.

_____

_____

_____ [1]

(iv) Some plant species growing in environments such as a woodland floor flower in response to changes in temperature, rather than daylength.

Suggest **one** reason for this.

_____

_____

_____ [1]

(b) Some plant growth substances are involved in promoting stem growth.

(i) Describe the role of auxin in promoting stem growth.

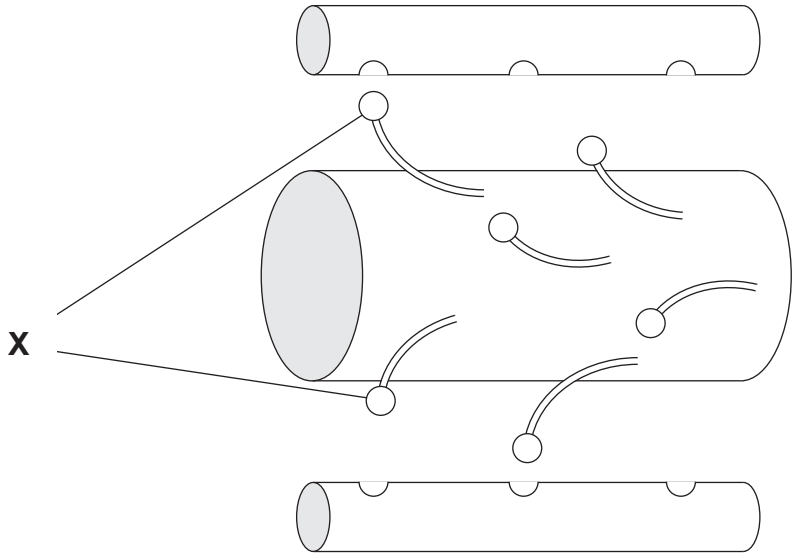
_____

_____ [1]

(ii) Name the plant growth substance responsible for promoting elongation of internodal regions.

_____ [1]

3 **(a)** The muscle proteins myosin and actin are represented in the diagram below.



(i) Explain the role of the structures labelled **X** in muscle contraction.

_____

_____

_____

_____

_____

_____ [2]

(ii) State precisely the role of ATP in muscle contraction.

_____

_____ [1]

(iii) Using the diagram, suggest why muscle tissue has more molecules of actin than myosin.

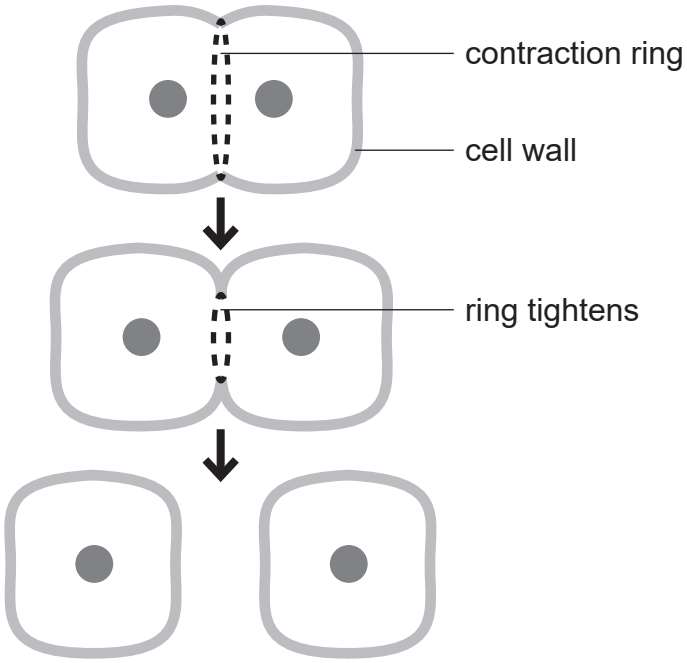
_____

_____

_____ [1]

(b) Myosin and actin also occur in plant cells, where they have a role in cytokinesis (cell division). They form a 'contraction ring' which surrounds the developing cell plate.

As cytokinesis proceeds, the myosin and actin filaments interact in a way which is similar to their interaction in muscle contraction.



