



Centre Number

71

Candidate Number

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ADVANCED
General Certificate of Education
2014

Biology

Assessment Unit A2 1
assessing
Physiology and Ecosystems
[AB211]

MV18

WEDNESDAY 21 MAY, MORNING

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 **Photographs 1.4A** and **1.4B** 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 at the end of each question 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. This may be longer if you have an additional time allowance.

You are expected to answer Section B in continuous prose.

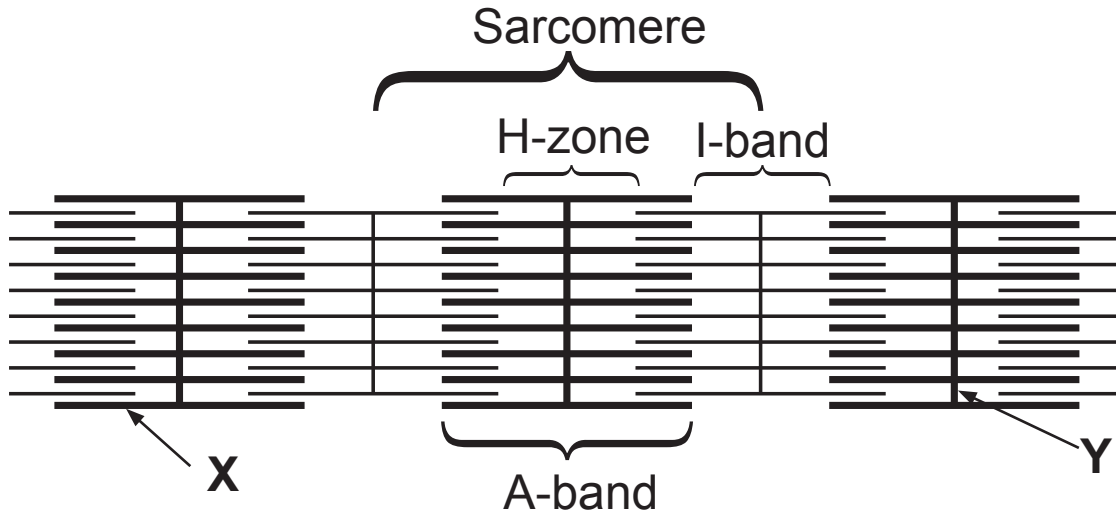
Quality of written communication will be assessed in Section B, and awarded a maximum of 2 marks.

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(Questions start overleaf)

Section A

- 1 The diagram below represents a section through a myofibril in a skeletal muscle.



- (a) Identify the structures labelled X and Y. [2 marks]

X _____
Y _____

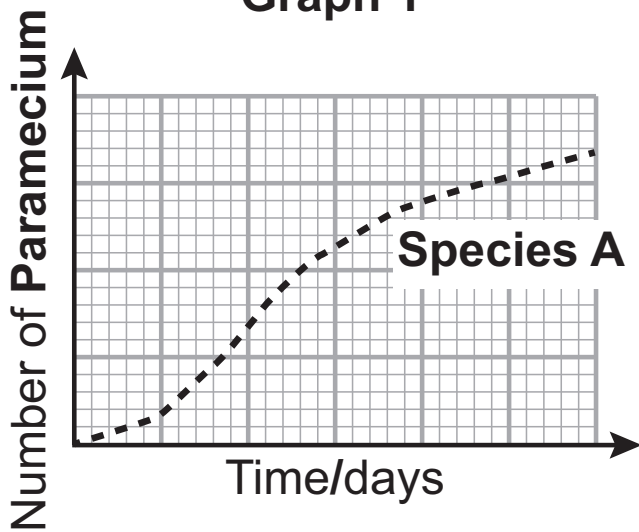
(b) The diagram on page 4 shows the myofibril in its relaxed state. Complete the table below by adding a tick (✓) in the appropriate box to describe what happens to each feature when the muscle contracts. [2 marks]

| Feature | Increases in length | Decreases in length | No change in length |
|-----------------|----------------------------|----------------------------|----------------------------|
| A-band | | | |
| I-band | | | |
| H-zone (H-band) | | | |
| Sarcomere | | | |

