Paper Reference(s) 4BI1/2B
Pearson Edexcel International GCSE (9–1)

Total Marks

Biology
UNIT: 4BI1
PAPER: 2B

Time: 1 hour 15 minutes

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

Surname					
Other names					
Centre Number					
Candidate Number					

Y69467A

Pearson

YOU MUST HAVE

Calculator, ruler

YOU WILL BE GIVEN

Source Booklet
Diagram Booklet

INSTRUCTIONS

Answer ALL questions.

Answer the questions in the spaces provided 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 Source Booklet. Use the information in the passage and your own knowledge to answer the questions that follow.

(a) (i) Carbon dioxide is a greenhouse gas.

State the name of another greenhouse gas (lines 14 and 15). (1 mark)

_____

_____

(continued on the next page)

1 continued.

(ii) Calculate the increase in mass, in kg, of atmospheric carbon dioxide in 2020 (lines 3 to 14).

Give your answer in standard form.
(3 marks)

[1 gigatonne = 1 000 000 000 000 kg]

Increase in mass = _____ kg

(continued on the next page)

1 continued.

(iii) State two consequences of global warming for the environment. (2 marks)

1 _____

_____

_____

2 _____

_____

_____

(continued on the next page)

1 continued.

(b) Explain why producing genetically engineered plants with additional suberin in their roots could reduce atmospheric carbon dioxide (lines 28 to 35 and lines 36 to 47). (4 marks)

(continued on the next page)

1 continued.

(c) Which enzyme is used to remove a gene from a section of DNA?
(1 mark)

☐ A amylase

☐ B ligase

☐ C lipase

☐ D restriction

(continued on the next page)

1 continued.

(d) Explain why the additional suberin in the cell walls of the roots will make the transgenic plants tolerant to soil with a high salt concentration (lines 51 to 56).
(2 marks)

(continued on the next page)

1 continued.

(continued on the next page)

1 continued.

(e) Give three reasons why the scientists use micropropagation to reproduce the transgenic crop plants (lines 47 to 50).
(3 marks)

1 _____

_____

_____

2 _____

_____

_____

3 _____

_____

_____

(Total for Question 1 = 16 marks)

2 A student uses this method to investigate the nitrogen cycle.

- take two samples of soil, each of mass 100 g
- sterilise one sample of soil by heating at 100 °C for one hour
- place the sterilised and unsterilised samples into separate filter funnels
- pour 25 cm^3 of water through each soil sample and collect the filtrate in a test tube
- test each filtrate for nitrates
- pour water through each soil sample for 5 minutes
- pour another 25 cm^3 of water through each soil sample and collect the filtrate in a test tube
- test each filtrate for nitrates
- add 1 cm^3 of a solution of ammonium salts to each soil and leave for three days

(continued on the next page)

2 continued.

- pour 25 cm^3 of water through each soil sample again and collect the filtrate in a test tube
- test each filtrate for nitrates

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

Look at the table for Question 2 in the Diagram Booklet. It shows the student's results.

(a) Give the independent variable in the investigation.
(1 mark)

(continued on the next page)

2 continued.

(b) (i) Suggest why the student poured water through the soil samples for five minutes before adding the ammonium salts.
(2 marks)

(continued on the next page)

2 continued.

(ii) Comment on the results of the nitrate tests on the two soil samples three days after adding ammonium salts.
(4 marks)

(continued on the next page)

2 continued.

(Total for Question 2 = 7 marks)

3 Look at the diagram for Question 3 in the Diagram Booklet. It shows a single-celled organism called **Chlorella** that lives in fresh water.

Chlorella has a chloroplast and can photosynthesise.

(a) (i) Which of these groups of organisms contains **Chlorella**? (1 mark)

- ☐ A animals
- ☐ B bacteria
- ☐ C plants
- ☐ D protoctists

(continued on the next page)

3 continued.

(ii) Which of these labelled structures would also be present in an animal cell?
(1 mark)

☐ A cell membrane and chloroplast

☐ B cell membrane and mitochondrion

☐ C cell wall and chloroplast

☐ D cell wall and mitochondrion

(continued on the next page)

3 continued.

(b) Complete the balanced chemical symbol equation for photosynthesis. (2 marks)

_____ + _____

→ _____ + $6O_2$

(continued on the next page)

3 continued.

(c) Look at the graph for Question 3(c) in the Diagram Booklet. It shows the effect of light intensity on gas exchange by *Chlorella*.

(i) Explain why *Chlorella* takes in oxygen at light intensities below 10 arbitrary units.
(2 marks)

(continued on the next page)

3 continued.

(ii) Explain the changes in the volume of oxygen released as the light intensity increases from 10 arbitrary units.
(3 marks)

(continued on the next page)

3 continued.

(continued on the next page)

3 continued.

(iii) The volume of oxygen released by **Chlorella** is the difference between the oxygen produced by photosynthesis and the oxygen taken in.

Use the graph to calculate the volume of oxygen produced in five minutes by photosynthesis at a light intensity of 45 arbitrary units.
(2 marks)

volume of oxygen = _____ mm^3

(continued on the next page)

3 continued.

