



Rewarding Learning

**ADVANCED**  
**General Certificate of Education**  
**2022 Reserve Series**

Centre Number

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Candidate Number

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# Biology

Assessment Unit A2 1

*assessing*

Physiology, Coordination and  
Control, and Ecosystems



**[ABY11]**

\*ABY11\*

**TUESDAY 21 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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\*40ABY1102\*



## Section A

1 The following statements refer to neurones and nerve impulses.

Identify the term which best matches each statement.

- The fine extensions at one end of a neurone where an impulse first develops.

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- The law which states that increasing the strength of a stimulus will not result in a stronger impulse, once the threshold is reached.

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- The period following an action potential when further stimulus will not result in another action potential.

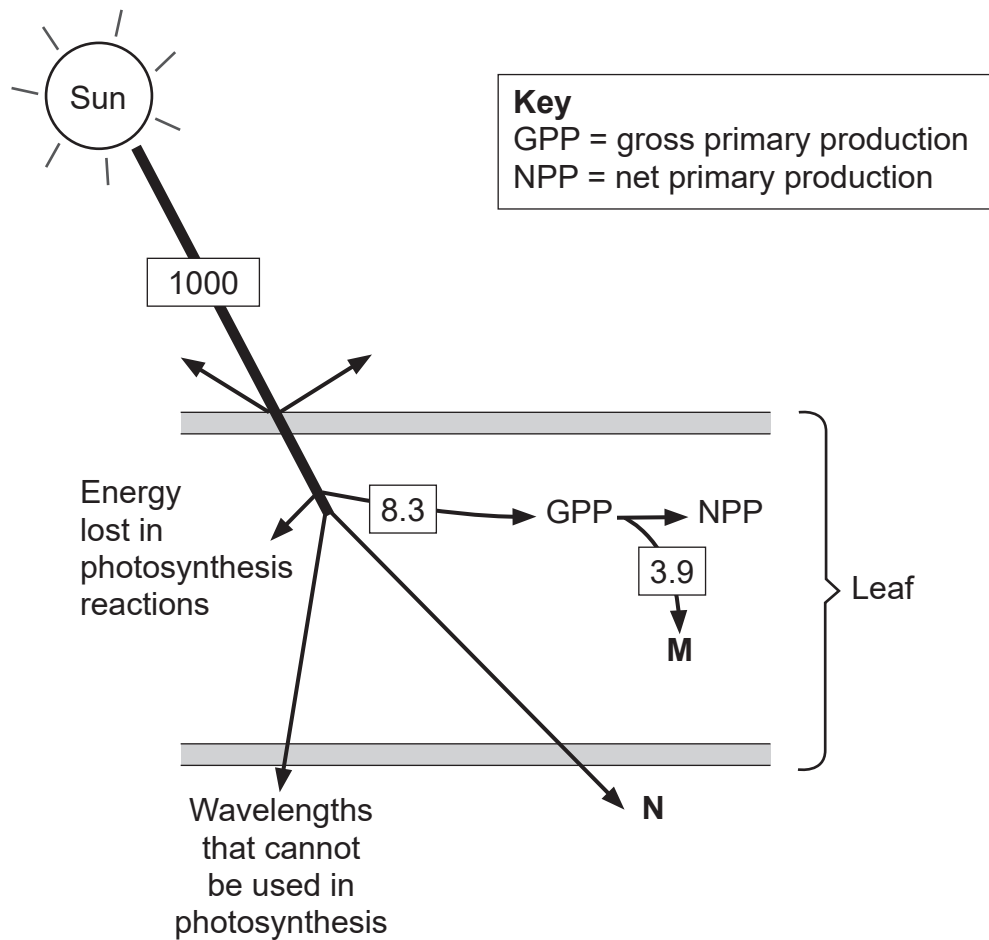
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[3]

[Turn over



- 2 (a) The diagram below outlines the fate of light energy falling on a plant leaf. (Numerical values are given in arbitrary units.)