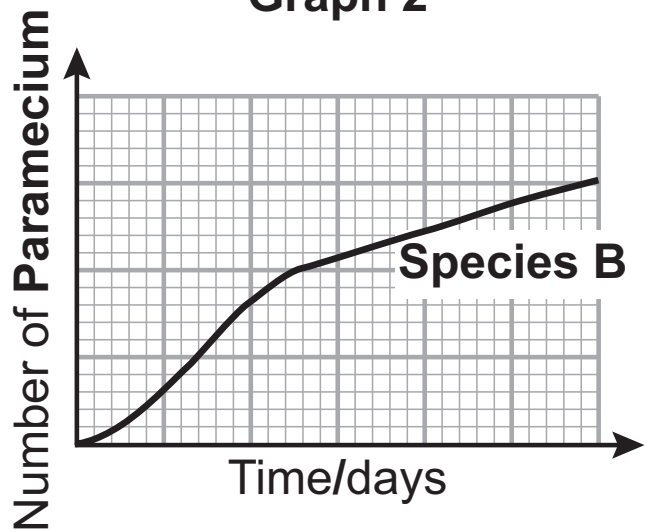
2 (a) In relation to the study of population growth, explain what is meant by the term 'biotic potential'. [1 mark]

(b) **Paramecium** are mobile protists. The graphs below show the population growth curves of two species (A and B) of **Paramecium** when cultured in separate beakers (**Graphs 1 and 2**) and when cultured together in the same beaker (**Graph 3**). Each beaker contained a rich supply of bacteria, the preferred food source of both species.

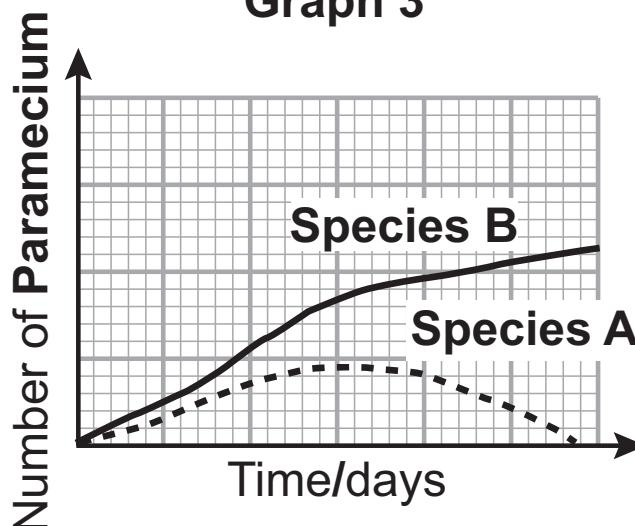
Graph 1



Graph 2



Graph 3



(i) Describe and give a possible explanation for the population growth curves of the two species when cultured together (**Graph 3**). [3 marks]

