Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2025

Centre Number

Candidate Number

Biology

Assessment Unit AS 1
assessing
Molecules and Cells

[SBY11]

SBY11

FRIDAY 9 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 questions in black ink and use a dark HB pencil for drawings and graphs.
Do not write with a gel pen.
Answer **all eight** 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 may use a scientific calculator.
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.

15819.06 **R**

BLANK PAGE

DO NOT WRITE ON THIS PAGE

Section A

1 Identify the most appropriate biological term or phrase for each of the following:

- The bond between two monosaccharides

  _____

- The location, within a cell nucleus, of the DNA that codes for ribosomal RNA

  _____

- The small loop of DNA found in prokaryotic cells

  _____

- The type of virus which contains the enzyme reverse transcriptase

  _____

- The molecule located in an animal cell membrane which influences membrane stability

  _____

[5]

2 Enzymes act as biological catalysts.

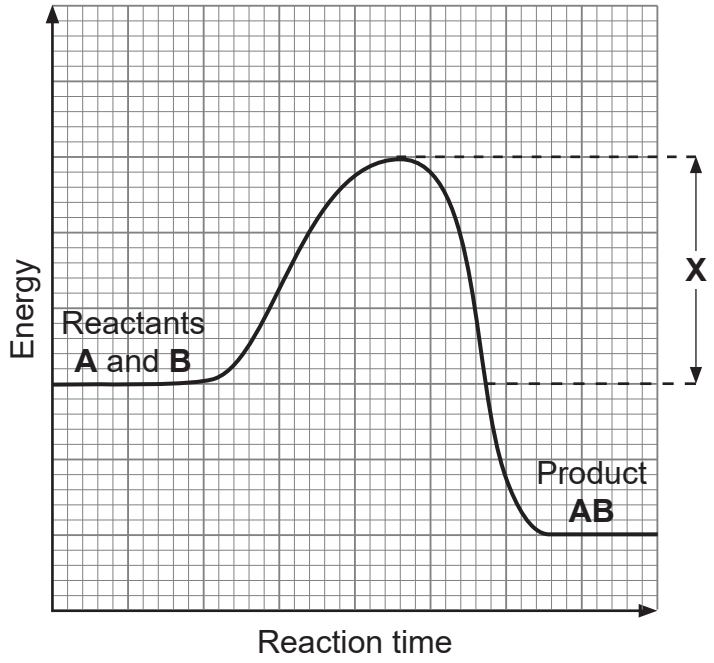
(a) Describe the induced-fit model of enzyme action.

_____ [2]

(b) Describe and explain the effect of temperature on enzyme activity.

_____ [3]

(c) The graph below shows the energy profile between two reactants, **A** and **B**.



(i) Identify the term represented by **X** on the graph.

_____ [1]

(ii) On the graph above, draw the alternative energy profile if an appropriate enzyme had been used to catalyse the reaction between **A** and **B**. [1]

[Turn over

3 Replication of DNA is described as ‘semi-conservative’.

(a) **(i)** Explain what this term means.

_____

_____

_____

_____

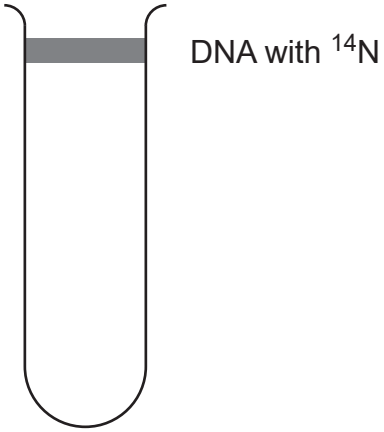
_____

_____ [2]

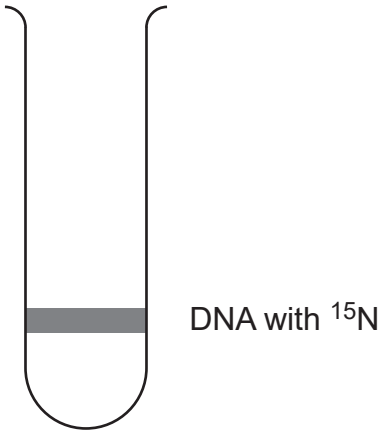
(ii) Name the bonds which form between base pairs in DNA.

