

Biology
UNIT: 4BI1
PAPER: 2B

Total Marks

Friday 17 November 2023 – Morning

Time: 1 hour 15 minutes

In the boxes below, write your name, centre number and candidate number.

Surname					
Other names					
Centre Number					
Candidate Number					

YOU MUST HAVE

Calculator, ruler

YOU WILL BE GIVEN

Text Booklet, Diagram Booklet

INSTRUCTIONS

Answer ALL questions.

Answer the questions in the spaces provided in this Question Paper or in the separate Diagram Booklet – there may be more space than you need.

Show all the steps in any calculations and state the units.

INFORMATION

The total mark for this paper is 70.

The marks for EACH question are shown in brackets – use this as a guide as to how much time to spend on each question.

There may be spare copies of some diagrams.

ADVICE

Read each question carefully before you start to answer it.

Try to answer every question.

Check your answers if you have time at the end.

Answer ALL questions.

Some questions must be answered with a cross in a box ☐. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☐.

- 1 Read the passage in the Text Booklet provided.
Use the information in the passage and your own
knowledge to answer the questions that follow.

- (a) Explain why more cars would result in an increase
in atmospheric carbon dioxide. (Lines 1–5)
(2 marks)

(continued on the next page)

1 continued.

- (b) Explain how increased carbon dioxide can cause climate change.
(2 marks)**

(continued on the next page)

1 continued.

- (c) Explain why increasing carbon dioxide concentration can increase photosynthesis in plants.
(2 marks)**

(continued on the next page)

1 continued.

- (d) Explain why the carbon sink depends upon respiration and deforestation as well as photosynthesis. (Lines 20 to 24)
(2 marks)**

(continued on the next page)

1 continued.

- (e) Light affects gas exchange in leaves.
(Lines 30 to 32)**

**Describe an experiment that shows how the
net gas exchange from a leaf varies with
light intensity.
(3 marks)**

Answer space continues on the next page.

Turn over

1(e) continued.

(continued on the next page)

1 continued.

- (f) Look at the photograph for Question 1(f) in the Diagram Booklet. It shows stomata on a small square of the lower surface of a leaf.**

The total area of the lower surface of the leaf is 150 cm^2 .

Using the photograph and the total lower surface area of the leaf, estimate the number of stomata on the lower surface of the leaf.

(3 marks)

number of stomata = _____

(continued on the next page)

1 continued.

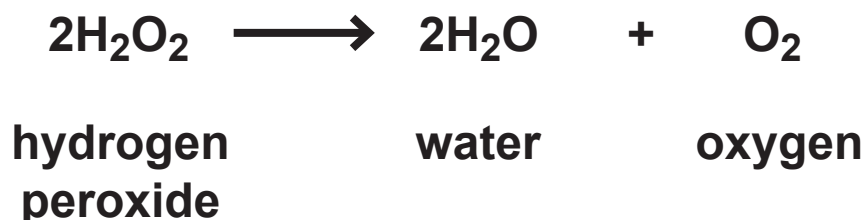
(g) Stomata also have a role in water transport in the plant.

**Explain the role of stomata in water transport.
(2 marks)**

(Total for Question 1 = 16 marks)

2 Catalase is an enzyme found in many cells.

This enzyme controls the breakdown of hydrogen peroxide into water and oxygen.



A teacher uses this method to investigate the effect of pH on catalase.

Step 1 cut a cylinder of potato tissue into six equal sized discs

Step 2 measure 10 cm^3 of hydrogen peroxide solution and place into a boiling tube

Step 3 add a pH buffer solution to the tube to keep the pH at 7

Step 4 add the six potato discs to the boiling tube

Step 5 collect the gas given off by the reaction in an inverted 20 cm^3 measuring cylinder

Step 6 measure the total volume of gas collected after five minutes

Repeat steps 1 to 6 using four different pH buffers (pH 4, pH 5, pH 6 and pH 8).

(continued on the next page)

Turn over

2 continued.

Look at the diagram for Question 2 in the Diagram Booklet. It shows the teacher's apparatus.

- (a) State what is meant by the term ENZYME.
(1 mark)**

- (b) Suggest why each potato cylinder was cut into six discs rather than left as one cylinder.
(1 mark)**

(continued on the next page)

2 continued.

- (c) (i) Give the dependent variable in this experiment.
(1 mark)**

- (ii) The teacher controls the time for gas collection and also the volume of hydrogen peroxide used.**

**State two other abiotic variables the teacher should control in this experiment.
(2 marks)**

1

2

(continued on the next page)

2 continued.

(d) Look at the table for Question 2(d) in the Diagram Booklet. It shows the teacher's results.

- (i) Calculate the percentage change in the mean rate of reaction as the pH is changed from pH 4 to pH 7.
(2 marks)**

percentage change = _____%

(continued on the next page)

2(d) continued.