(i) Using the information provided and your understanding, suggest and explain how myosin and actin aid cytokinesis.

_____

_____

_____

_____

_____

_____

_____

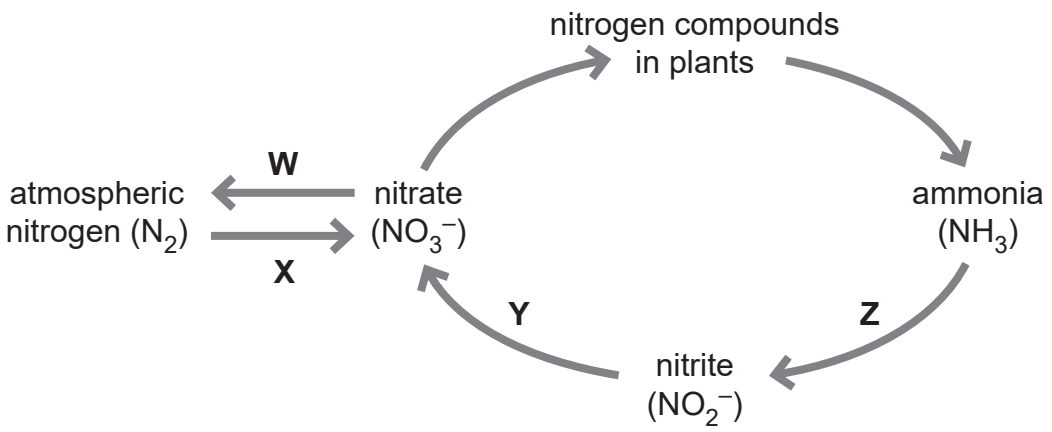
_____ [3]

(ii) Following cytokinesis, the myosin and actin are broken down.

Name the breakdown products formed.

_____ [1]

4 **(a)** The diagram below represents a simplified version of the nitrogen cycle.



(i) State the letter(s) of the stage(s) which represent(s) nitrification.

_____ [1]

(ii) State the evidence from the diagram which indicates that nitrification is an oxygen-requiring process.

_____

_____ [1]

(iii) State the letter(s) of the stage(s) which represent(s) nitrogen fixation.

_____ [1]

(iv) State the letter(s) of the stage(s) which is/are promoted by anaerobic conditions.

_____ [1]

(b) Energy losses in food chains occur in many ways, including egestion and respiration.

(i) Primary consumers (herbivores) typically have relatively high losses of energy through egestion.

State the reason for this.

_____

_____

_____ [1]

(ii) Secondary consumers (carnivores) typically have relatively higher respiratory losses than primary consumers.

Suggest **one** reason for this.

_____

_____

_____ [1]

(c) Succession is a change in species composition in a habitat over time. In cow dung (faeces), the fungal species found change as the dung ages. This is an example of succession.

While the faeces are still in the cow's body, spores from a range of fungal species are present. Once the dung is released, relatively simple fungi are active initially in decomposing the dung. At this stage, the dung is dense and compact, and contains a wide range of organic compounds.

Over subsequent weeks, the dung becomes more fragmented and less dense, and organic content is reduced. At this stage, more complex fungi are active in decomposition as shown in the photograph below.

Source: Chief Examiner

(i) Using the information provided, suggest what causes succession of fungal species to take place in cow dung.