_____ [1]

(b) Meselson and Stahl investigated DNA replication. They first grew *E.coli* bacteria in a medium containing ^{14}N (a 'light' nitrogen isotope). When the DNA was extracted, centrifuged and examined under UV light, the DNA was seen as a band in the centrifuge tube, as shown below.

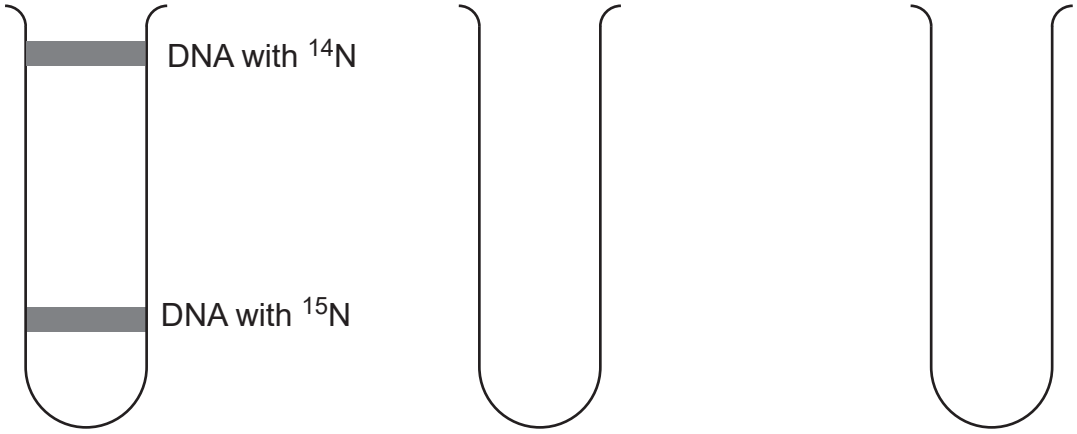


The bacteria were then transferred to a medium containing ^{15}N (a 'heavy' nitrogen isotope), and allowed to reproduce for many generations. The band was seen to be much lower in the tube as shown below.



The bacteria were then transferred back to a medium containing ^{14}N and allowed to reproduce. Samples of DNA were extracted and centrifuged after one generation. This process was repeated for further generations.

(i) **Complete the diagrams below** by drawing appropriate bands to show the position of the extracted DNA. The first tube shows the position of bands when grown on ^{14}N and ^{15}N as described previously.



Reference bands | After **one** generation in ^{14}N | After **two** generations in ^{14}N

[2]

(ii) Explain the result obtained following **two** generations in ^{14}N.

_____

_____

_____

_____

_____

_____

_____ [2]

(iii) Meselson and Stahl continued this experiment for several generations.

Suggest the appearance of the bands in the tube after several generations.

_____

_____

_____

_____

_____

_____ [2]

(c) Identify the stage of the cell cycle during which DNA replication occurs.

_____ [1]

4 Mitosis and meiosis are both processes of nuclear division. However, meiosis is a two-stage process.

(a) State one **similarity** and one **difference** between the following phases:

Prophase in mitosis and prophase I in meiosis.

Similarity _____

_____

Difference _____

_____

Metaphase in mitosis and metaphase I in meiosis.

Similarity _____

_____

Difference _____

_____ [4]

(b) Mitosis is the division of the nucleus and cytokinesis is the division of the cell into two daughter cells. Cytokinesis differs in plant and animal cells.

Describe concisely the main events which take place during cytokinesis in plant and animal cells.

Plant cells _____

_____

_____

Animal cells _____

_____

_____ [2]

(c) Asbestos is a substance which has been used to strengthen and fireproof materials. It has been found to be harmful to human health and is no longer used as a building material.

