Rewarding Learning

| Centre Number | |
|---|---|
| 71 | |

Candidate Number

ADVANCED
General Certificate of Education
January 2014

# Biology

## Assessment Unit A2 1

*assessing*

## Physiology and Ecosystems

**[AB211]**

AB211

**FRIDAY 10 JANUARY, AFTERNOON**

**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 **Photograph 1.4** for use with Question 4 in this paper.
Do not write your answer 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

**1** The following statements relate to the structure or function of the eye. Identify the term described by each statement.

- The structures that link the ciliary body and the lens

_____

- The layer that prevents internal reflection of light in the eye

_____

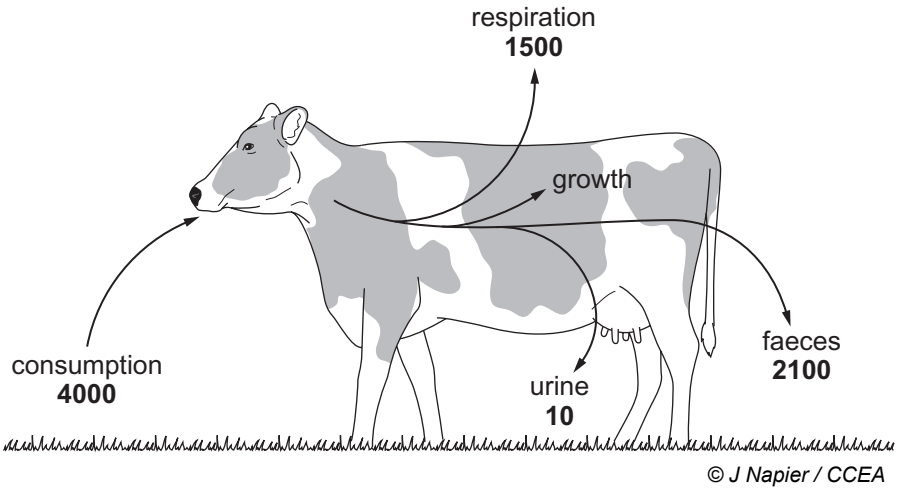
- The neurone arrangement that provides high sensitivity in low light intensities

_____

- The type of vision that makes three dimensional images possible

_____ [4]

**2** **(a)** The diagram below shows part of the energy budget of a cow grazing in a field. Figures are in $kJ\,m^{-2}\,year^{-1}$.






**(i)** Calculate the percentage of energy consumed that is available for the growth of the cow.
(Show your working.)

_____ % [2]

**(ii)** In terms of energy loss, explain the reason for the high values shown for respiration and faeces in the cow.

Respiration _____

_____

_____

Faeces _____

_____

_____ [2]

**(b)** One method of increasing the efficiency of energy transfer in livestock is to confine the animals in small enclosed areas.

**(i)** State **two** ways that confining livestock in small enclosed areas can increase the efficiency of energy transfer.

1. _____

_____

_____

2. _____

_____

_____ [2]

**(ii)** Apart from ethical considerations, give **one** argument against the practice of confining animals in small enclosed areas in intensive farming.

_____

_____

_____ [1]

**3** The levels of atmospheric carbon dioxide were recorded daily by a monitoring station in the Northern Hemisphere. Monthly and annual averages were calculated.

The table below shows the annual averages for every five years between 1975 and 2005.

Atmospheric carbon dioxide levels varied within each year and highest and lowest monthly averages are also shown.

| | **Atmospheric $CO_2$/parts per million** | | |
|---|---|---|---|
| **Year** | **Annual average** | **Highest monthly average** | **Lowest monthly average** |
| 1975 | 329 | 332 | 326 |
| 1980 | 336 | 340 | 331 |
| 1985 | 345 | 347 | 341 |
| 1990 | 354 | 357 | 350 |
| 1995 | 359 | 363 | 355 |
| 2000 | 366 | 371 | 362 |
| 2005 | 378 | 381 | 374 |

**(a)** Suggest reasons for the high and low levels of carbon dioxide within each year.

_____

_____

_____

_____

_____ [2]

**(b)** The global temperature has risen by approximately 0.7 °C during the period 1975–2005. Most scientists argue that the data in the table supports the theory that man is responsible for this global warming.