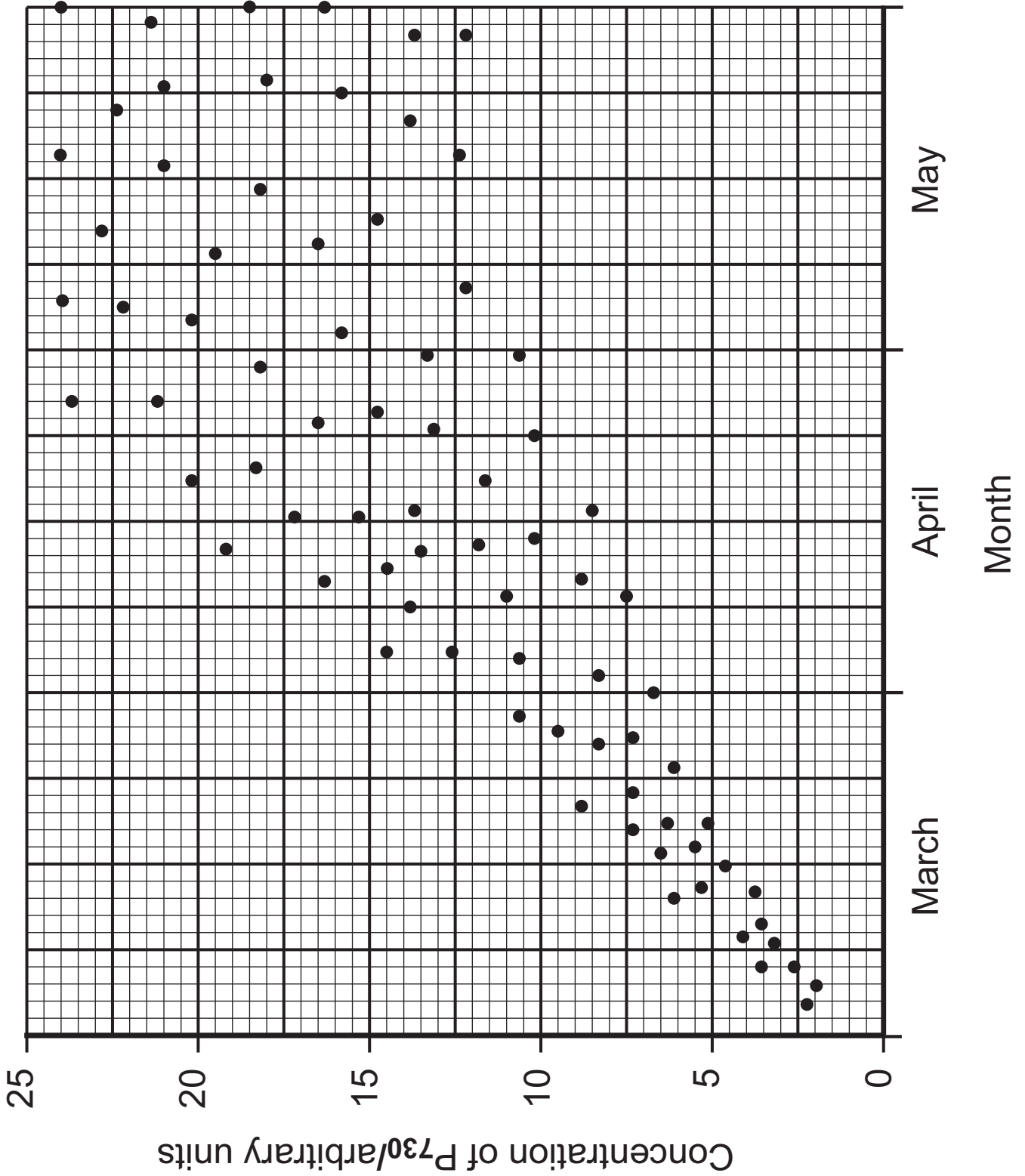
(ii) Protoctistan numbers can be estimated using a haemocytometer. Suggest **one** reason why it might be difficult to estimate **Paramecium** numbers accurately using this technique. [1 mark]

(c) Other species of protocists can photosynthesize. They live in the surface layers of seas and lakes. Numbers of individuals of these species often increase rapidly in spring and fall very sharply in mid to late summer, producing J-shaped growth curves.

Suggest reasons for the J-shaped growth curves of these species. [3 marks]

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(Questions continue overleaf)

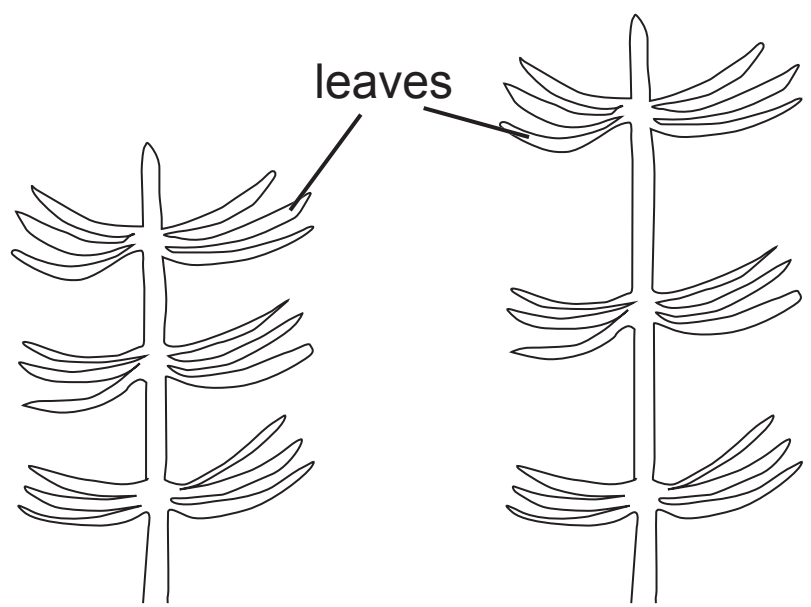


3 (a) In an investigation into flowering in plants, the concentration of phytochrome P₇₃₀ in the leaves of one species of flowering plant was measured between March and May. The results are shown in the graph on page 10.

(i) Describe and explain fully the results shown.
[3 marks]

(ii) In May, the concentration of P₇₃₀ ranges from 12–24 arbitrary units. Suggest **one** reason for this high degree of variability. [1 mark]

(b) In a different investigation into plant growth, a particular plant growth substance was applied to the tip of a stem and left for a period of time. The diagram below shows the results of this investigation.