- (i) Name the process represented by arrow **M**.

\_\_\_\_\_

[1]

- (ii) Explain the energy loss represented by arrow **N**.

\_\_\_\_\_

\_\_\_\_\_

[1]



(iii) Calculate the percentage of energy reaching the leaf surface which is available for growth.

(Show your working.)

\_\_\_\_\_ [2]

(b) State **two** possible reasons why only some of the energy in leaves is passed on to primary consumers.

1. \_\_\_\_\_

\_\_\_\_\_

2. \_\_\_\_\_

\_\_\_\_\_ [2]

(c) A simple food chain is shown below.

Oak tree → Aphids → Ladybirds

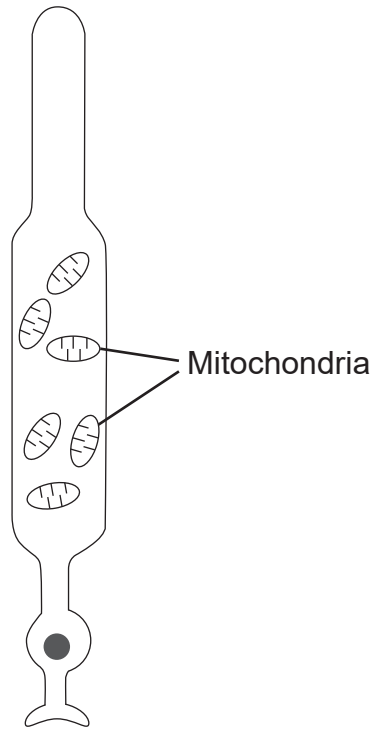
Draw and label a pyramid of **energy** to represent this food chain.

[2]

[Turn over



3 (a) The diagram below represents a rod cell found in the retina.



(i) Use the letter **X** to show the position on the diagram of the membranes containing photoreceptor molecules. [1]

(ii) State the precise role of the ATP produced by the mitochondria in rod cells.  
\_\_\_\_\_  
\_\_\_\_\_ [1]





- (c) (i) When individuals move from a bright area to a dim area, their pupils increase in size. Describe how this change is brought about and explain its advantage.

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[2]

- (ii) When individuals move from a bright area into near darkness, they notice that, over a period of time, their vision gradually improves. However, it does not reach the level of visual acuity experienced in bright light.

State the name of this phenomenon and explain the changes to vision involved.

Name \_\_\_\_\_

Explanation \_\_\_\_\_

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[4]



- 4 (a) The two primary functions of the mammalian kidney are excretion and osmoregulation.

Explain the term 'osmoregulation'.

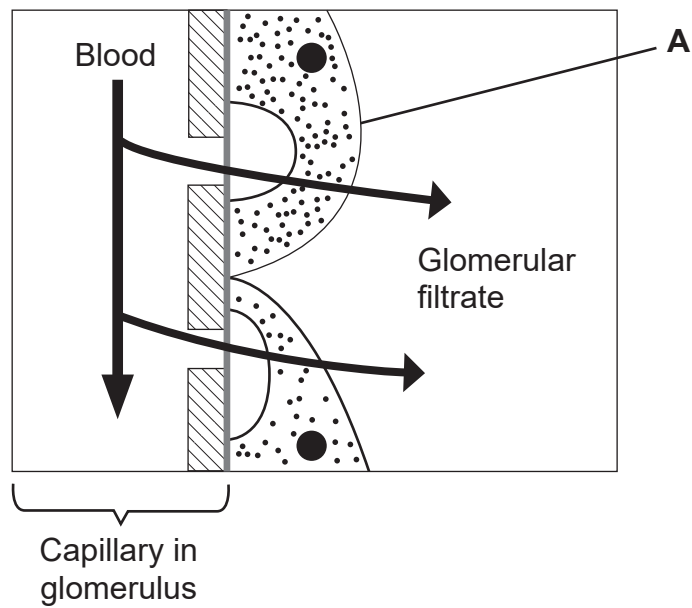
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[1]

- (b) The site of ultrafiltration in the kidney is represented in the diagram below.



