Rewarding Learning

Centre Number

71	

Candidate Number

ADVANCED
General Certificate of Education
2014

Biology

Assessment Unit A2 1

assessing

Physiology and Ecosystems

[AB211]

AB211

WEDNESDAY 21 MAY, MORNING

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 **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 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.

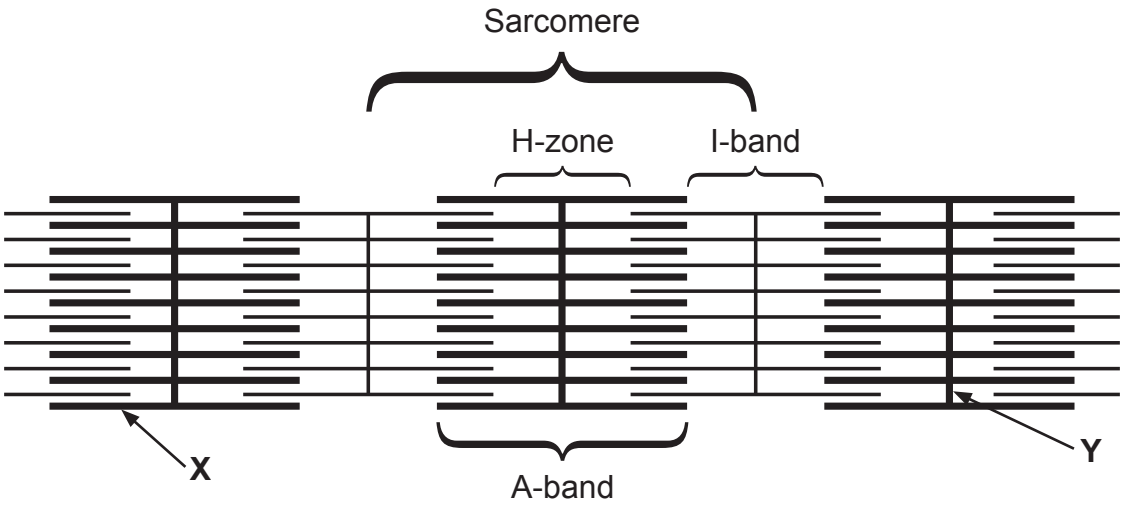
For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
6	
7	
8	
9	
Total Marks	

BLANK PAGE

Section A

Examiner Only	
Marks	Remark

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



(a) Identify the structures labelled **X** and **Y**.

X _____

Y _____ [2]

(b) The diagram above 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.

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

[2]

Examiner Only	
Marks	Remark

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

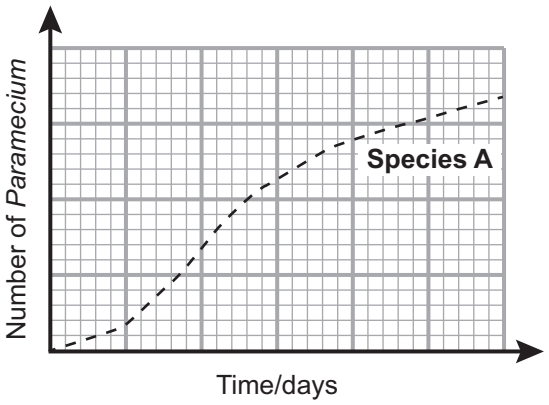
_____

_____

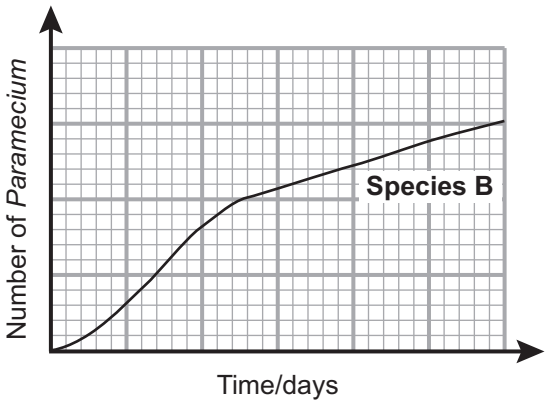
_____ [1]

(b) *Paramecium* are mobile protoctistans. 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.