Control

Growth substance added

(i) Name the plant growth substance involved. [1 mark]

(ii) The plant growth substance causes its effect mainly through the increased elongation of cells. Suggest why it produces the greatest growth when cytokinin levels are not limiting. [2 marks]

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(Questions continue overleaf)

4 (a) **Photograph 1.4A** shows part of a softwood forest in midsummer.

(i) Give **one** piece of evidence which suggests that this forest has been planted by man rather than developing naturally. [1 mark]

The photograph suggests that the biodiversity in the softwood forest is low.

(ii) Suggest **two** reasons for the low biodiversity of the forest in **photograph 1.4A**. [2 marks]

1. _____

2. _____

(iii) Apart from the conservation of native forests, give **one** advantage of softwood plantations. [1 mark]

(b) **Photograph 1.4B** shows part of the same forest after being damaged by fire. The photograph was taken in March, nearly two years after the fire.

(i) Give **one** piece of evidence which suggests that succession is already taking place. [1 mark]

(ii) Name the type of succession taking place. [1 mark]

(iii) Assuming that the fire-damaged area is not replanted by man, describe and explain the sequence of plant succession that will occur in the following years. [4 marks]

5 Excretion in the kidney involves both ultrafiltration and selective reabsorption.

(a) Name the effective filter during ultrafiltration. [1 mark]

(b) The relative concentrations of a range of substances found in the glomerular (renal) filtrate and the plasma can be compared.

The relative concentration is expressed as the filtrate/plasma (**F/P**) ratio which is calculated by dividing the concentration of the substance in the filtrate by its concentration in the plasma. Some **F/P** ratios are shown in the table below.

| Substance | F/P ratio |
|-----------------------|-----------|
| Glucose | 1 |
| Amino acids | 1 |
| Small proteins | 0.002 |
| Medium-sized proteins | 0.0003 |
| Urea | 1 |

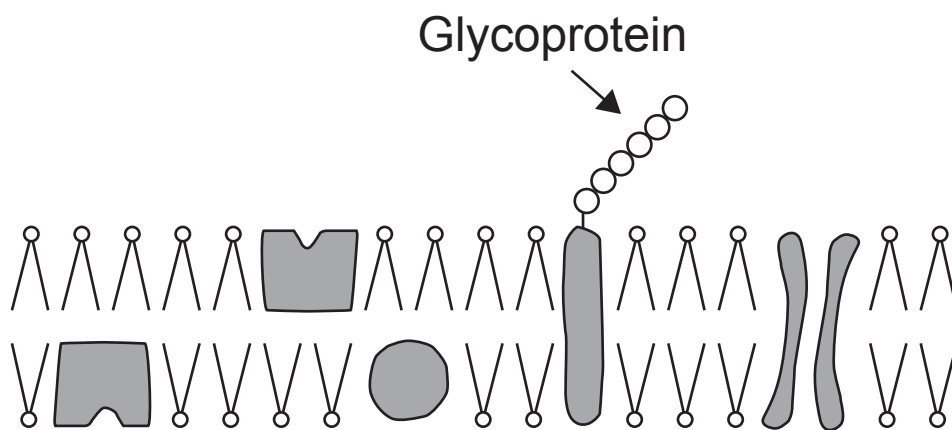
(i) Explain the ratios shown in the table. [3 marks]

(ii) Normally, all of the glucose which is in the proximal tubule returns to the blood. Explain how this is brought about. [2 marks]

- (c) Another function of the kidney is osmoregulation, which involves antidiuretic hormone (ADH). ADH exerts its greatest effect in the collecting ducts of the kidney.

ADH binds to protein receptor molecules in the cell surface membrane of the cells lining the collecting ducts. This subsequently leads to an increased number of protein channel molecules (aquaporins) in the cells.

The diagram below represents a section through the cell surface membrane of a cell lining a collecting duct.