- (i) Name the type of cell labelled A.

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[1]

[Turn over



(ii) Using the diagram and your knowledge, state **two** features of the kidney circulatory system which bring about the process of ultrafiltration.

1. \_\_\_\_\_

2. \_\_\_\_\_

\_\_\_\_\_ [2]

(c) The filtrate/plasma (**F/P**) ratio of a substance is the concentration of that substance in the glomerular filtrate (in the Bowman's capsule) divided by the concentration of that substance in the blood plasma immediately prior to filtration.

**F/P** ratios for some substances are shown in the table below.

Substance	F/P ratio
large proteins	0
small proteins	0.002
amino acids	1
glucose	1
urea	1





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5 (a) In terms of populations, define the term 'carrying capacity'.

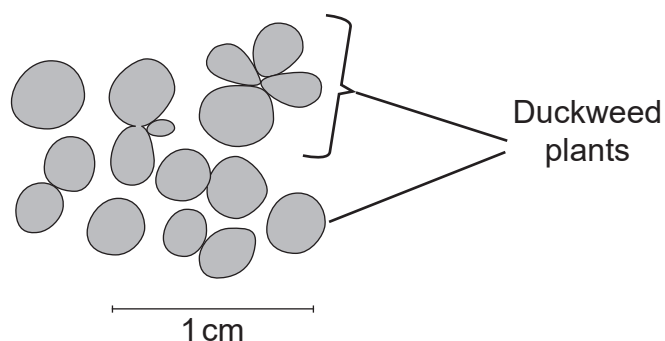
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[1]

The common duckweed (*Lemna minor*) is a small, free-floating plant, commonly occurring in ponds. Each duckweed plant has between one and four leaves and new plants are formed when a plant splits into two as new leaves grow. The drawing below represents a surface view of duckweed plants.



(b) State **one** hydrophytic adaptation likely to be found in duckweed.

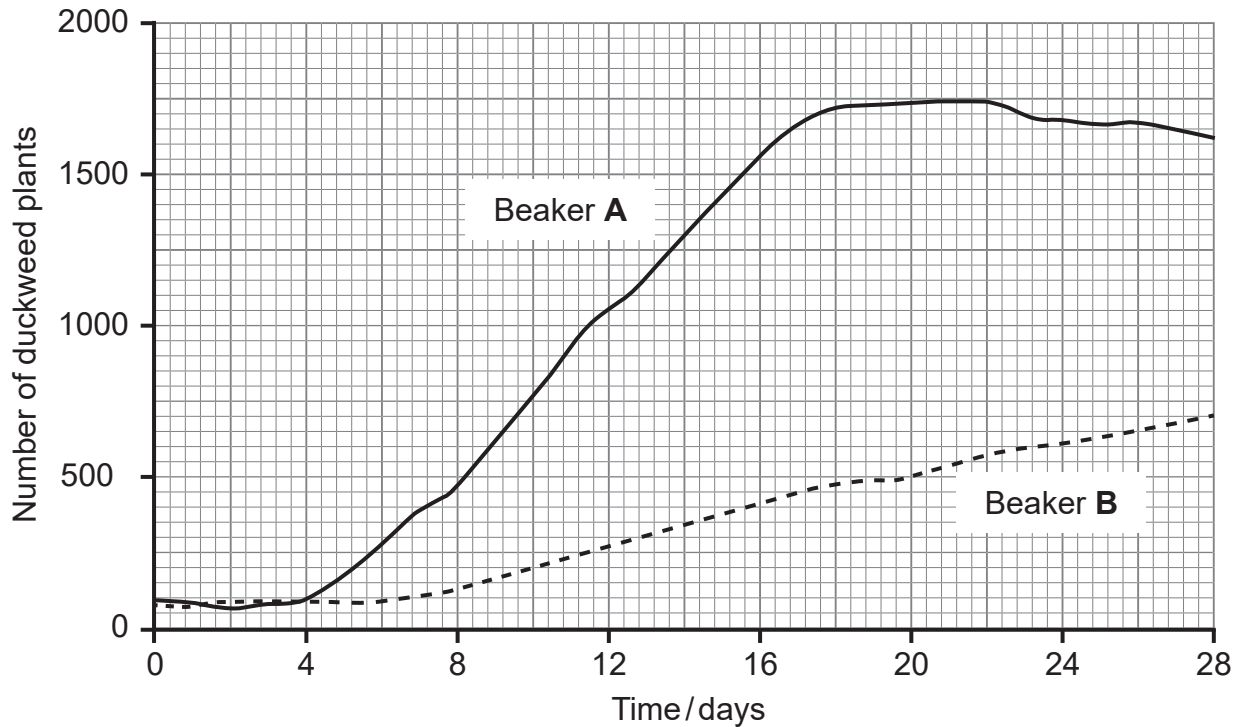
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[1]