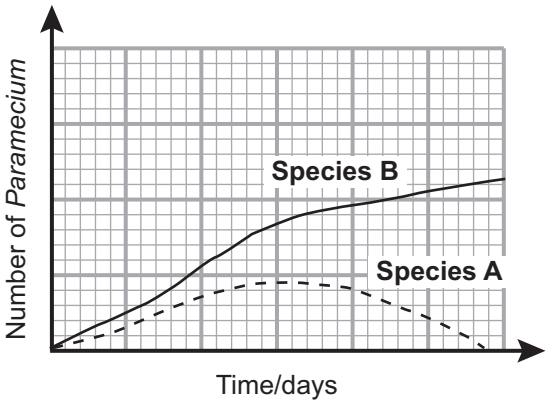
Graph 1



Graph 2



Graph 3



Examiner Only	
Marks	Remark

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

[3]

(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]

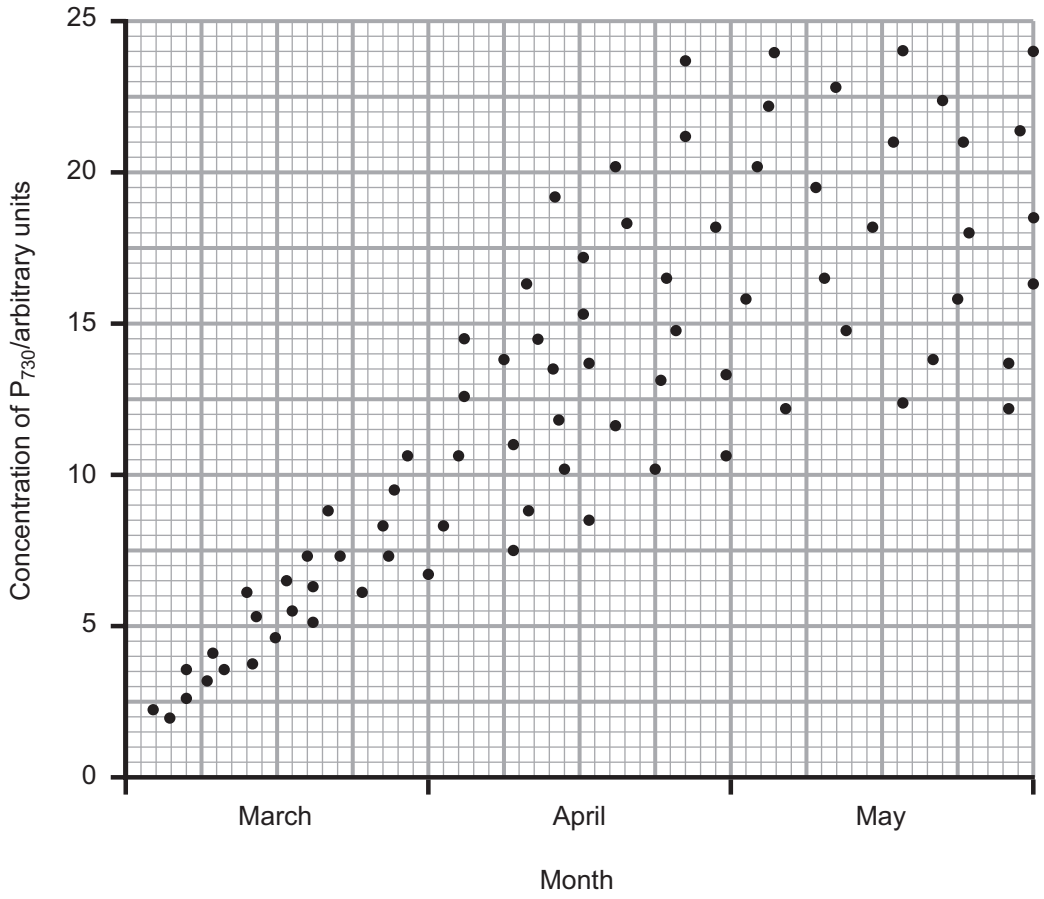
(c) Other species of protoctistans can photosynthesise. They live in the surface layers of seas and lakes. Numbers of individuals of these species often increase rapidly in spring and fall very sharply in mid to late summer, producing J-shaped growth curves.

Suggest reasons for the J-shaped growth curves of these species.