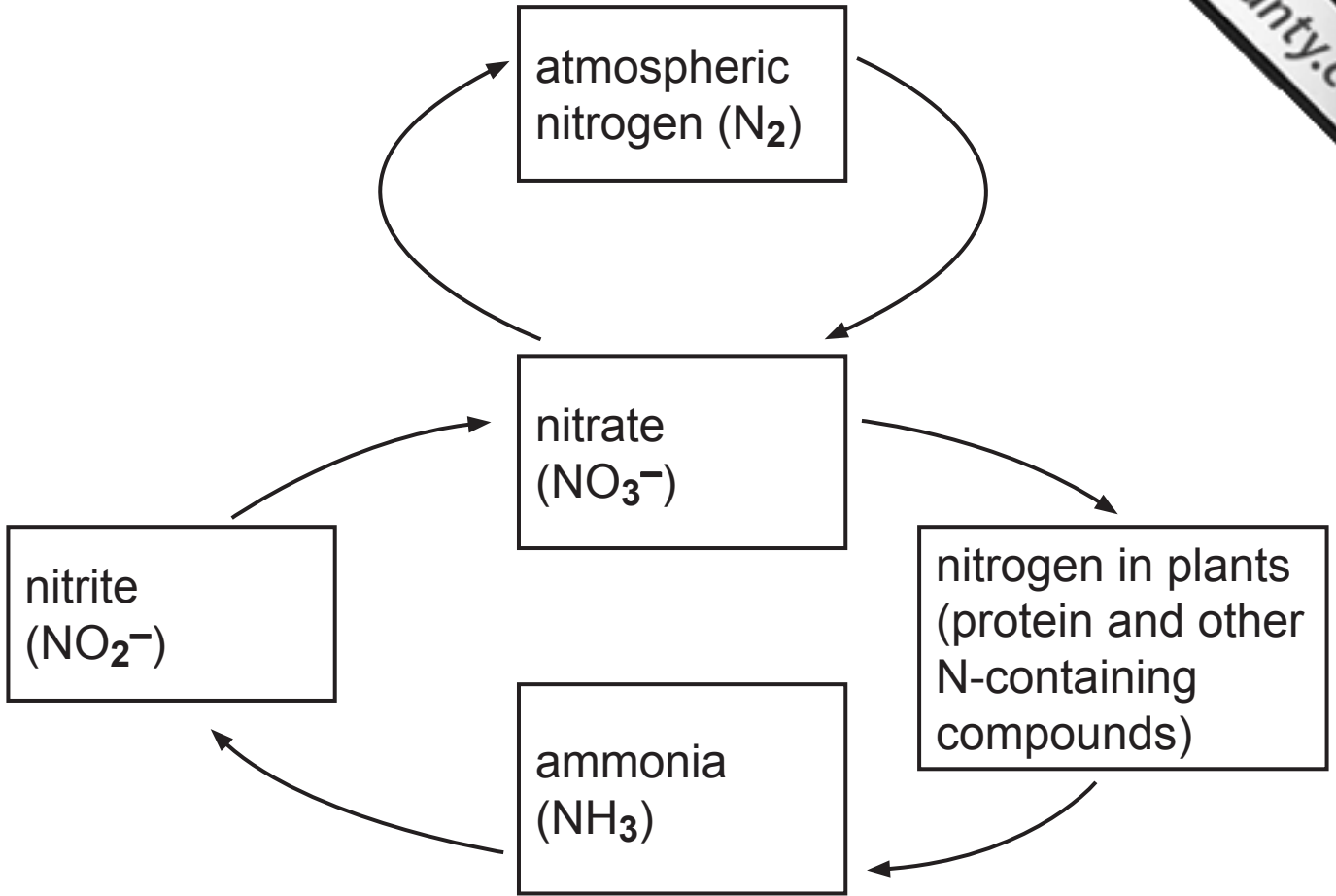


- (i) Label on the diagram above:
- with **A**, the location of an ADH receptor molecule
 - with **B**, a channel protein (aquaporin). [2 marks]

(ii) Using the information provided and your knowledge, explain the link between a more negative blood solute potential and osmoregulation in the kidney. [3 marks]

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6 A simplified nitrogen cycle is represented by the diagram below.



(a) How does the diagram show that the process of nitrification involves oxidation? [1 mark]

(b) Pea plants are able to fix nitrogen using nitrogen-fixing bacteria. These bacteria are found in nodules, which are small oval swellings in the roots. The bacteria have a mutualistic association with the pea plant.

(i) Explain what is meant by 'mutualistic association'. [1 mark]

To determine if a relationship exists between soil nitrogen concentration and root nodule size in pea plants, the following investigation was carried out.