**(i)** Explain the link between the data in the table and global warming.

[3]

**(ii)** Suggest why some scientists could argue that the data does **not** support the theory that man is responsible for global warming.

[1]

**(c)** Acid rain is also a form of atmospheric pollution.

**(i)** Explain how acid rain is formed.

[2]

**(ii)** Explain fully how acid rain damages trees.

[2]

4 **(a)** **Photograph 1.4** is a photomicrograph of muscle tissue.

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

**A** _____

**B** _____ [2]

**(ii)** Identify the evidence from the photomicrograph which indicates that this section is:

- skeletal muscle and not cardiac muscle

_____

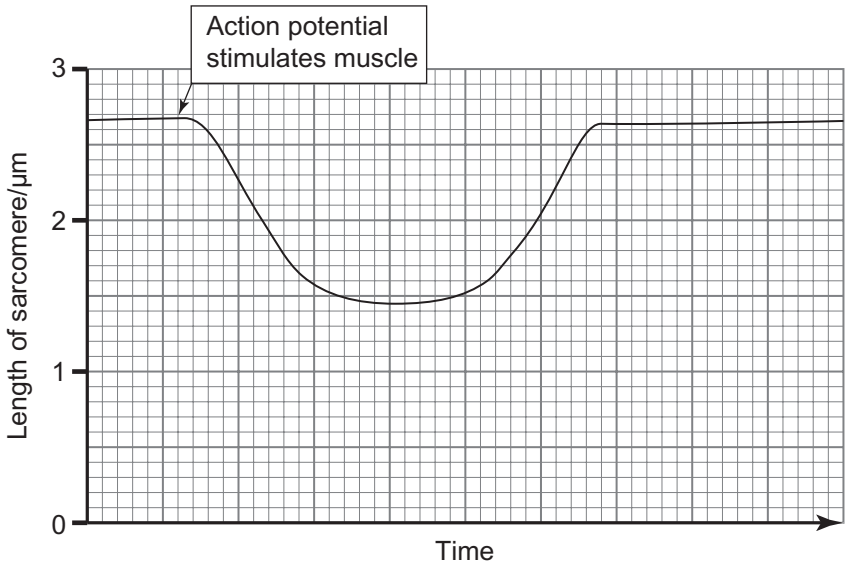
_____

- skeletal muscle and not smooth muscle

_____

_____ [2]

**(b)** The graph below shows the length of a sarcomere during muscle contraction.



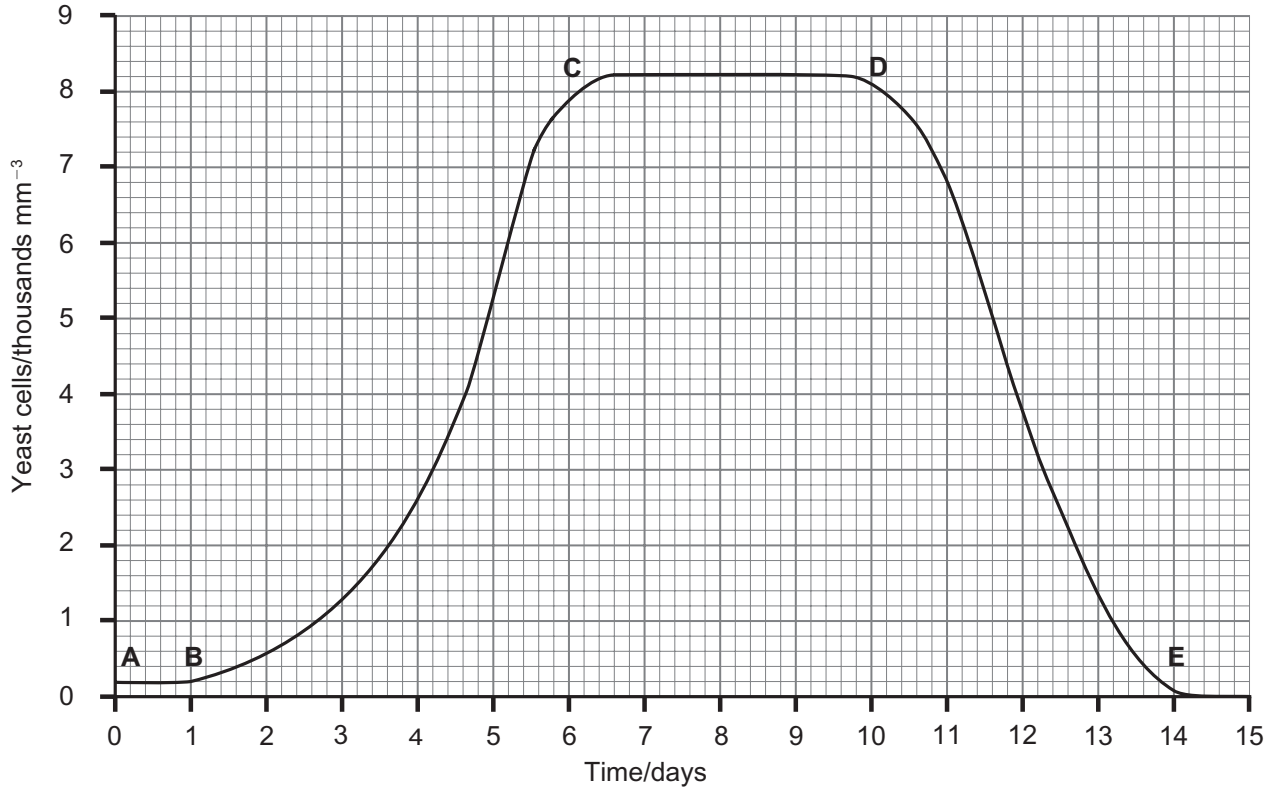
**(i)** Explain the role of calcium ions, myosin and actin in bringing about the changes in the length of the sarcomere, as shown in the graph opposite.

[3]