[3]

Examiner Only	
Marks	Remark

3 **(a)** In an investigation into flowering in plants, the concentration of phytochrome P_{730} in the leaves of one species of flowering plant was measured between March and May. The results are shown in the graph below.



(i) Describe and explain fully the results shown.

[3]

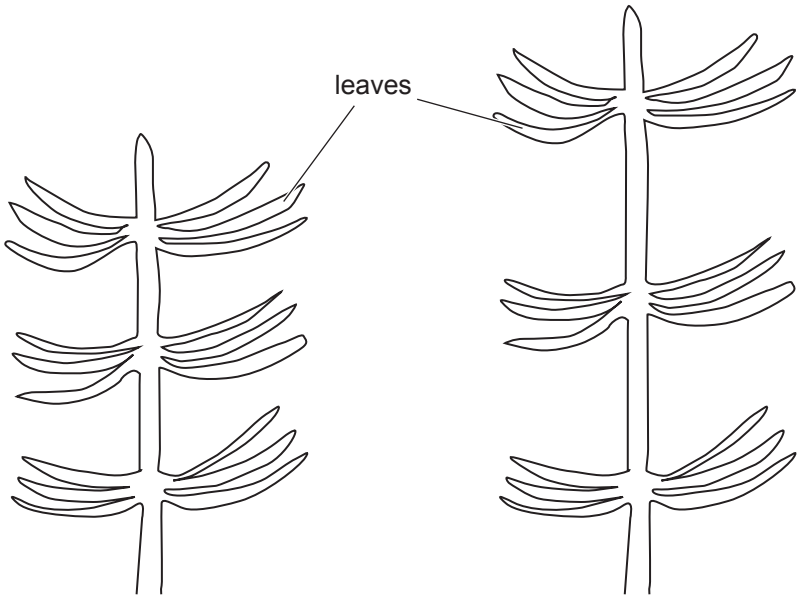
Examiner Only	
Marks	Remark

(ii) In May, the concentration of P_{730} ranges from 12–24 arbitrary units. Suggest **one** reason for this high degree of variability.

_____

_____ [1]

(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]

(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]

Examiner Only	
Marks	Remark

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]

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**.

1. _____

_____

2. _____

_____ [2]

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

_____ [1]

(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]

(ii) Name the type of succession taking place.

_____ [1]

(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]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

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

(a) Name the effective filter during ultrafiltration.

_____ [1]

(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]

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

[2]

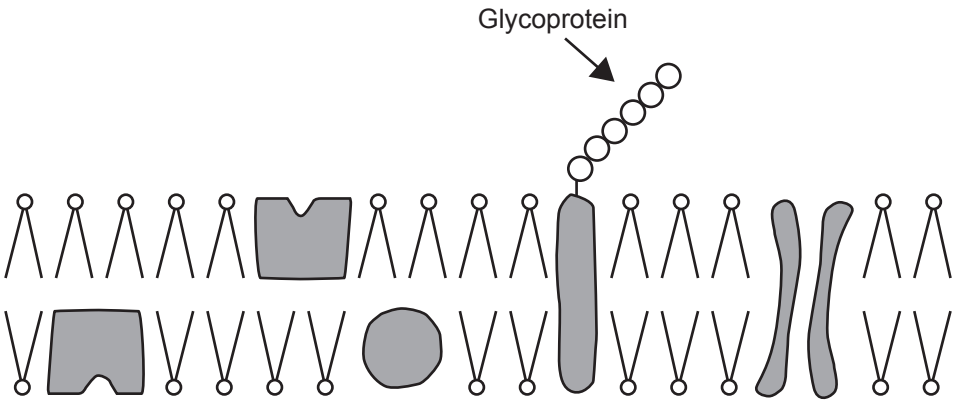
Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

(c) Another function of the kidney is osmoregulation and 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]