- The nitrogen content of the soil at the base of the stem of 10 pea plants was determined
- The pea plants were carefully excavated and the length of 10 randomly selected root nodules from each plant was measured
- A mean value for nodule length in each plant was calculated

The table below shows the results obtained.

| Plant | Soil nitrogen content/% | Mean nodule length/mm |
|--------------|--------------------------------|------------------------------|
| 1 | 0.17 | 3.2 |
| 2 | 0.36 | 0.8 |
| 3 | 0.24 | 2.4 |
| 4 | 0.29 | 1.6 |
| 5 | 0.14 | 3.8 |
| 6 | 0.20 | 2.8 |
| 7 | 0.37 | 1.0 |
| 8 | 0.09 | 4.1 |
| 9 | 0.11 | 3.6 |
| 10 | 0.33 | 1.2 |

(ii) Using the results, state the relationship between soil nitrogen content and mean nodule length. Suggest a possible explanation for the relationship. [3 marks]

(iii) State **two** factors (variables) that should have been considered in the investigation design to ensure that valid results were obtained. [2 marks]

1. _____

2. _____

7 Leprosy is an infectious disease caused by the bacterium, **Mycobacterium leprae**. The bacterium has an optimum temperature for growth of around 32 °C, a few degrees below core body temperature.

M. leprae is unusual as an infectious bacterial pathogen in that it is only able to live within body cells. Parts of the body most affected by leprosy include the lining of the nasal cavity, ear lobes, fingers and feet. Here, the nervous tissue is affected by bacteria entering and damaging the Schwann cells.

(a) Using the information provided, suggest why leprosy mainly affects the external parts of the body. [1 mark]

(b) Explain how damage to Schwann cells could affect nervous transmission. [3 marks]

(c) (i) Using the information provided, explain why the immune response to **M. leprae** is likely to be cell-mediated. [1 mark]

(ii) Killer T-cells are produced as a consequence of cell-mediated immunity.

- Name the type of cell which produces them. [1 mark]

- Describe how killer T-cells combat pathogenic microorganisms. [2 marks]

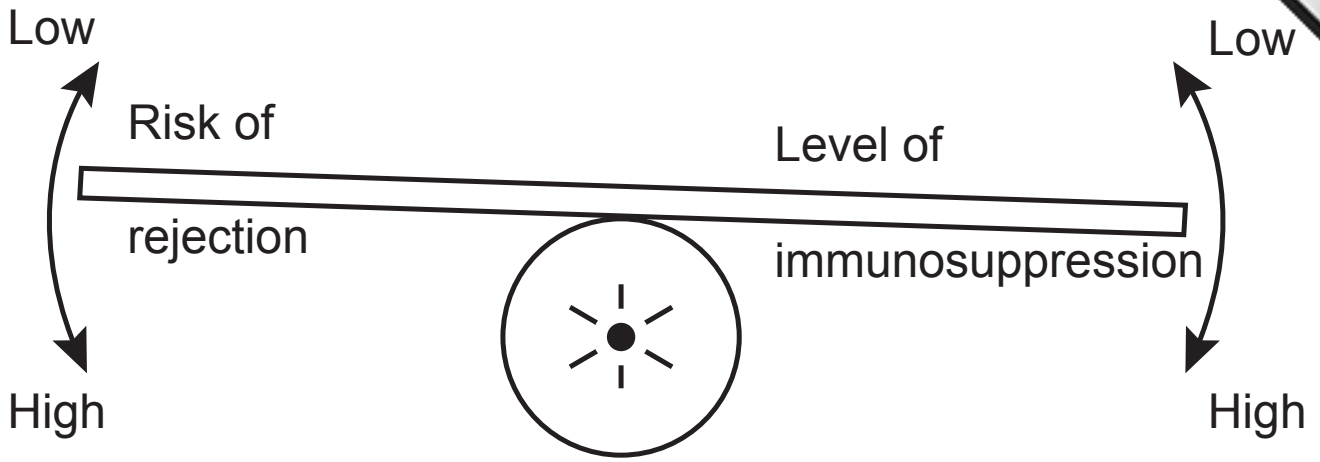
(d) Rejection of transplants is also a consequence of cell-mediated immunity. However, a range of techniques is used to suppress the immune response to prevent rejection.