_____

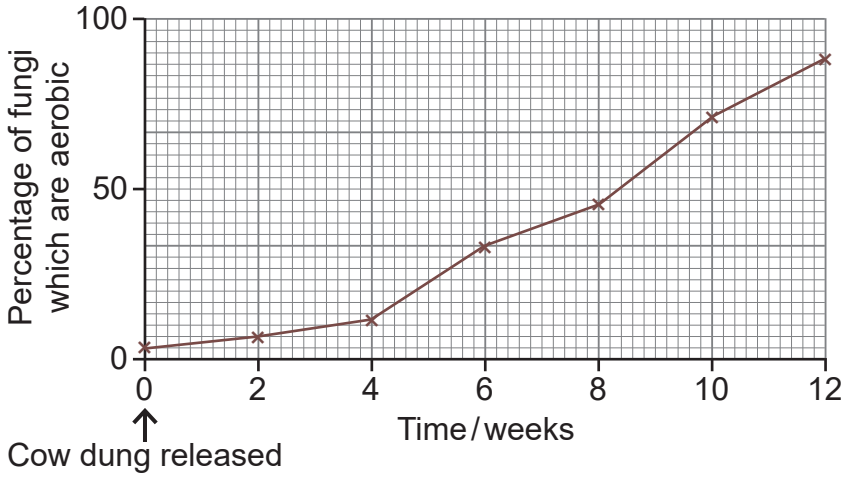
_____

_____

_____

_____ [2]

Investigations have shown that the percentage of fungal species in the dung which are aerobic changes over time, as shown in the graph below.



(ii) Using the information provided, suggest an explanation for the trend shown.

_____

_____

_____

_____

_____

_____ [2]

(iii) Succession in cow dung is very different to succession in a woodland.

Suggest **two** ways in which fungal succession in cow dung is different to a woodland succession.

1. _____

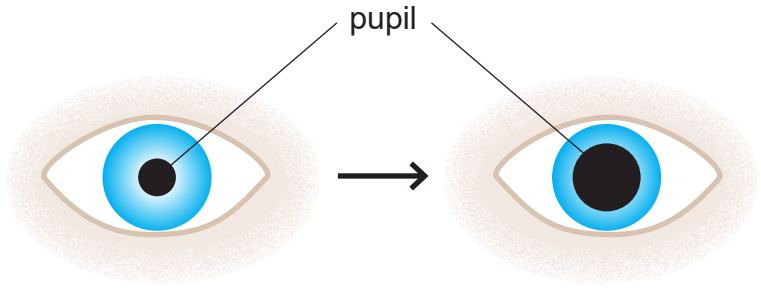
_____

2. _____

_____ [2]

[Turn over

5 **(a)** The diagram below represents a reflex action important in the functioning of the mammalian eye.



(i) Suggest the change in the environment (stimulus) which would have brought about this response.

_____ [1]

(ii) In terms of structures within the eye, describe the response shown and explain how it is brought about.

_____

_____

_____

_____

_____ [2]

(iii) Explain the advantage of this response.

_____

_____

_____ [1]

(b) Eagles have a much higher level of visual acuity than humans. This is partly because eagles have a larger fovea and cones are more tightly packed within it. In the eagle fovea, cones are 2 μm apart, whereas in the human fovea, cones are 3 μm apart.

The arrangement of cones and their associated neurones is the same in eagles and humans.

(i) Using the information provided, calculate how many more cones there are along one mm of an eagle fovea compared to a human fovea.

(Show your working.)

_____ [2]

(ii) Using the information above and your knowledge, suggest how this contributes to eagles having higher visual acuity than humans.