- (c) In ideal conditions, duckweed plants multiply rapidly and can cover much of the pond in a short time.

A study was carried out to investigate population growth of duckweed in two large beakers (**A** and **B**) in a laboratory. Beaker **A** was kept at a higher light intensity than beaker **B**, but all other conditions were the same for both beakers. The results are shown in the graph below.



- (i) Suggest **one** reason why there is no increase in duckweed numbers for the first four days.

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[1]



(ii) Using the information provided, explain the more rapid growth rate in Beaker **A** between day 4 and day 16.

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[2]

(iii) Suggest **two** reasons why the number of duckweed plants levelled off in Beaker **A** between day 18 and day 22.

1. \_\_\_\_\_

2. \_\_\_\_\_ [2]

(d) In a separate investigation, the growth of duckweed in a large pond and in laboratory conditions was compared. The maximum rate of growth, measured as the shortest time for the population to double, is shown in the table below.

Environment	Shortest doubling time/hours
Laboratory	75
Pond	144

Suggest **two** reasons for the difference in the maximum rate of growth in the two environments.

1. \_\_\_\_\_

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2. \_\_\_\_\_

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[2]

[Turn over



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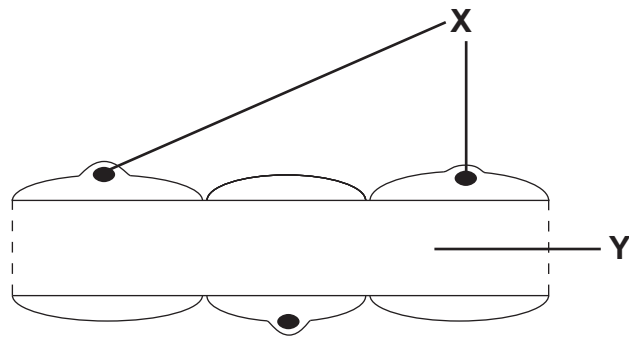
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\*40ABY1116\*



6 (a) The diagram below represents a short section of a neurone.



(i) Identify precisely the structures **X** and **Y**.

**X** \_\_\_\_\_

**Y** \_\_\_\_\_ [2]

(ii) Name the type of conduction which occurs in this neurone and describe the passage of a nerve impulse along the section shown.

Type of conduction \_\_\_\_\_

Description \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

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\_\_\_\_\_ [3]

(iii) State the main advantage of this type of conduction.