(i) Explain **two** ways in which cell-mediated immunity can be suppressed. [2 marks]

1. _____

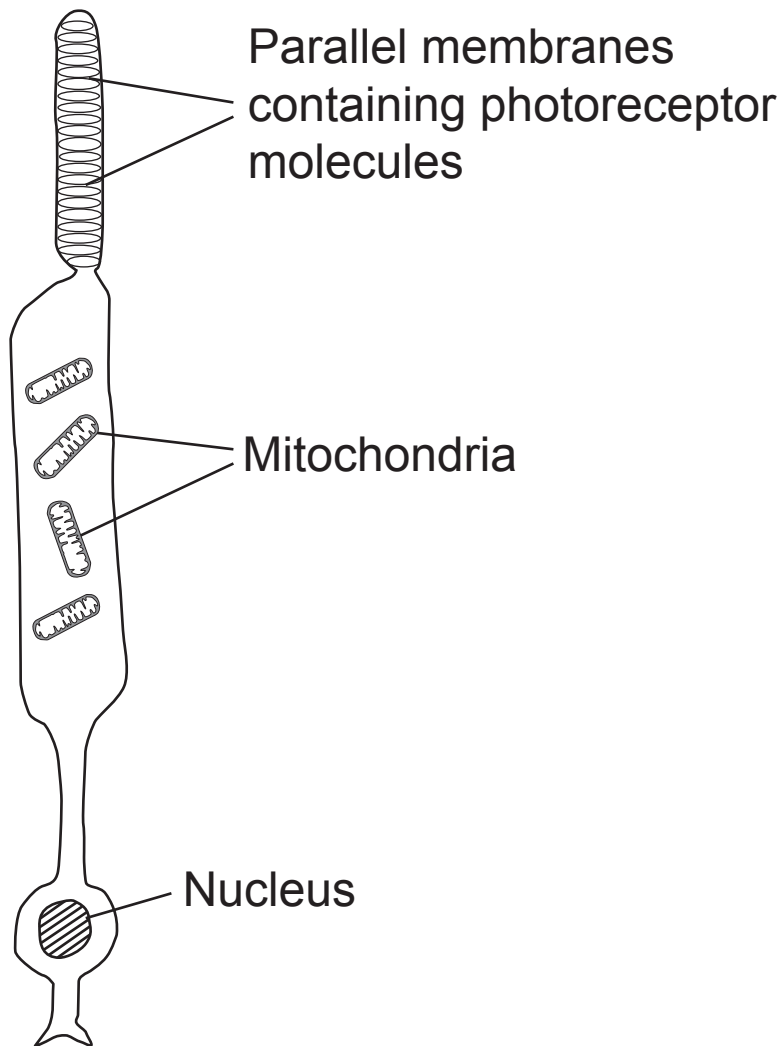
2. _____

Immunosuppression is a delicate balancing act as shown in the diagram below.



(ii) Using the information provided and your understanding, explain why the level of immunosuppression must be carefully balanced. [2 marks]

8 (a) The diagram below represents a rod cell.



- (i) Add an arrow beside the diagram to show the direction of light entering the retina. [1 mark]
- (ii) State the precise function of the mitochondria found in rod cells. [1 mark]

(b) Transduction is the process of changing energy from one form to another. Phototransduction is a term that describes the general function of rod cells.

Suggest a definition for phototransduction in the context of rod cells. [1 mark]

(c) In the retina, rod cells synapse with an adjacent bipolar cell. When a rod is not stimulated, the transmitter substance, glutamate, diffuses across to the bipolar neurone reducing the possibility of it becoming depolarised.

When the rod cell is stimulated, it stops releasing glutamate. The reduction in glutamate crossing the synaptic gap promotes depolarisation in the bipolar cell.

(i) Using the information provided, give **one** similarity and **one** difference between the synaptic transmission described above and that in typical neurone to neurone synapses. [2 marks]