_____

_____

_____

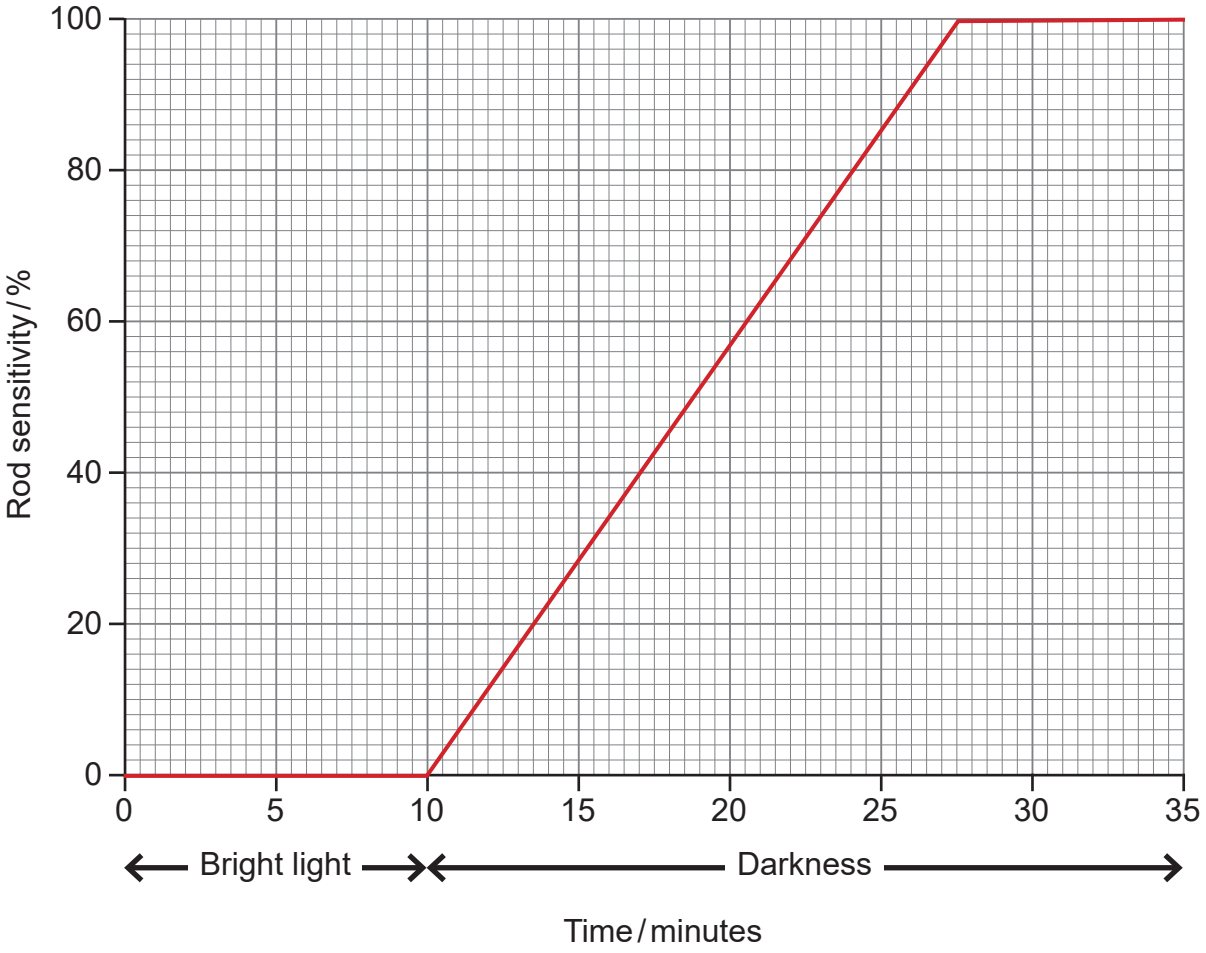
_____

_____

_____ [2]

(c) In an investigation of dark adaptation in rods, an individual spent time in very bright light followed by time in darkness. Rod sensitivity, as a percentage of maximum visual sensitivity, was measured throughout the investigation.

The results are shown in the graph below.



(i) Determine the time taken for the rods to gain maximum visual sensitivity once in darkness.

_____ minutes [1]

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(ii) Explain the results for rod sensitivity during the whole investigation.

_____

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_____

_____

_____

_____

_____

_____

_____ [3]

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6 **(a)** The partially completed table below shows the outcomes of transfusions between people with different ABO blood groups.

Blood group of recipient	Blood group of donor			
	A	**B**	**AB**	**O**
A	✔			✔
B	✘			✔
AB	✔			✔
O	✘			✔

Key: ✔ = no reaction ✘ = agglutination

(i) Complete the table above, using ✔ or ✘. [2]

(ii) Explain precisely why an individual with blood group **B** should **not** receive a transfusion of group **A** blood.

_____

_____

_____ [1]

(iii) Using the information in the table, describe and explain why people with blood group **O** are described as 'universal donors'.

_____

_____

_____

_____

_____ [2]

[Turn over

(b) Some individuals have the Rhesus antigen on the surface of their red blood cells. They are described as being Rhesus positive (Rh^+) and those without are Rhesus negative (Rh^-). Rh^+ (anti-D) antibodies are not normally found in most individuals.

Rhesus incompatibility can cause adverse immune responses.
The incompatibility can arise between mother and foetus during pregnancy.