**(ii)** The graph shows that a sarcomere will only shorten by a very small amount (approximately 1.2 μm) when it contracts. Explain how muscle tissue is able to contract many centimetres when stimulated.

[2]

**5** Yeast, cultured in a conical flask containing glucose solution, will produce the population growth pattern shown in the graph below. Increase in population size is due to the yeast cells growing and producing daughter cells as outgrowths (buds) that break off as they reach an appropriate size. The graph shows how the number of living yeast cells changes over time.




**(a)** Explain the population growth pattern between positions:

**A–B** _____

_____

_____

_____

_____

**D–E** _____

_____

_____

_____

_____ [4]

Examiner Only

| Marks | Remark |
|---|---|
| | |

**(b) (i)** Determine the carrying capacity for this particular culture.

_____ [1]

**(ii)** Suggest how a higher carrying capacity could have been achieved in this investigation.

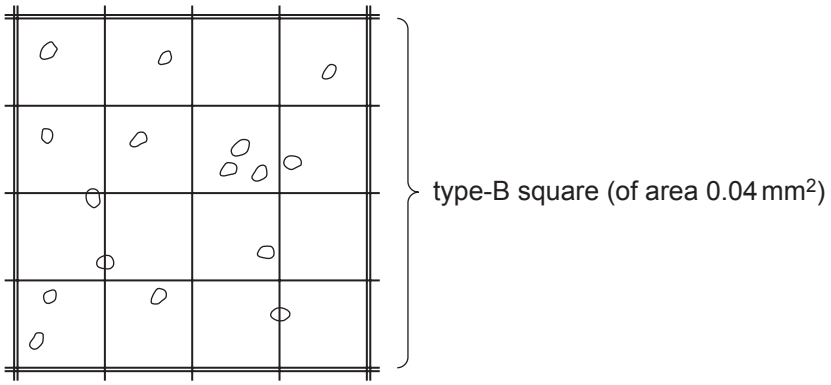
_____

_____

_____ [1]

In a class experiment investigating the population growth of yeast, the culture was sampled at intervals and the number of yeast cells estimated using a haemocytometer.