Similarity

Difference

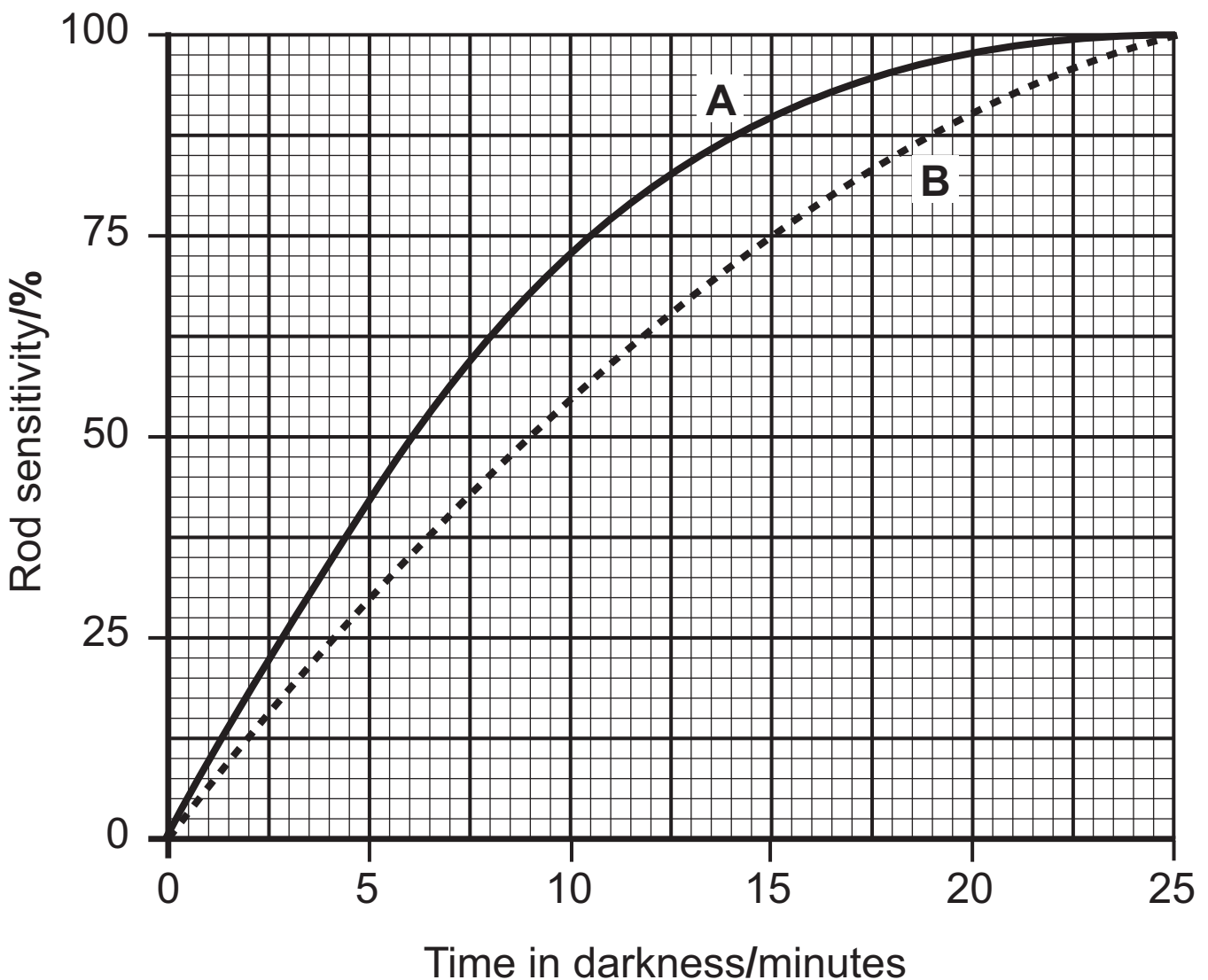
(ii) Give **one** advantage of the presence of synapses in nervous communication. [1 mark]

(d) In an investigation concerning dark adaptation in rods, two individuals (**A** and **B**) were subjected to a period of time in very bright light.

This was immediately followed by a period of time in darkness.

Rod sensitivity was measured throughout the time in darkness.

The results are shown in the graph below.



- (i) Calculate the percentage change in rod sensitivity for individual **A** between 5 minutes and 15 minutes after entering dark conditions. [2 marks]

(Show your working.)

_____ %

- (ii) Explain the results shown in the graph for individual **A**. [2 marks]

- (iii) Suggest **one** reason for the difference in response between individuals **A** and **B**. [1 mark]

(e) When viewing objects in the night sky, people view them with their eyes at a slight angle rather than focusing directly on the object of interest. Suggest a reason for this. [2 marks]

Section B

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

9 Sustainable farming practices promote both the conservation and fertility of soils and also biodiversity in terrestrial (land-based) habitats.

(a) Describe and explain how sustainable farming practices help promote the conservation and fertility of soils. [8 marks]

(b) Describe and explain how sustainable farming practices help promote biodiversity in terrestrial (land-based) habitats. [8 marks]

Quality of written communication [2 marks]

(a) Describe and explain how sustainable farming practices help promote the conservation and fertility of soils.

(b) Describe and explain how sustainable farming practices help promote biodiversity in terrestrial (land-based) habitats.

THIS IS THE END OF THE QUESTION PAPER

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

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**GCE Biology Advanced (A2)
Assessment Unit A2 1
Physiology and Ecosystems
Summer 2014**

**Photograph 1.4A
(for use with question 4(a))**



Source: Chief Examiner

**Photograph 1.4B
(for use with question 4(b))**



Source: Chief Examiner