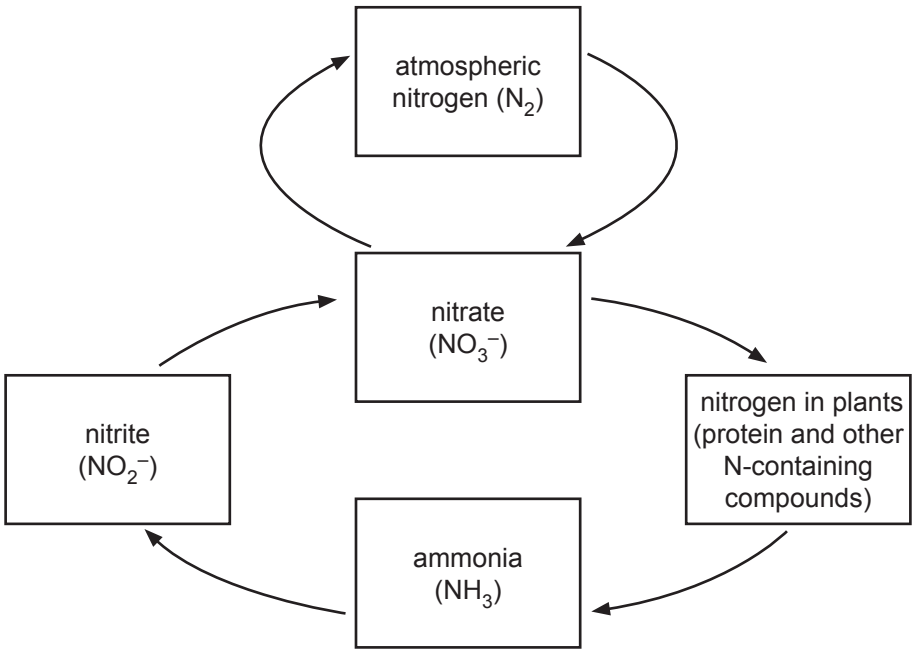
(ii) Using the information provided and your knowledge, explain the link between a more negative blood solute potential and osmoregulation in the kidney.

Examiner Only	
Marks	Remark

[3]

Examiner Only	
Marks	Remark

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]

(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]

To determine if a relationship exists between soil nitrogen concentration and root nodule size in peas, 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]

Examiner Only

Marks	Remark

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

1. _____

_____

2. _____

_____ [2]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

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]

(b) Explain how damage to Schwann cells could affect nervous transmission.

_____

_____

_____

_____

_____

_____

_____

_____ [3]

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

_____

_____ [1]

Examiner Only	
Marks	Remark

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

- Name the type of cell which produces them.

_____ [1]

- Describe how killer T-cells combat pathogenic microorganisms.

_____

_____

_____

_____

_____ [2]

(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.