**(c)** The diagram below represents the results obtained by a student from one type-B square. The distance between the surface of these type-B squares and the overlying coverslip is 0.1 mm.




**(i)** Using the information in the type-B square above, calculate the number of yeast cells per mm$^3$.
(Show your working.)

Answer _____ cells mm$^{-3}$ [2]

Other students also took samples from the conical flask at the same time. The table below shows the values calculated by three students.

| Student | Number of yeast cells /mm$^{-3}$ |
|---|---|
| A | 4900 |
| B | 2800 |
| C | 3300 |

**(ii)** Apart from inaccurate counting of yeast cells, suggest **two** reasons that could account for the large variation among the results obtained.

1. _____

_____

2. _____

_____ [2]

The students found that the number of yeast cells sampled did **not** fall as expected nearing the end of the investigation, but remained relatively constant (as shown in the plateau part of the graph).

**(iii)** Suggest an explanation for this observation.

_____

_____ [1]

**(d)** In investigations of this nature, it is possible that there could be too many cells to clearly see the grid lines on the haemocytometer.

Suggest what steps can be taken to ensure that the number of cells can be accurately estimated.

_____

_____

_____

_____

_____ [2]

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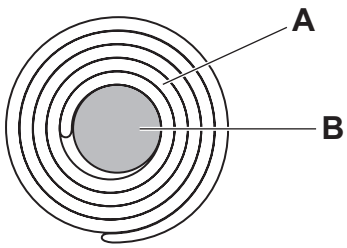
**(Questions continue overleaf)**

**6** **(a)** Diagram **X** below represents a myelinated neurone in transverse section (T.S.).

Two important features of the neurone are labelled **A** and **B**.

**Diagram X**



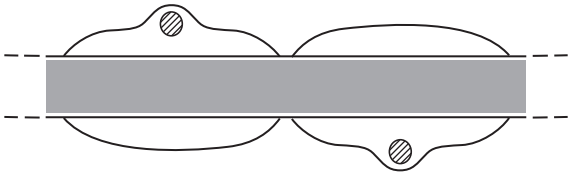

**(i)** Identify the features labelled **A** and **B**.

**A** _____

**B** _____ [2]

Diagram **Y** below represents part of the myelinated neurone in longitudinal section (L.S.).

**Diagram Y**



**(ii)** Draw a line on diagram **Y** to show where the section represented in diagram **X** could have been taken. [1]

**(b)** Describe how an action potential is propagated along a myelinated neurone.

_____

_____

_____

_____

_____

_____ [2]

Neurones in an earthworm are non-myelinated and most are very thin in transverse section. However, earthworms have a small number of axons (giant axons) that are much thicker than the others. When an earthworm has pressure applied suddenly to its body surface, or the surface is damaged, the giant axons are involved in a withdrawal response.

**(c)** Using the information provided, explain the advantage to the earthworm of possessing giant axons.

_____

_____

_____

_____

_____

_____ [2]

**7** In combating disease, antibody production in the body can be stimulated as a result of infection or by vaccination. Alternatively, antibodies can be injected directly into the blood if required.

**(a)** Antibodies are specific to the antigens on the microbe causing the disease. Suggest how the structure of an antibody molecule results in this specificity.

_____

_____

_____

_____

_____

_____

_____

_____ [3]

Antibodies necessary for medical treatment of humans can be obtained from horses that have been given the appropriate vaccination. Serum (plasma minus the clotting factors) containing the required antibodies is subsequently extracted from the horse.

This method of providing passive immunity was used for many years but it had its limitations. It was difficult to produce enough antibodies to meet medical demand. Additionally, the horse serum contained many different types of antibodies rather than just the specific type required.