(i) In terms of anti-D antibodies, describe and explain the immune response arising from a mother who is Rh^- having a **first** pregnancy where the foetus is Rh^+.

_____

_____

_____

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_____ [3]

(ii) Describe and explain why the risk of harm to the foetus is much greater in a **second** pregnancy with a Rh^+ foetus.

_____

_____

_____

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_____

_____

_____ [3]

[Turn over

7 **(a)** Ermine moths are regarded as a pest species because of their impact on hawthorn plants in hedgerows. The moths develop from eggs into larvae (caterpillars) and later into adult moths.

The moth larvae feed extensively on hawthorn leaves during May and June. The adults lay their eggs in July and August on undamaged sections of the hawthorn hedge.

Some years, there are so many larvae feeding on hawthorn that most of the leaves can be destroyed in a section of hedge.

(i) Define the term 'pest species'.

_____

_____

_____ [1]

In an affected hawthorn hedge, large numbers of moth larvae are surrounded by a network of 'webbing' that the larvae produce.

The photograph below shows a short section of hawthorn hedge containing an infestation of ermine moth larvae.

Source: Chief Examiner

(ii) Suggest **one** function of the webbing that surrounds large numbers of moth larvae.

_____

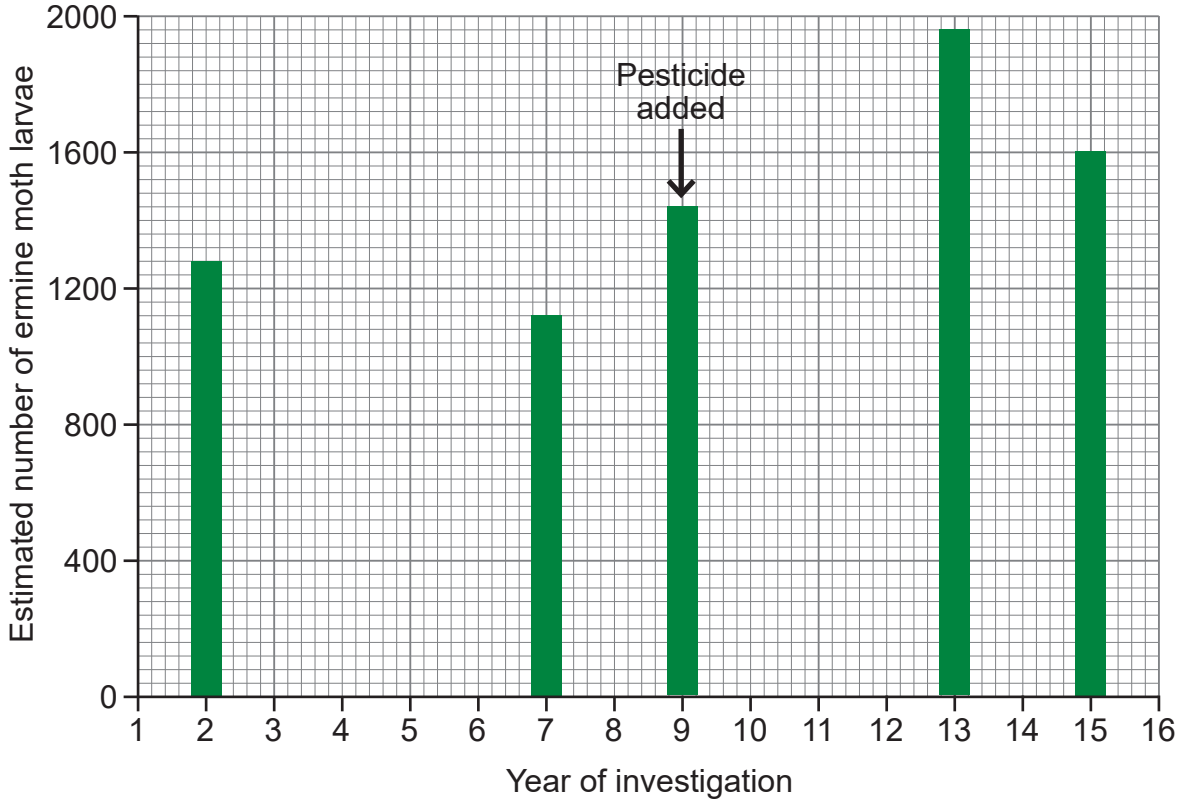
_____

_____ [1]

[Turn over

An investigation was carried out to monitor the numbers of ermine moth larvae in a short section of hawthorn hedge. This was done at the end of May every year over a 15-year period. In year nine, pesticide was applied to the hedge.