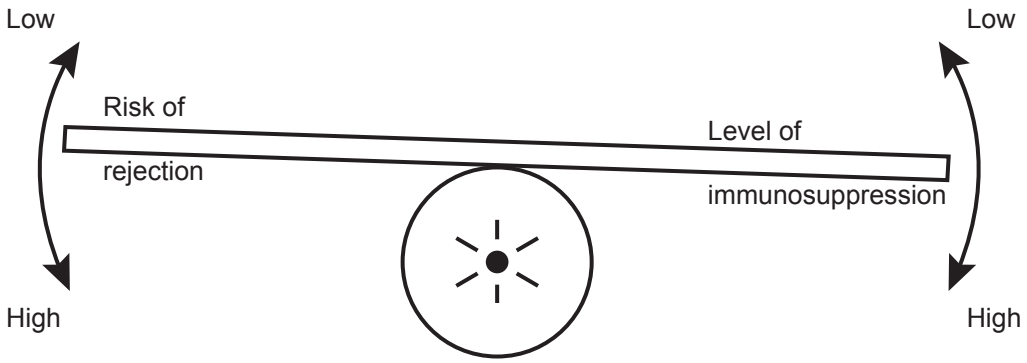
1. _____

_____

2. _____

_____ [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.

_____

_____

_____

_____

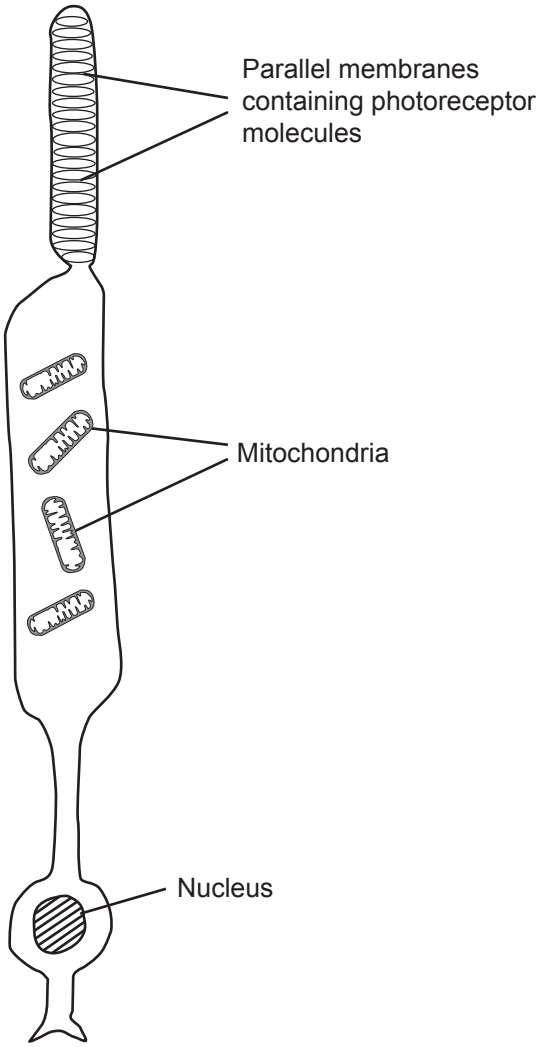
_____ [2]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

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]

(ii) State the precise function of the mitochondria found in rod cells.

_____

_____ [1]

Examiner Only	
Marks	Remark

(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]

(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.

Similarity

_____

_____

Difference

_____

_____ [2]

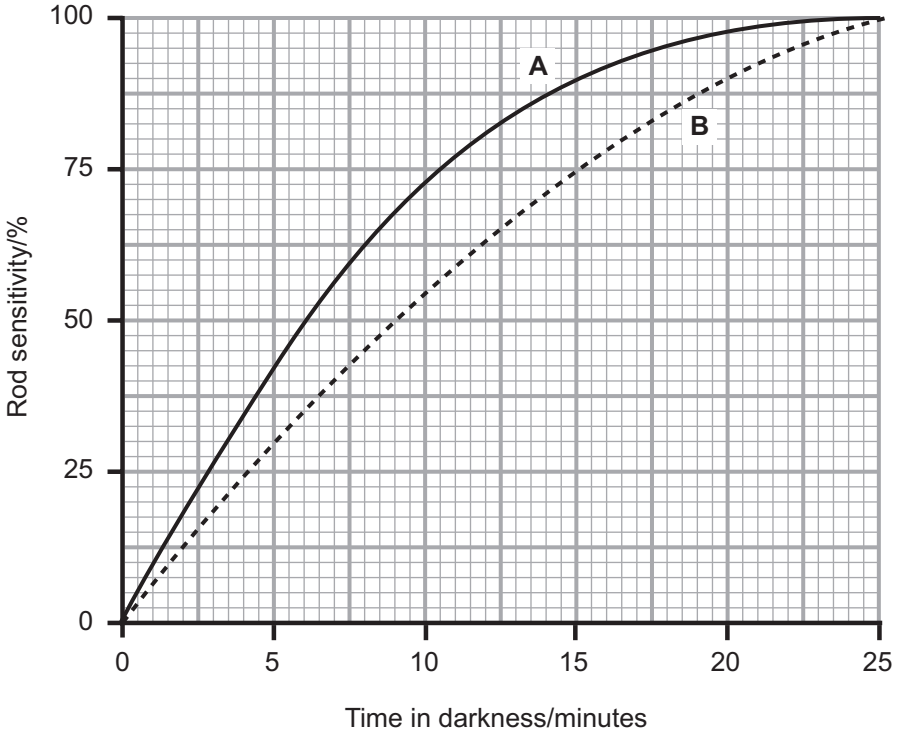
(ii) Give **one** advantage of the presence of synapses in nervous communication.

_____

_____ [1]

Examiner Only	
Marks	Remark

(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.

(Show your working.)

_____ % [2]

(ii) Explain the results shown in the graph for individual **A**.

_____

_____

_____

_____

_____ [2]

(iii) Suggest **one** reason for the difference in response between individuals **A** and **B**.

_____

_____ [1]

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

_____

_____

_____

_____ [2]

Examiner Only	
Marks	Remark

Section B

Examiner Only	
Marks	Remark

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]

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

Quality of written communication [2]

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

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

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

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
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