Asbestos can interfere with the production of spindle fibres, reducing the number of fibres formed.

Asbestos has also been shown to block chromosomes from moving in the cell.

(i) Using the information provided, explain why prophase is likely to be affected by the presence of asbestos.

_____

_____

_____ [1]

(ii) Metaphase is also affected by asbestos.

Using the information provided, describe and explain how asbestos interferes with metaphase.

_____

_____

_____

_____

_____

_____ [2]

(d) Drugs described as mitotic poisons can be used as cancer treatments.

Name a mitotic poison used for this purpose and describe how it works.

Name _____

_____

_____

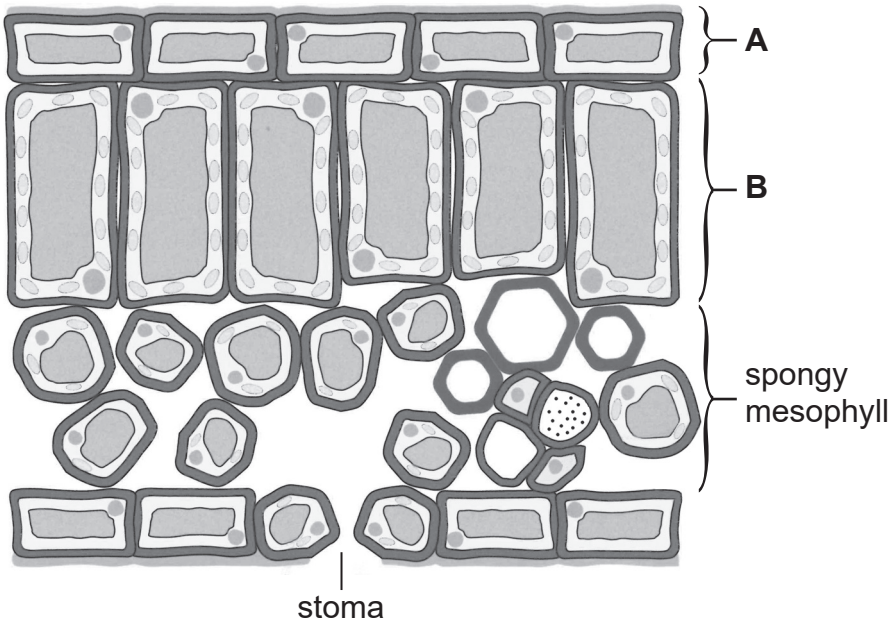
_____ [2]

BLANK PAGE

DO NOT WRITE ON THIS PAGE

(Questions continue overleaf)

5 The diagram below represents a transverse section through a mesophytic leaf.



Source: © Biology for CCEA AS Level by Dr J Napier, Colourpoint Books, 2016

(a) Identify **one** difference between tissue layers **A** and **B** and explain the reason for this difference.