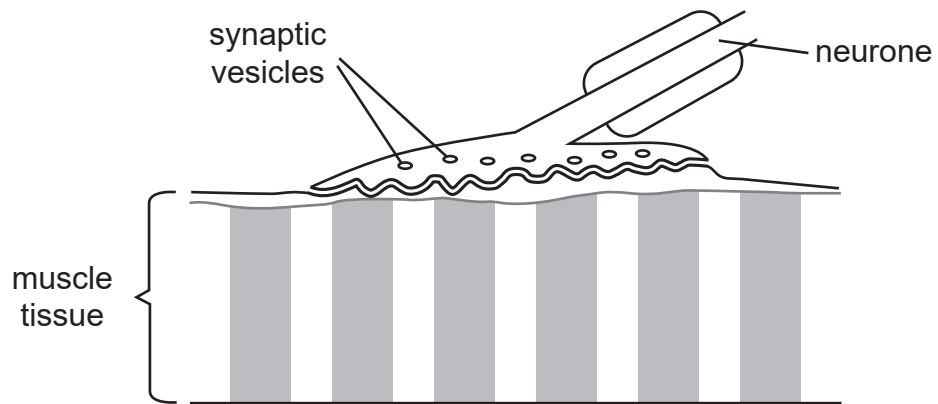
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\_\_\_\_\_ [1]

[Turn over



- (b) Many neurones synapse with muscle tissue rather than with other neurones. These synapses are specialised and are referred to as neuromuscular junctions. A neuromuscular junction is represented in the diagram below.



- (i) Describe the role of synaptic vesicles in enabling stimulation to pass from the neurone to the muscle tissue.

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[3]



(ii) The diagram shows that both the pre-synaptic and post-synaptic membranes are folded. Suggest the reason for this and explain the importance of this adaptation for muscle contraction.

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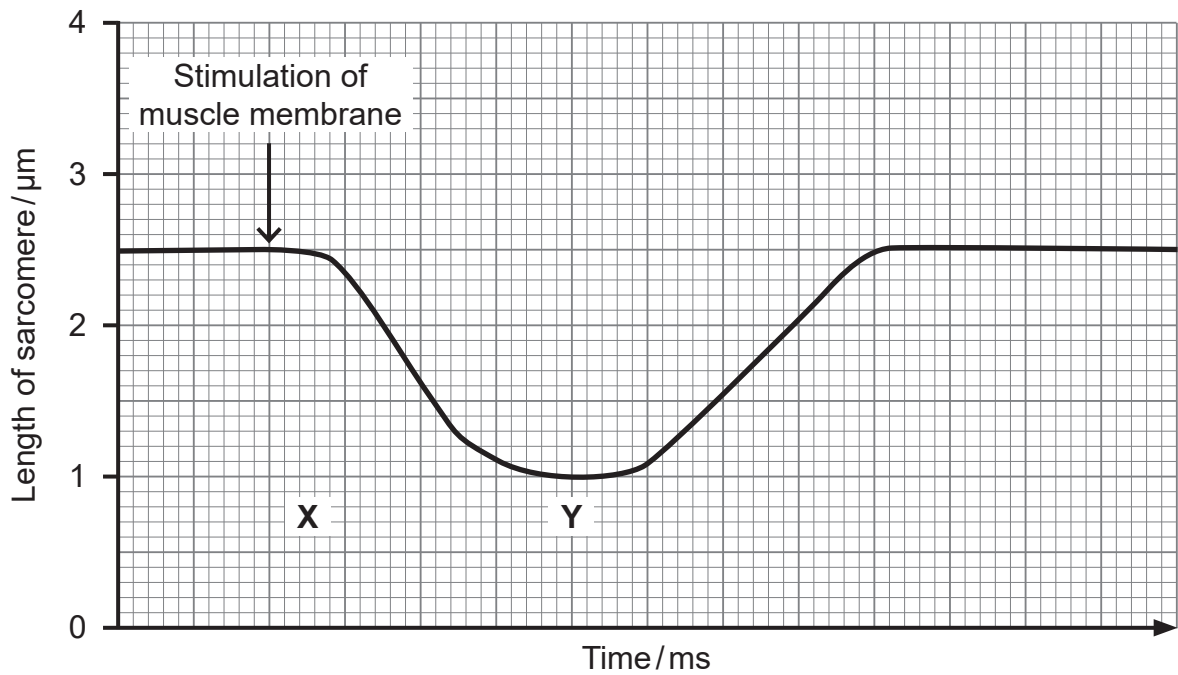
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[2]

[Turn over



(c) The change in length of a sarcomere following nervous stimulation is shown in the graph below.



