Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2022

Centre Number

Candidate Number

Biology

Assessment Unit AS 1
assessing
Molecules and Cells

[SBY11]

SBY11

FRIDAY 20 MAY, AFTERNOON

TIME

1 hour 30 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 seven** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 75.
Section A carries 60 marks. Section B carries 15 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 **20 minutes** on Section B.
You are expected to answer Section B in continuous prose.
Quality of written communication will be assessed in Section B.

12952

Section A

1 Identify the main inorganic ion involved in each of the following:

- pectate in the middle lamella of cell walls

  _____

- chlorophyll

  _____

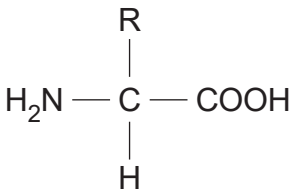
- haemoglobin

  _____

- buffering systems

  _____ [4]

2 The diagram below represents the general structure of an amino acid molecule. There are approximately 20 different amino acids.



(a) Using the diagram, describe how amino acids differ.

_____

_____ [1]

(b) Proteins may be described as having primary, secondary and tertiary structures.

(i) Describe what is meant by the 'primary structure' of a protein, and identify the type of bond involved.

_____

_____

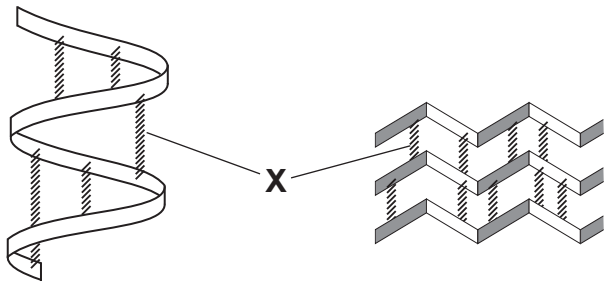
_____

_____ [2]

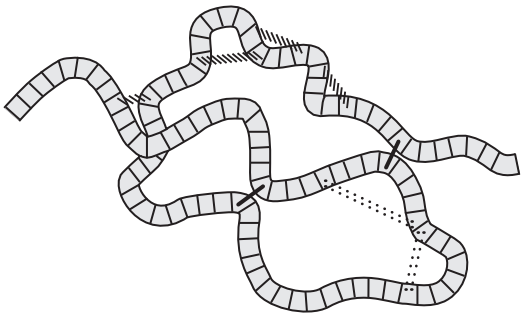
[Turn over

The diagram below represents the α-helix and β-pleated sheet secondary protein structures, together with the tertiary structure.

secondary structures



tertiary structure



Note: Only some bonds are shown in the protein.

Source: © Biology for CCEA, AS Level by Dr James Napier (ISBN: 9781780730998) Published by Colourpoint Educational, 2016

(ii) Identify the bonds labelled **X** in the diagram.

_____ [1]

(iii) Using the diagram and your knowledge, compare and contrast the bonds present in secondary and tertiary structures of proteins.

_____

_____

_____

_____

_____ [2]

(iv) Using the diagram and your knowledge, state the function of fibrous proteins and explain how their structure adapts them for this role.

_____

_____

_____

_____

_____

_____ [2]

(c) Proteins such as amylase can become denatured due to changes in pH and this can have a significant effect on the ability of the protein to function.

Explain precisely how a change in pH can cause amylase to lose its ability to carry out its function.

_____

_____

_____

_____

_____

_____

_____ [2]

[Turn over

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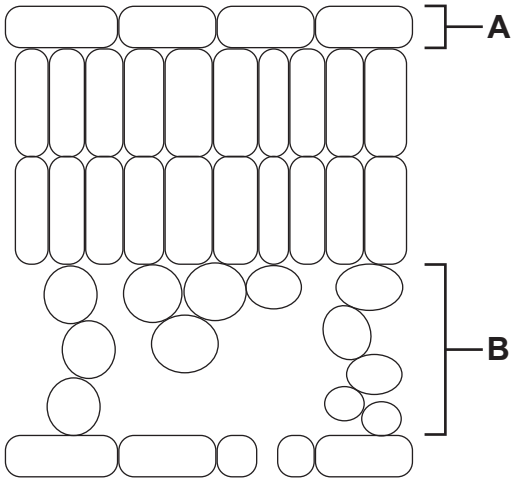
3 **(a)** The drawing below represents a section through a mesophytic leaf.



Note: No cell detail is provided in the drawing.

Source: Chief Examiner

(i) Identify the tissue layers labelled **A** and **B**.

A _____

B _____ [2]

(ii) Using **only** features shown in the diagram, describe **two** ways in which the leaf represented is adapted to maximise light absorption.