**(b)** Suggest **two** reasons why the horse serum contained many different types of antibody.

1. _____

_____

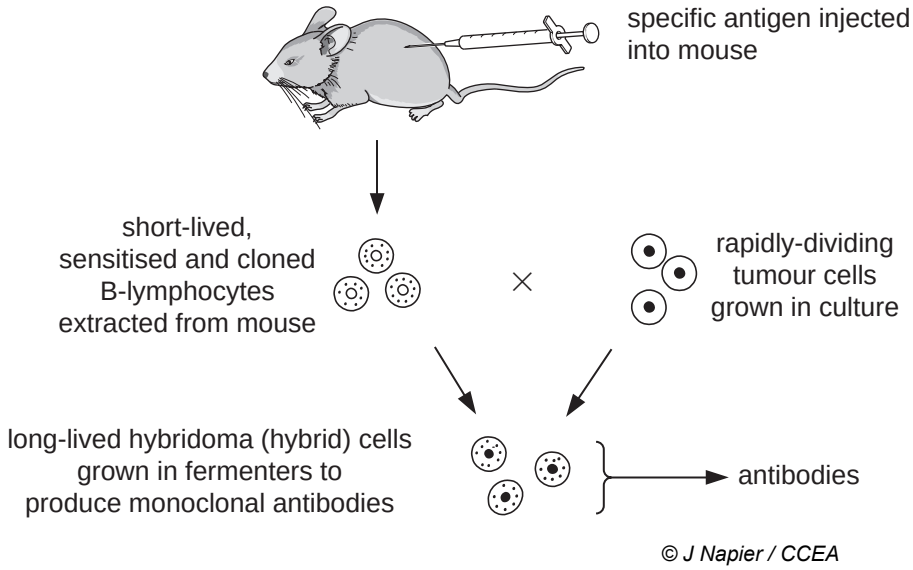
_____

2. _____

_____

_____ [2]

**(c)** In 1975, Kohler and Milstein made a breakthrough in the production of antibodies for human use. They used B-lymphocytes from mice to produce a single type of antibody (a monoclonal antibody). The technique they used is outlined in the following diagram.






**(i)** Using the information provided, explain why only one type of antibody was produced.

_____

_____ [1]

**(ii)** Suggest why Kohler and Milstein fused tumour cells with the B-lymphocytes.

_____

_____ [1]

**(iii)** Two advantages of this method are that animals such as the horse do not have to be used, while the antibodies produced are of a single type. Suggest **one** other advantage in producing antibodies by this method.

_____

_____ [1]

**(iv)** Both the extraction of antibodies from horses and monoclonal antibody production involve non-human cells. Suggest why many people regard monoclonal antibody production as the more ethically acceptable of the two processes.

_____

_____ [1]

**8** The distribution of plants in sand dunes typically reflects a pattern of succession. The young, unstable dunes closest to the sea are dominated by marram grass, a species particularly effective at growing in sand. Its roots bind the sand together and provide stability.

The dune slacks (hollows) behind the young dunes have a very shallow soil. Although little marram grass grows here, the slacks are species-rich with 'ground-hugging' plant species such as thyme and birdsfoot trefoil. These species are highly adapted to thrive in the nutrient-poor, shallow soils that are frequently battered by onshore winds.

Further inland, as the dunes become older and more stable, the marram grass is gradually replaced by small shrubs (mainly heather) and even further inland by the larger bracken and gorse. In these older dunes the ground layer is dominated by moss species.

**(a) (i)** Although sand dunes typically receive high levels of rainfall, marram grass is a xerophyte. Suggest why marram grass requires xerophytic adaptations in this environment.