(i) Suggest a reason for the short delay between the stimulation of the muscle membrane and the sarcomere starting to change in length.

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[1]





7 Carbon and nitrogen are elements which are cycled within ecosystems.

(a) Photosynthesis, respiration and decomposition are processes important in the recycling of carbon.

(i) Name the biological process which removes carbon from the atmosphere.

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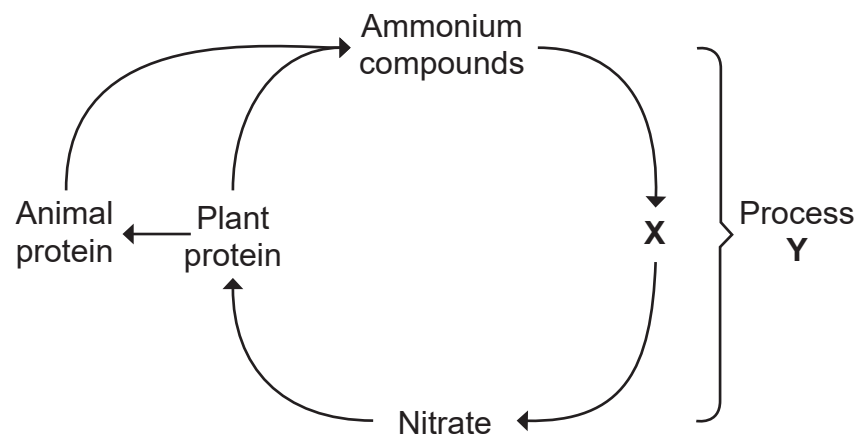
[1]

(ii) Carbon-rich organic compounds in dead organisms are broken down by the process of decomposition. Describe fully how the process of decomposition contributes to the recycling of carbon.

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\_\_\_\_\_  
\_\_\_\_\_  
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[2]

(b) The diagram below represents a simplified nitrogen cycle.



(i) Identify compound **X**.

\_\_\_\_\_

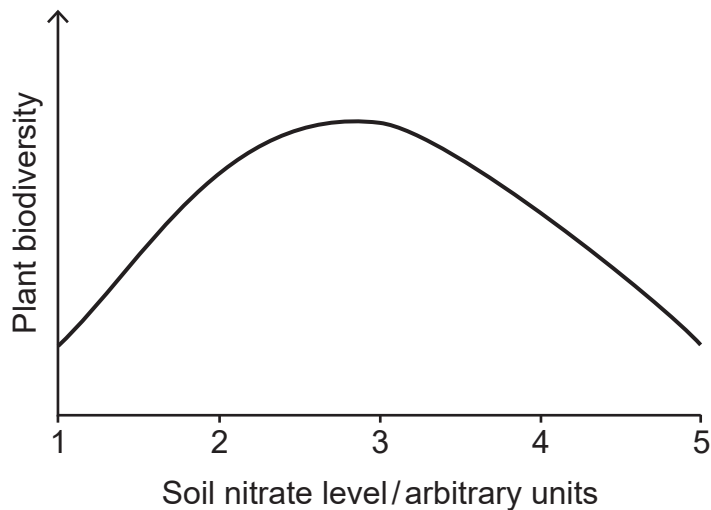
[1]



(ii) Name precisely the group of organisms responsible for carrying out process Y.

\_\_\_\_\_ [1]

(c) The distribution of many plant species is dependent on soil nitrate level. The generalised relationship between plant biodiversity and soil nitrate level is shown in the graph below.



(i) State the soil nitrate level number (1–5), in areas where plants which fix nitrogen typically occur.

\_\_\_\_\_ [1]

[Turn over





8 (a) Auxins, gibberellins and cytokinins are plant growth substances (hormones).