1. _____

_____

2. _____

_____ [2]

[Turn over

(b) Chloroplasts contain the pigment chlorophyll, which absorbs light.

(i) Identify the part of the chloroplast where chlorophyll is located.

_____ [1]

Scientists investigated how the size and number of chloroplasts in leaf cells affected the photosynthesis rate.

They investigated two varieties of thale cress (*Arabidopsis thaliana*) – the 'normal' variety **A** and variety **B**, which had fewer but larger chloroplasts.

Some of the data collected is shown in the table below.

Plant variety	Mean number of chloroplasts per cell	Mean chloroplast area / μm^2	Mean chlorophyll content / gm^{-2}	Mean rate of photosynthesis / arbitrary units
A	100	14.6	0.239	7.69
B	2	198.2	0.233	3.86

(ii) Identify the dependent variable in this investigation.

_____

_____ [1]

Source:

Q3.....© Xiong, D., Huang, J., Peng, S. et al. A few enlarged chloroplasts are less efficient in photosynthesis than a large population of small chloroplasts in Arabidopsis thaliana. Sci Rep 7, 5782 (2017). https://doi.org/10.1038/s41598-017-06460-0 https://creativecommons.org/licenses/by/4.0/

(iii) Consider the hypothesis:

'A higher rate of photosynthesis occurs in plants which contain larger chloroplasts.'

Comment on whether the data in the table provides evidence to support this hypothesis.

_____

_____

_____

_____

_____

_____ [2]

(iv) It is thought that larger chloroplasts are less able to move around within palisade cells.

Using all the information provided, suggest an explanation for the outcome of the investigation.

_____

_____

_____

_____

_____

_____ [2]

[Turn over

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4 Enzymes are biological catalysts which speed up reactions. They may require a cofactor.

(a) Define the term 'cofactor'.

_____

_____ [1]

(b) In mammals, the function of the ileum is to digest and absorb nutrients. Amylase breaks down starch into maltose. Maltose is then broken down by maltase, an enzyme which is embedded in the membrane of the microvilli of cells lining the gut lumen.

(i) Name the **tissue layer** of the ileum where microvilli are found.

_____ [1]

(ii) Distinguish precisely between microvilli and villi in the ileum.

_____

_____

_____

_____

_____ [2]

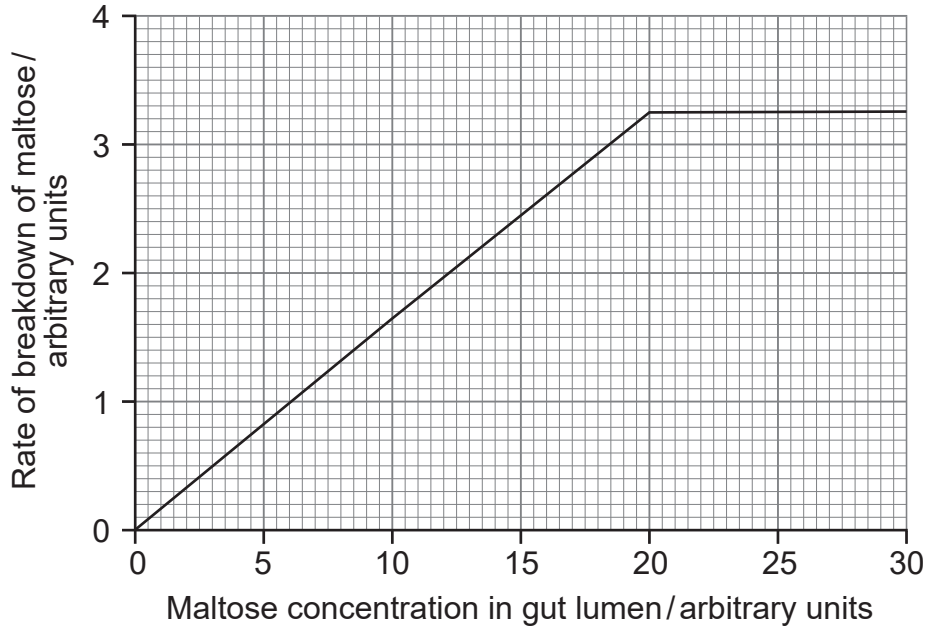
(iii) Suggest **one** advantage of maltase being embedded in the membrane of the microvilli, rather than being released into the gut lumen.

_____

_____ [1]

[Turn over

(c) In an experiment, the relationship between the concentration of maltose in the lumen of the gut and the rate of breakdown of maltose by maltase was investigated. The results are shown in the graph below.



(i) Calculate the percentage increase in the rate of breakdown of maltose when the maltose concentration increased from 10 to 20 arbitrary units.
(Show your working.)