The graph below shows the results of the investigation.



(iii) Calculate the maximum range in estimated larval numbers over the 15-year period.

(Show your working.)

_____ [2]

(iv) Describe and suggest explanations for the results shown.

_____

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_____

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_____

_____ [4]

(v) Most hawthorn hedges recover fully from infestations such as that shown in the photograph on page 23.

Using all the information provided, suggest **two** reasons for this.

1. _____

_____

2. _____

_____ [2]

(b) Ermine moths feeding on hawthorn are an example of a +/– interaction. Cattle grazing in fields is another example of a +/– interaction.

The Common Nettle (*Urtica dioica*) is a plant which often occurs in hedgerows or field edges grazed by cattle. Nettles have small needle-shaped hairs called trichomes which can release chemicals that irritate skin.

The relative number of trichomes on nettle plants was investigated in several fields. Some fields had been grazed by cattle for several years, while others had only occasional or no grazing.

Level of grazing	**Relative number of trichomes**
none	low
continuous over many years	high
occasional	moderate
previously heavily grazed, but none for two years	moderate
none until three years ago – now heavily grazed	high

(i) Summarise the trend shown by these results.

_____

_____

_____ [1]

(ii) Suggest and explain the advantage to nettle plants of the trend identified.

_____

_____

_____

_____

_____

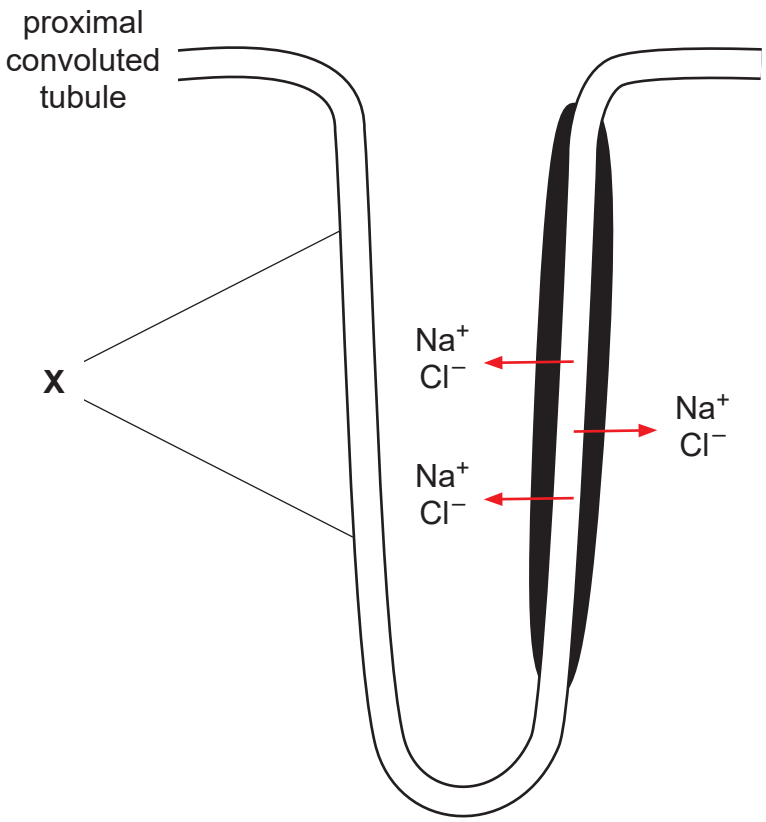
_____ [2]

8 Osmoregulation involves maintaining the solute potential of the blood close to its set point (normal value). Osmoregulation is possible because the process of reabsorption of water from the urinary filtrate into the blood can be controlled.

(a) Name the hormone responsible for controlling reabsorption of water in the kidney.

_____ [1]

(b) The diagram below represents the part of a nephron containing the loop of Henle.