_____

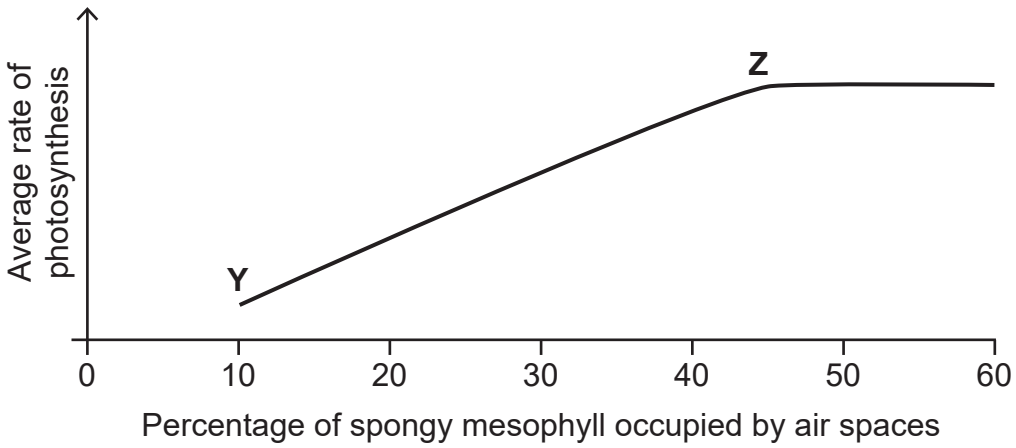
_____

_____

_____ [2]

The spongy mesophyll tissue layer contains air spaces between cells to allow for the diffusion of gases through the leaf. Different species of plant vary in the percentage of spongy mesophyll occupied by air spaces. Investigations have been conducted to determine how this impacts the rate of photosynthesis.

The graph below shows the average rate of photosynthesis in plants with different percentages of spongy mesophyll occupied by air spaces.



(b) Describe the trend shown between **Y** and **Z** and suggest an explanation.

_____

_____

_____

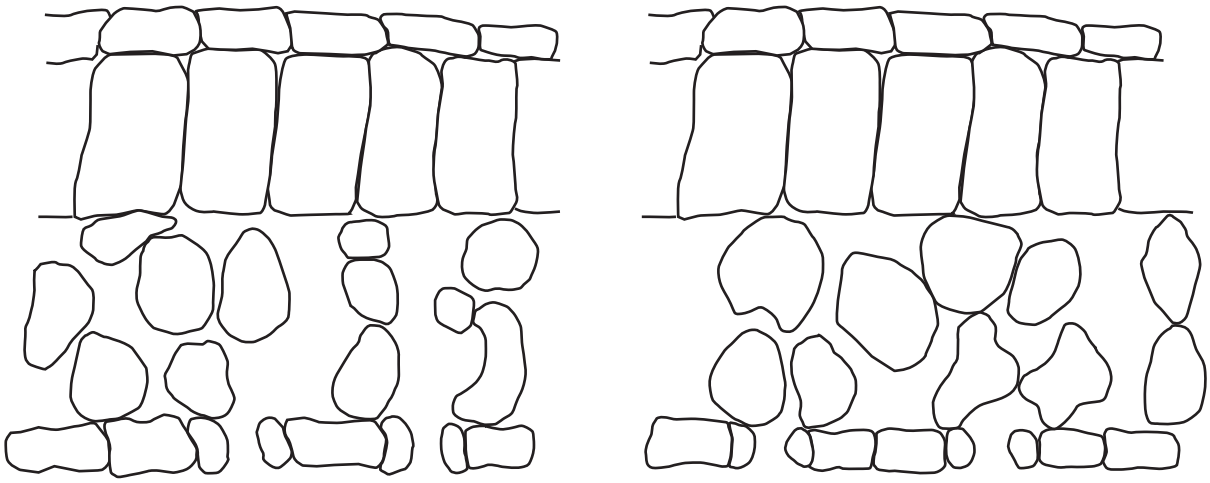
_____

_____

_____ [2]

[Turn over

The drawings below represent leaf sections of two plant species, **1** and **2**. They both have similar percentages of their spongy mesophyll occupied by air spaces. However, species **1** photosynthesises at a faster rate.



Species **1** Species **2**

Source: Principal Examiner

(c) Using the drawings, suggest and explain **one** possible reason for the faster rate of photosynthesis in species **1**.

_____

_____

_____

_____

_____

_____ [2]

(d) In another investigation, stomatal distribution and density (average number of stomata per mm^2) were recorded in Magnolia and Acacia leaves.

The results are shown in the table below.

Plant species	Average number of stomata / mm^{-2}	
	Upper surface	Lower surface
Magnolia	115	400
Acacia	20	210

(i) Summarise the data shown in the table and suggest a reason for the density of stomata on the upper surface of Acacia.

_____

_____

_____

_____

_____

_____

_____

_____ [3]

(ii) Calculate the percentage of the Acacia's stomata which are on its lower surface.