_____ % [3]

(ii) Describe and explain the results of the investigation.

_____

_____

_____

_____

_____

_____

_____

_____

_____ [3]

[Turn over

5 DNA and RNA are nucleic acids.

(a) Other than the number of strands, state **two** structural differences between DNA and RNA.

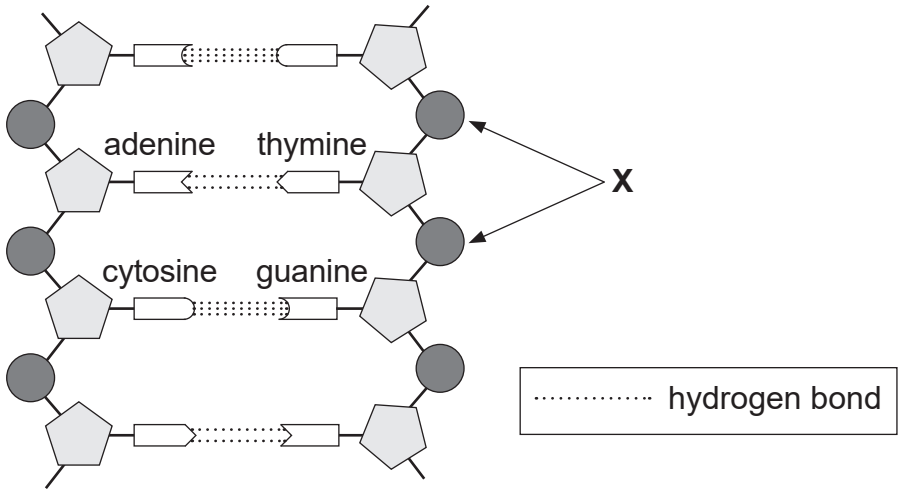
1. _____

_____

2. _____

_____ [2]

The diagram below represents a short section of DNA.



Source: © Biology for CCEA, AS Level by Dr James Napier (ISBN: 9781780730998) Published by Colourpoint Educational, 2016

(b) Identify the components labelled **X**.

X _____ [1]

(c) Before a cell divides to form two new cells, the DNA is replicated.

(i) Explain why it is necessary for the DNA to be replicated before a cell divides.

_____

_____ [1]

The process by which DNA is copied is known as semi-conservative replication.

(ii) Describe the process of semi-conservative replication.

_____

_____

_____

_____

_____

_____

_____

_____

_____ [3]

(iii) The position on the DNA where replication begins is referred to as the 'origin of replication'.

The section of DNA that contains the origin of replication usually has a high proportion of adenine and thymine base pairs. Using the diagram opposite, suggest a possible explanation for this.

_____

_____

_____

_____

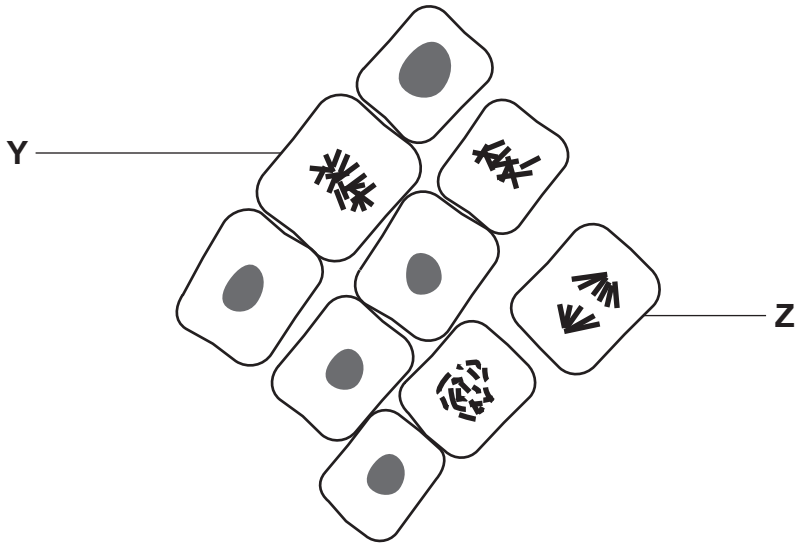
_____ [2]

[Turn over

(iv) State precisely the part of the cell cycle in which semi-conservative replication occurs.

_____ [1]

(d) The drawing below represents some cells from a section through an onion root tip.



Source: Chief Examiner

(i) Identify the stages of mitosis represented by cells **Y** and **Z**.

Y _____

Z _____ [2]

(ii) Describe **two** events which would take place in the cell immediately after the stage shown in cell **Z**.

1. _____

_____

2. _____

_____ [2]

6 **(a)** Osmosis is important in maintaining the water balance in plant and animal cells.