- (ii) The teacher calculated the mean rate of reaction by collecting the oxygen released for the first five minutes of the reaction.**

**Explain why the mean rate of reaction changes beyond the first five minutes.
(2 marks)**

Answer space continues on the next page.

2(d)(ii) continued.

(continued on the next page)

2(d) continued.

**(iii) Explain the effect of changing pH on an enzyme-controlled reaction.
(3 marks)**

Answer space continues on the next page.

[illegible]

Turn over

2(d)(iii) continued.

(Total for Question 2 = 12 marks)

- 3 Look at the diagram for Question 3(a) in the Diagram Booklet. It shows a nephron from a human kidney with some structures labelled.**

**(a) (i) Which structure is the Bowman's capsule?
(1 mark)**

☐ A P

☐ B R

☐ C S

☐ D T

**(ii) Which structure is the loop of Henle?
(1 mark)**

☐ A P

☐ B Q

☐ C S

☐ D U

(continued on the next page)

3(a) continued.

**(iii) Which structure is affected by ADH?
(1 mark)**

☐ **A P**

☐ **B Q**

☐ **C S**

☐ **D T**

(continued on the next page)

3 continued.

- (b) (i) Blood plasma contains much glucose, but urine normally does not.**

Explain what happens to glucose in the kidney.

(3 marks)

Answer space continues on the next page.

3(b)(i) continued.

(continued on the next page)

3(b) continued.

- (ii) Describe how a sample of urine could be tested for glucose.
(2 marks)**

(continued on the next page)

3 continued.

(c) As a person sweats, they may become dehydrated.

Describe the changes in a person's urine if they become dehydrated.

(2 marks)

(Total for Question 3 = 10 marks)

4 Mutation can cause changes in the enzymes produced during protein synthesis.

**(a) State what is meant by the term MUTATION.
(1 mark)**

(continued on the next page)

4 continued.

- (b) Explain the different effects that a single base mutation can have on transcription and translation and the production and activity of an enzyme.
(5 marks)**

Answer space continues on the next page.

4(b) continued.

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4 continued.

- (c) Scientists investigate the rate of spontaneous mutations in yeast.**

They record the number of mutations per cell during mitosis and during meiosis.

They count the mutations in three different strains of yeast and repeat each count.

The mutation rates are counted per division per cell.

Look at the table for Question 4(c) in the Diagram Booklet.

- (i) Calculate the mean mutation rate for strain 5207 during meiosis.
(2 marks)**

mean rate = _____ $\times 10^8$ per division per cell

(continued on the next page)

Turn over

4(c) continued.

- (ii) Suggest why the mutation is calculated per division per cell rather than just per cell.
(1 mark)**

- (iii) Comment on the differences in rates of mutation for mitosis and meiosis in the different yeast strains.
(4 marks)**

Answer space continues on the next page.

4(c)(iii) continued.

[illegible]

(Total for Question 4 = 13 marks)

5 Look at the diagram for Question 5(a) in the Diagram Booklet. It shows the nitrogen cycle with some processes labelled.

**(a) (i) Explain why plants need nitrate ions.
(2 marks)**

(continued on the next page)

5(a) continued.

**(ii) Name the processes V, X and Y.
(3 marks)**

V _____

X _____

Y _____

(continued on the next page)

5 continued.

- (b) Scientists measure the dissolved nitrate levels in a river that passes through farmland.**

They also measure the nitrogen compounds being used on the farmland either as fertiliser or as manure from livestock.

Look at the graph for Question 5(b) in the Diagram Booklet. It shows how the nitrate levels in the river and the nitrogen compounds applied to the farmland changed from 1950 to 2005.

- (i) Comment on the relationship between nitrate levels in the river and the nitrogen compounds applied to the farmland.
(4 marks)**

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5(b)(i) continued.

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5(b) continued.

- (ii) Describe the changes within the river that would have occurred between 1950 and 2000. (3 marks)**

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5(b)(ii) continued.

(Total for Question 5 = 12 marks)

- 6 (a) Describe how stem cells are different from other cell types.
(2 marks)**

(continued on the next page)

6 continued.

- (b) Stem cells from a donor can be used for stem cell therapy.**

Human blood cells are produced in bone marrow.

Explain how using stem cells from the bone marrow enables doctors to treat a number of different blood conditions.

(3 marks)

Answer space continues on the next page.

6(b) continued.

(continued on the next page)

6 continued.

- (c) One type of stem cell transplant uses a patient's own stem cells.**

They can be used if the patient is producing enough healthy bone marrow cells. These cells can be collected, frozen and stored for later use.

Explain the advantage of using the patient's own stem cells rather than using stem cells from a donor.

(2 marks)

Answer space continues on the next page.

Turn over

6(c) continued.

(Total for Question 6 = 7 marks)

TOTAL FOR PAPER = 70 MARKS
END OF PAPER