(i) Name the part of the loop of Henle labelled **X**.

_____ [1]

(ii) Using the letter **Y**, label the part of the loop of Henle where the filtrate would be expected to be most concentrated. [1]

[Turn over

(iii) In terms of reabsorption of water, describe and explain the effect of sodium and chloride ions leaving the loop of Henle, as shown in the diagram.

_____

_____

_____

_____

_____

_____

_____

_____

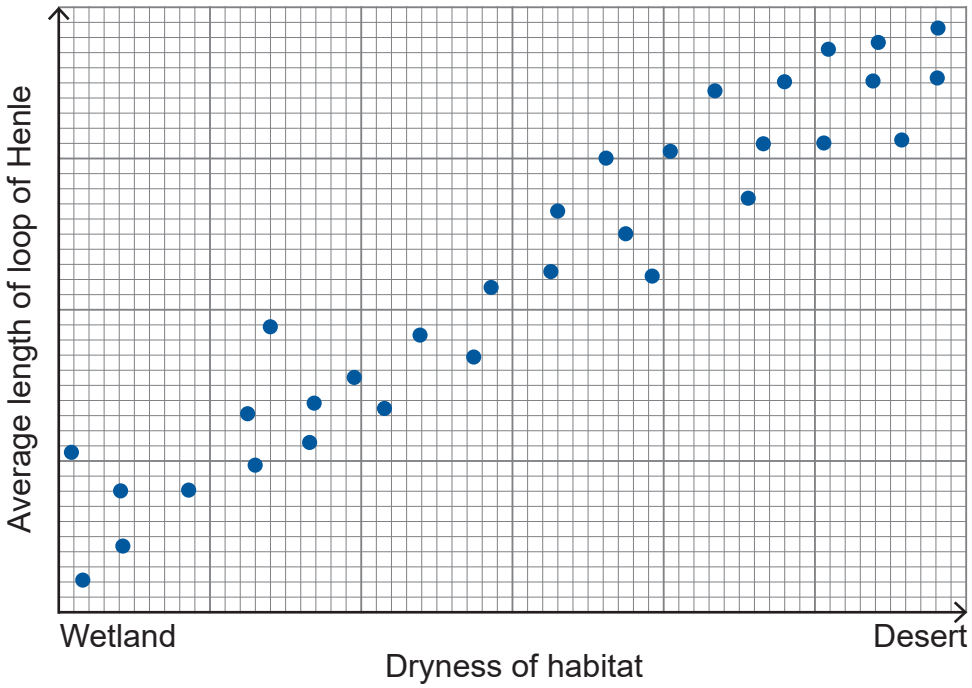
_____

_____

_____

_____ [4]

The graph below shows the relationship between the aridity (dryness) of a habitat and the average lengths of the loop of Henle in the kidneys of mammalian species found in those habitats.



(c) Describe and suggest an explanation for the results shown.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____ [4]

[Turn over

(d) Osmoregulation is a homeostatic mechanism which involves a corrective response and negative feedback.

In the context of osmoregulation, explain the difference between the 'corrective response' and 'negative feedback'.

_____

_____

_____

_____

_____

_____ [2]

(e) In addition to osmoregulation, excretion is an important function of the kidney.

Define the term 'excretion'.

_____

_____

_____ [1]

Section B

Quality of written communication will be assessed in this section.

9 Nervous communication in mammals involves the initiation and propagation of impulses along neurones and chemical transmission across synapses.

(a) Describe how impulses are initiated and propagated along neurones. Include a description of how neurones are adapted to maximise the speed of impulse conduction. [9]

(b) Describe the process of synaptic transmission. Include an explanation of the functions of synapses in nervous communication. [9]

(a) Describe how impulses are initiated and propagated along neurones. Include a description of how neurones are adapted to maximise the speed of impulse conduction.

[Turn over

(b) Describe the process of synaptic transmission. Include an explanation of the functions of synapses in nervous communication.

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THIS IS THE END OF THE QUESTION PAPER

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Question Number	Marks
1	
2	
3	
4	
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6	
7	
8	
9	
Total Marks	

Examiner Number

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