(d) Describe how hydrogen-carbonate indicator could be used to investigate the effect of light intensity on carbon dioxide exchange by *Chlorella*.
(3 marks)

(continued on the next page)

3 continued.

(Total for Question 3 = 14 marks)

4 Look at the diagram for Question 4(a) in the Diagram Booklet. It shows part of the human urinary system.

(a) Name the structures labelled A and B.
(2 marks)

A _____

_____

B _____

_____

(continued on the next page)

4 continued.

(b) Look at the diagram for Question 4(b) in the Diagram Booklet. It shows a kidney nephron.

Look at the table for Question 4(b) in the Diagram Booklet. It shows the relative concentrations of glucose and protein in the areas labelled X, Y and Z on the diagram.

(i) Explain the difference between the concentration of protein in area X and the concentration of protein in area Y.
(2 marks)

(continued on the next page)

4 continued.

(continued on the next page)

4 continued.

(ii) Explain the difference between the concentration of glucose in area Y and the concentration of glucose in area Z.
(2 marks)

(continued on the next page)

4 continued.

(continued on the next page)

4 continued.

(c) When the body becomes dehydrated, the concentration of urine increases.

Explain the changes that occur in the body that lead to the production of concentrated urine.
(4 marks)

(continued on the next page)

4 continued.

(Total for Question 4 = 10 marks)

5 Pineapple juice contains a protease called bromelain.

A student uses this method to investigate the digestion of solid gelatine protein by bromelain.

- place solid gelatine protein into a test tube up to a height of 5 cm
- mix 5 cm^3 pineapple juice with 1 cm^3 of pH 4 buffer
- place 1 cm^3 of the pineapple juice and buffer solution on top of the gelatine
- leave for one hour in a water bath set to 37 °C
- measure the height of the solid gelatine and use it to calculate the volume of gelatine that has been digested

Repeat the method three more times.

(continued on the next page)

5 continued.

Look at the diagram for Question 5 in the Diagram Booklet. It shows part of the student's method.

(a) Look at the table for Question 5(a) in the Diagram Booklet. It shows the student's results for the volumes of gelatine digested at pH 4.

(i) Calculate the mean volume of gelatine digested in cm^3.

Give your answer to two decimal places.
(3 marks)

(continued on the next page)

5 continued.

mean volume = _____ cm^3

(continued on the next page)

5 continued.

(ii) State what substances are produced when the gelatine protein is digested.
(1 mark)

_____

_____

(continued on the next page)

5 continued.

(b) The student repeats the investigation with different pH buffers.

Look at the table for Question 5(b) in the Diagram Booklet. It shows their results.

(i) Give two variables the student should control.
(2 marks)

1 _____

_____

2 _____

_____

(continued on the next page)

5 continued.

(ii) Explain the effect of changing the pH on the mean volume of gelatine digested.
(3 marks)

(continued on the next page)

5 continued.

(c) Describe how to test for the presence of protein.
(2 marks)

(Total for Question 5 = 11 marks)

6 Beta thalassaemia is a genetic condition caused by a mutation in a gene for haemoglobin.
People with beta thalassaemia produce less haemoglobin and fewer red blood cells than people without the condition.

(a) Explain why people with beta thalassaemia may experience severe tiredness.
(2 marks)

(continued on the next page)

6 continued.

(continued on the next page)

6 continued.

(b) A new treatment for beta thalassaemia has been developed that edits the haemoglobin gene. These are the steps in the treatment.

- remove blood stem cells from a patient's bone marrow
- put a strand of RNA and an enzyme into the blood stem cells to correct the haemoglobin gene
- use drugs to destroy the patient's remaining bone marrow cells
- replace the patient's bone marrow cells with the modified stem cells

The modified stem cells that are in the bone marrow now produce red blood cells containing sufficient haemoglobin.

(continued on the next page)

6 continued.

(i) The strand of RNA used in this treatment is complementary to one strand of the DNA in the haemoglobin gene.

Look at the table for Question 6(b)(i) in the Diagram Booklet. Complete the table to give the base sequence of RNA that is complementary to this sequence of DNA.
(2 marks)

(continued on the next page)

6 continued.

(ii) Protein synthesis of the modified gene will produce haemoglobin.

Describe the stages of this protein synthesis.
(4 marks)

(continued on the next page)

6 continued.

(continued on the next page)

6 continued.

(iii) The standard treatment for beta thalassaemia is a weekly blood transfusion.

The new treatment has so far been tested on two patients, with these results.

- both patients started making large numbers of red blood cells with sufficient haemoglobin
- both patients experienced serious side effects from the drugs used, needing to spend several months in isolation in hospital before recovering
- 15 months after the treatment, neither patient required further blood transfusions
- both patients were able to exercise normally without feeling tired

(continued on the next page)

6 continued.

Evaluate the use of the new treatment compared to weekly blood transfusions.
(4 marks)

(continued on the next page)

6 continued.

(Total for Question 6 = 12 marks)

TOTAL FOR PAPER = 70 MARKS
END OF PAPER