(i) State the precise role of auxin in plant growth.

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[1]

(ii) Auxin is shown to be most effective in promoting plant growth if the concentration of cytokinin is also at optimum concentration. Suggest an explanation for this.

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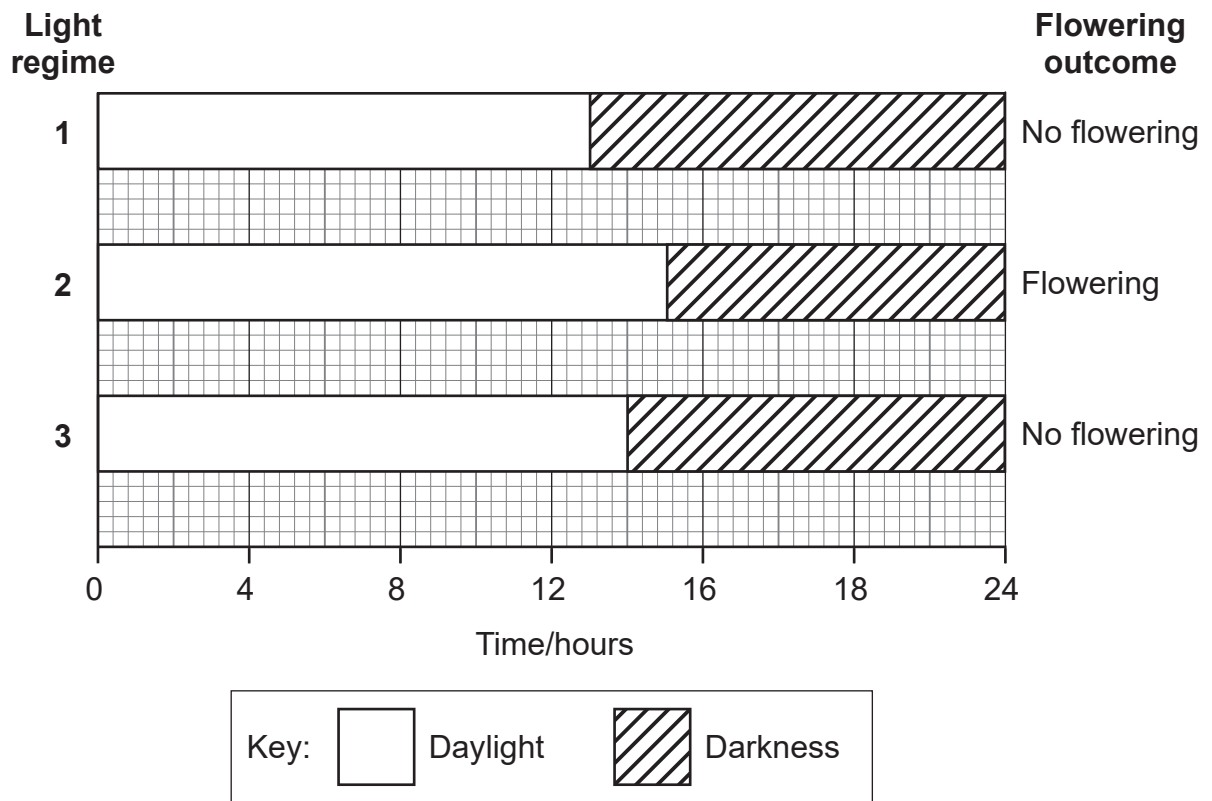
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[2]

[Turn over



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



(i) Using the information provided, determine the minimum daylight length required to bring about flowering in this species.

\_\_\_\_\_ [1]



(ii) In terms of phytochrome conversions, explain the result for light regime 2.