Show your working out.

_____ % [2]

[Turn over

BLANK PAGE

DO NOT WRITE ON THIS PAGE

6 **(a)** Osmosis involves the movement of water between a cell and its external environment. Solute potential and pressure potential are two factors involved in osmosis.

(i) Explain why solute potential is always a **negative** value and pressure potential is always a **positive** value in turgid plant cells.

_____

_____

_____

_____

_____

_____ [2]

(ii) State the equation used to calculate the water potential of a cell (Ψ_{cell}).

_____ [1]

(iii) A plant cell has a Ψ_{cell} of −900 kPa. The pressure potential (Ψ_p) of the cell is 250 kPa.

Calculate the solute potential (Ψ_s) of this cell.

_____ kPa [1]

[Turn over

(b) Rock Samphire, shown in the photograph below, is a plant which is often found growing in coastal areas. The water in these areas has a salt concentration of 3–5%.

Source: Dr James Napier

The plants store salt in the vacuoles of their cells. The vacuoles can have salt concentrations of 30–45%.

(i) Suggest how this adaptation enables Rock Samphire to survive in coastal areas.

_____

_____

_____

_____

_____

_____ [2]

(ii) In the past, Rock Samphire growing in coastal areas was harvested for human consumption. It was transported in saltwater to restaurants.

Describe and explain what would happen if the Rock Samphire was transported in tap water rather than saltwater.

_____

_____

_____

_____

_____

_____

_____ [3]

7 Eukaryotic cells contain membrane-bound organelles.

Table 1 below shows the relative volumes of some cell organelles found inside a liver cell, presented as percentage of total cell volume, and the approximate number of each within a liver cell.

Table 1

Organelle	Percentage of total cell volume	Approximate number per cell
Mitochondria	22	1700
Endoplasmic reticulum	11	3
Nucleus	7	1
Golgi apparatus	3	1
Lysosomes	1	300

(a) Using the information in **Table 1**, suggest **two** cell processes which occur at relatively high rates in liver cells.

1. _____

_____

2. _____

_____ [2]

(b) **Table 2** below shows the percentage of some membrane types within a liver cell.

Table 2

Membrane type	Percentage of total membranes within a liver cell
Mitochondria	39
Rough endoplasmic reticulum	35
Smooth endoplasmic reticulum	16
Nucleus (inner)	0.2
Golgi apparatus	7
Lysosomes	0.4

(i) Using the information provided in **Table 1** and your knowledge, suggest explanations for the high percentage shown for mitochondria in **Table 2**.

_____

_____

_____

_____

_____ [2]

(ii) Using the information provided and your knowledge, suggest explanations for the low percentage shown for lysosomes in **Table 2**.

_____

_____

_____

_____

_____ [2]

[Turn over

Plant cells are eukaryotic cells surrounded by a cell wall.

(c) Cell walls of adjacent plant cells are linked by the middle lamella.

Name the substance which forms the middle lamella.

_____ [1]

Section B

In this question you will be assessed on the quality of your written communication skills including the use of specialist scientific terms.

8 **(a)** Give an account of the structure of proteins, including conjugated proteins. You should include details of the type of bond involved in each level of structure. [9]

(b) Proteins can be classified as globular or fibrous. Distinguish between the two, with reference to structure and function. [6]

(a) Give an account of the structure of proteins, including conjugated proteins. You should include details of the type of bond involved in each level of structure.

[Turn over

(b) Proteins can be classified as globular or fibrous.
Distinguish between the two, with reference to structure and function.

[Turn over

THIS IS THE END OF THE QUESTION PAPER

BLANK PAGE

DO NOT WRITE ON THIS PAGE

Source: All images © CCEA unless otherwise stated.

DO NOT WRITE ON THIS PAGE

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

Examiner Number

Permission to reproduce all copyright material has been applied for.
In some cases, efforts to contact copyright holders may have been unsuccessful and CCEA will be happy to rectify any omissions of acknowledgement in future if notified.