(i) Define the term 'osmosis'.

_____

_____

_____ [1]

In certain types of throat infection, the cells lining the throat become swollen due to excess water. Rinsing the mouth and throat (gargling) with salt water is a traditional remedy to relieve the pain caused by this swelling.

(ii) With reference to osmosis, suggest how gargling with salt water could relieve this pain.

_____

_____

_____

_____

_____

_____ [2]

[Turn over

(b) Fluids can be transported into a cell by pinocytosis.

(i) Describe fully the process of pinocytosis.

_____

_____

_____

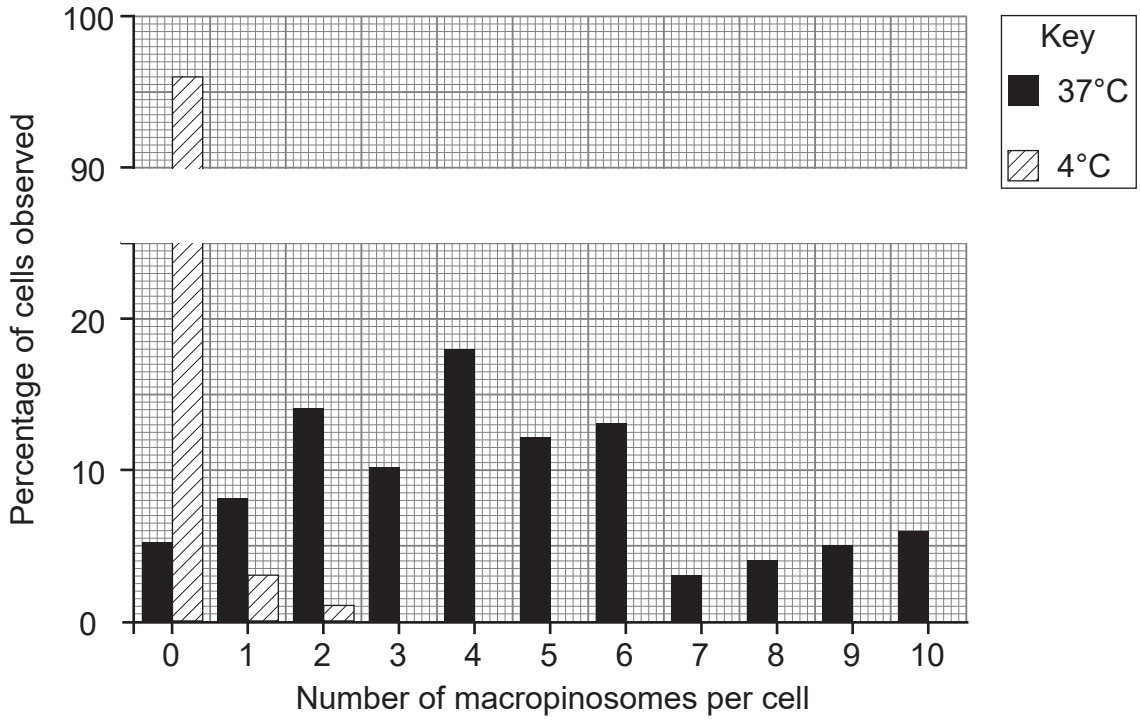
_____

_____

_____ [2]

The fluid taken into a cell by pinocytosis is contained within a sac called a 'macropinosome'.

In an investigation, scientists studied the effect of temperature on pinocytosis. Their results are summarised in the graph below.



Source: © Charpentier, J.C., Chen, D., Lapinski, P.E. et al. Macropinocytosis drives T cell growth by sustaining the activation of mTORC1. Nat Commun 11, 180 (2020). https://doi.org/10.1038/s41467-019-13997-3 https://creativecommons.org/licenses/by/4.0/

(ii) State the mode for number of macropinosomes per cell at 37°C.

_____ [1]

(iii) Summarise the results shown for 4°C and for 37°C.

4°C _____

_____

_____

_____

37°C _____

_____

_____

_____ [4]

Mammals have body temperatures of approximately 37°C.

(iv) Using the information provided and your knowledge, suggest an advantage of mammals maintaining a body temperature of 37°C.

_____

_____

_____ [1]

[Turn over

Section B

Quality of written communication will be assessed in this section.

7 Plant and animal cells each have a plasma membrane.

In addition, many membranes are found within cells, where they have a variety of roles as part of membrane systems or organelles.

Outline the structure of the plasma membrane and briefly describe the variety of roles performed by membranes within cells. [15]

Outline the structure of the plasma membrane and briefly describe the variety of roles performed by membranes within cells.

[Turn over

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THIS IS THE END OF THE QUESTION PAPER

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

Examiner Number