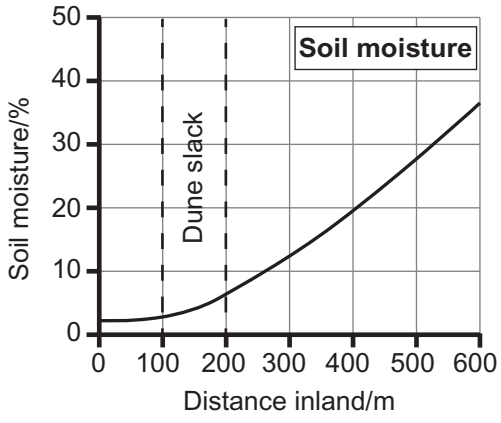
_____

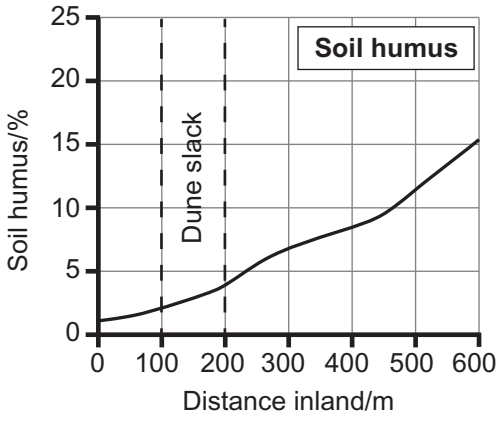
_____ [1]

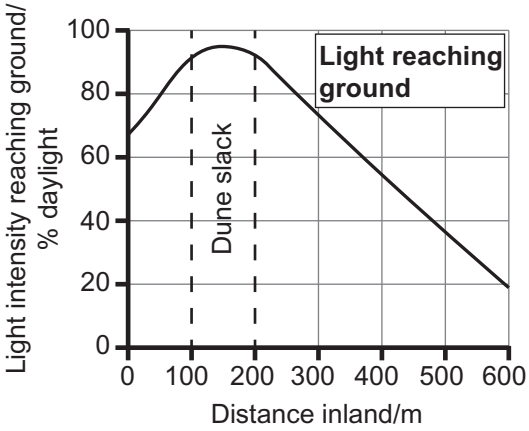
**(ii)** Name **one** xerophytic adaptation that marram grass would be expected to possess.

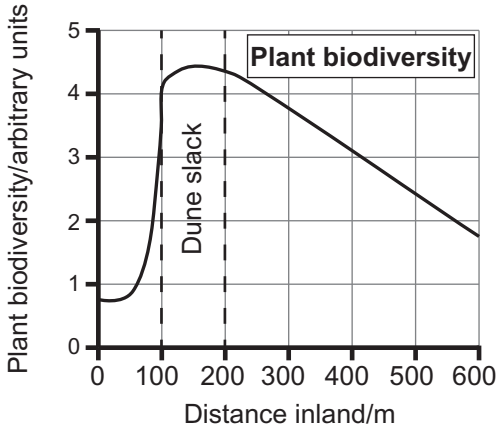
_____ [1]

**(b)** In an ecological investigation of a sand dune system the following data was obtained.




**(i)** Using the information provided, describe and explain the change in plant biodiversity across the sand dune system.

[5]

**(ii)** When carrying out this investigation, it was important that the data was gathered within a reasonably short time frame (i.e. a few hours). Suggest **two** reasons for this.

1. _____

_____

2. _____

_____ [2]

Abandoned quarries are also common settings for observing succession. The gorse shrub is an early coloniser in quarry successions. It is able to grow in the very thin soils that develop in rock crevices, often becoming the dominant species at a relatively early stage.

**(c)** Gorse is a species that is able to fix nitrogen. Using this information, explain its dominant position in the early stages of succession in quarries.

_____

_____

_____

_____

_____ [2]

**(d)** **(i)** Explain why both a sand dune and a quarry succession can be regarded as a primary succession.

_____

_____ [1]

**(ii)** Identify a major difference between a sand dune succession and a quarry succession. (Your answer does not need to refer to the different type of substrate or the different species present.)

_____

_____

_____ [1]

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**(Questions continue overleaf)**

## Section B

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

**9** The kidney is a homeostatic organ important in excretion and osmoregulation.

**(a)** Describe and explain the processes of ultrafiltration and reabsorption in excretion in the kidney. [11]

**(b)** Using osmoregulation in the kidney as an example, explain the term homeostasis and outline the essential components of homeostatic mechanisms. [5]

Quality of written communication [2]