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[2]

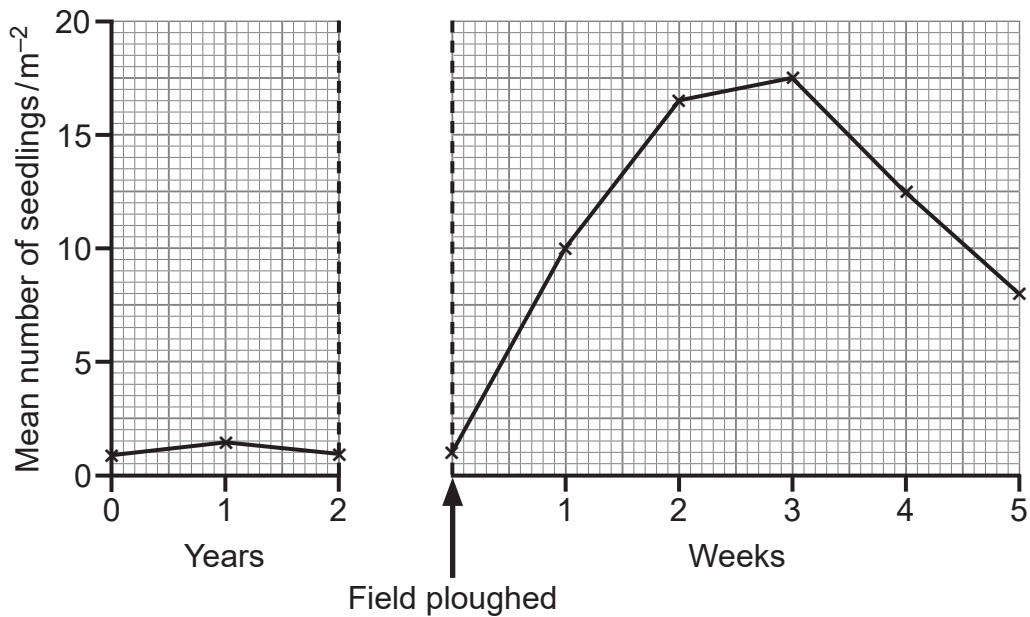
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- (c) The first stage of growth of a seed (germination) also involves phytochrome in some species. Many weed species have phytochrome on the seed surface and germination will only begin if the  $P_{730}$  form reaches a high enough concentration.

The seeds of many common weeds are tiny. These seeds will only produce healthy seedlings if they germinate close to the soil surface; they do not have the food stores to grow from deeper in the soil.

A field, which had been grassland for many years, was ploughed in preparation for planting crops. The graph below shows how the mean number of seedlings of a particular weed species changed over time in this field.



- (i) Describe the results shown.

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[2]



(ii) Calculate the percentage change in seedling number between week 1 and week 2 after ploughing.

(Show your working.)

\_\_\_\_\_ % [2]

(iii) Explain the results for seedling numbers in the first two weeks after ploughing.

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(iv) Explain the advantage to these seedlings of having the start of germination controlled by phytochrome.

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[Turn over



(d) Give **two** pieces of evidence which suggest that this weed species is r-selected.

1. \_\_\_\_\_

\_\_\_\_\_

2. \_\_\_\_\_

\_\_\_\_\_ [2]



## Section B

*Quality of written communication will be assessed in this section.*

- 9** Antibodies are globular proteins which are essential in protecting the body from infection and disease.
- (a)** Describe the role of antibodies in protection against disease. Your answer should include both active and passive immunity and describe the role of T-lymphocytes in regulating antibody activity, as well as the role of B-lymphocytes. [12]
- (b)** Treatment for extensive burns often involves skin transplants (grafts). Early work on skin transplants led to the following conclusions:
- an initial skin graft from a donor will be rejected over time and, if a second graft from the same donor is added later, it will be rejected more quickly (than the initial graft);
  - if the skin for the second graft is obtained from a different donor, i.e. not the donor of the first graft, it will be rejected more slowly.

Suggest explanations for these conclusions and outline how the rejection of transplants can now be avoided. [6]

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[Turn over







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Question Number	Marks
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<b>Total Marks</b>	
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Examiner Number

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