---

**(a)** Describe and explain the processes of ultrafiltration and reabsorption in excretion in the kidney.

r Only
mark

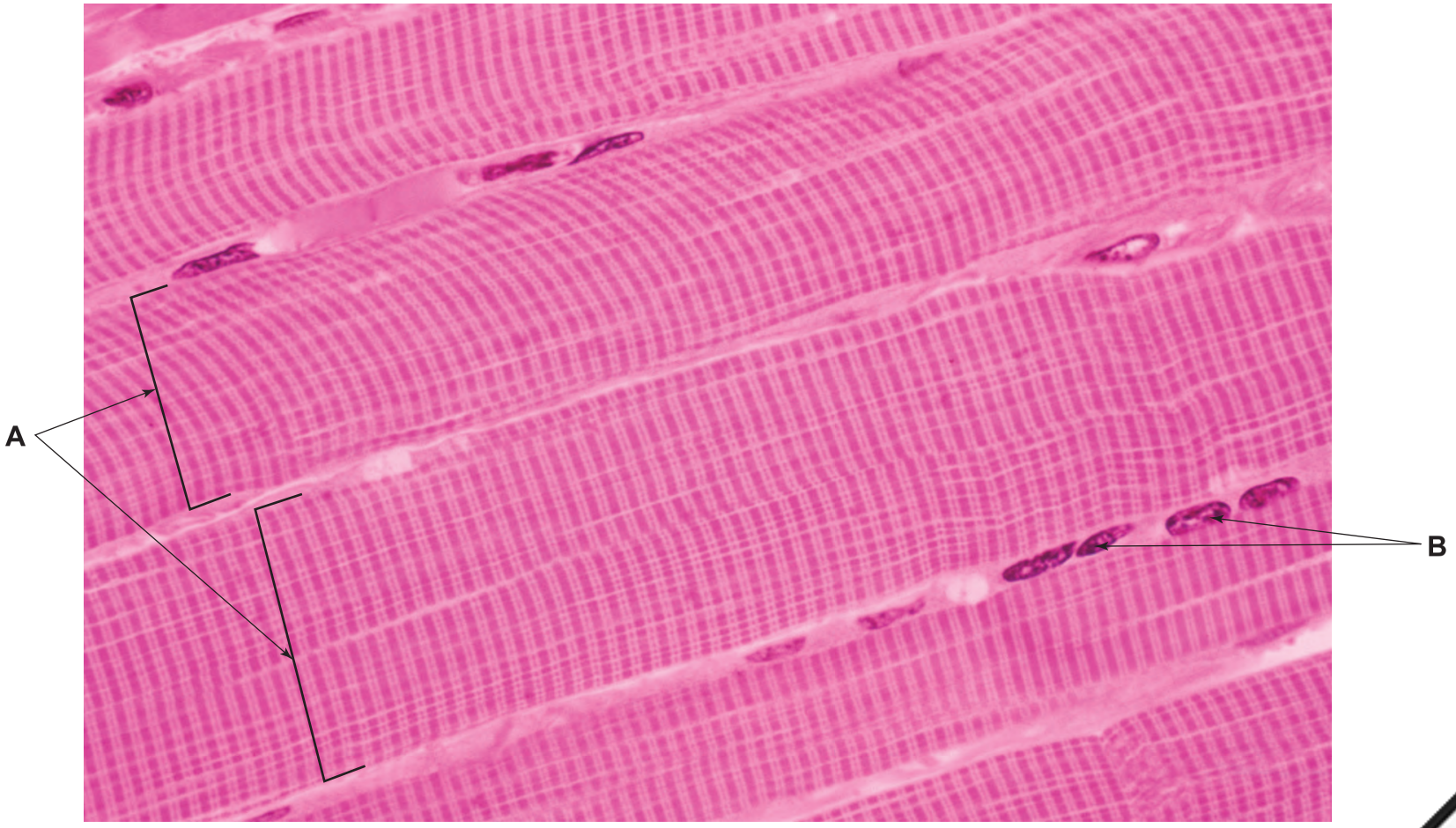
**(b)** Using osmoregulation in the kidney as an example, explain the term homeostasis and outline the essential components of homeostatic mechanisms.

***Extra lined page***

**THIS IS THE END OF THE QUESTION PAPER**

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

## Photograph 1.4
## (for use with Question 4)






**Magnification × 320**