Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International GCSE (9-1)

Friday 17 November 2023

Morning (Time: 1 hour 15 minutes)

Paper reference **4BI1/2B**

Biology

UNIT: 4BI1
PAPER: 2B

You must have:
Calculator, ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *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.*

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.

Turn over ▶

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P 7 3 4 9 2 R R A 0 1 2 0

Pearson

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 below. Use the information in the passage and your own knowledge to answer the questions that follow.

Plants to the rescue

Since the early 20th century, the concentration of carbon dioxide in the atmosphere has increased rapidly. This has further increased in recent years due to more cars and the increased demand for electricity for homes and industry.

Scientists have found that plants play a critical part in removing this excess carbon dioxide from the atmosphere. Using computer models, the scientists concluded that photosynthesis has increased by 30 per cent.

The scientists measured carbonyl sulfide found in ice cores and air samples. In addition to carbon dioxide, plants take in carbonyl sulfide gas during their natural carbon cycle, and this is frequently used as a measure of photosynthesis on a global scale. Terrestrial plants are removing about 29 per cent of carbon dioxide emissions that would otherwise contribute to an increase in the atmospheric carbon dioxide concentration.

A carbon sink is an ecosystem, such as a forest, that absorbs more carbon dioxide than it releases. The size of the carbon sink depends on the rate of photosynthesis but also on the levels of deforestation and respiration. The model the scientists used showed that the role of photosynthesis in producing a carbon sink in land plants is larger than estimated in most other models.

Other scientists are less confident about using carbonyl sulfide as a measure of photosynthesis. Plant absorption of carbonyl sulfide can vary depending upon the amount of light the plants receive. Therefore, the measure of global photosynthesis could be overestimated.

Regardless of the rate at which photosynthesis has increased, scientists agree that excess carbon dioxide is boosting the growth of plants. Trees are becoming leafier, and there is more wood. The wood is where most of the carbon is stored in the plant.

In experimental research, scientists exposed plants to double the normal concentration of carbon dioxide found in the atmosphere. Under these increased carbon dioxide conditions, the composition of the leaf tissues changed. This made the leaves tougher for herbivores to eat and made it harder for insect larvae to grow.

Scientists have also observed that when plants are exposed to increasing levels of carbon dioxide, the size of the stomatal pores on a leaf increases.

(a) Explain why more cars would result in an increase in atmospheric carbon dioxide. (Lines 1-3)

(2)

(b) Explain how increased carbon dioxide can cause climate change.

(2)

(c) Explain why increasing carbon dioxide concentration can increase photosynthesis in plants.

(2)

(d) Explain why the carbon sink depends upon respiration and deforestation as well as photosynthesis. (Lines 13 to 15)

(2)

(e) Light affects gas exchange in leaves. (Lines 19 and 20)

Describe an experiment that shows how the net gas exchange from a leaf varies with light intensity.

(3)

(f) The photograph shows stomata on a small square of the lower surface of a leaf.

(Source: © Kallayanee Naloka/Shutterstock)

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)

number of stomata = ...

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

Explain the role of stomata in water transport.

(2)

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.....

(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.

$$2H_2O_2 \longrightarrow 2H_2O + O_2$$

hydrogen peroxide — water — 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

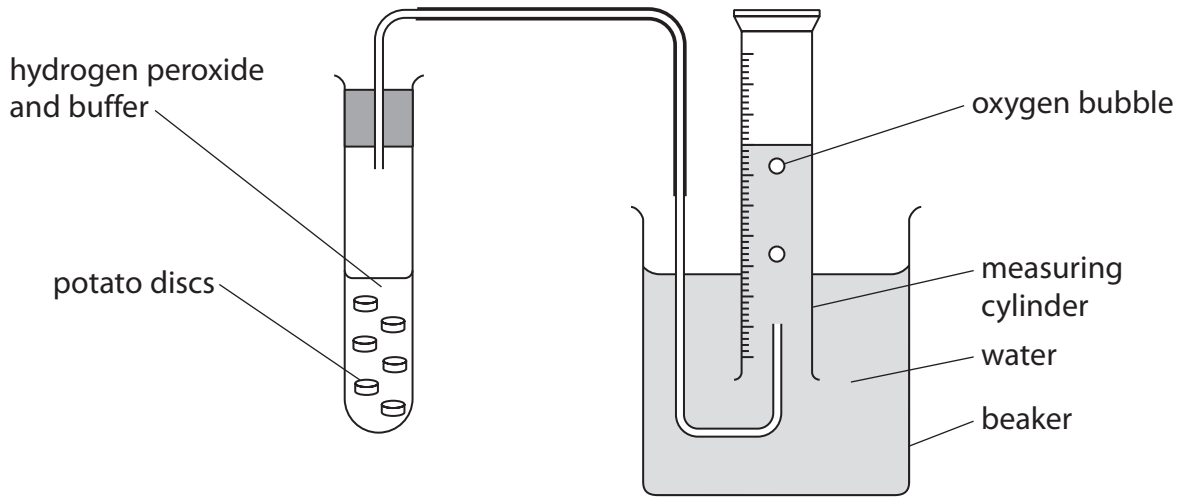
Step 4 add the six potato discs to the boiling tube

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).

The diagram shows the teacher's apparatus.



(a) State what is meant by the term **enzyme**.

(1)

.....

.....

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

(1)

.....

.....

(c) (i) Give the dependent variable in this experiment.

(1)

.....

.....

(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)

1 .....

2 .....

(d) The table shows the teacher's results.

pH of solution	Volume of oxygen after 5 minutes in cm^3	Mean rate of reaction in cm^3 per minute
4	4	0.8
5	6	1.2
6	7	1.4
7	12	2.4
8	3	0.6

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

(2)

percentage change = ... %

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(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)

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

(3)

(Total for Question 2 = 12 marks)

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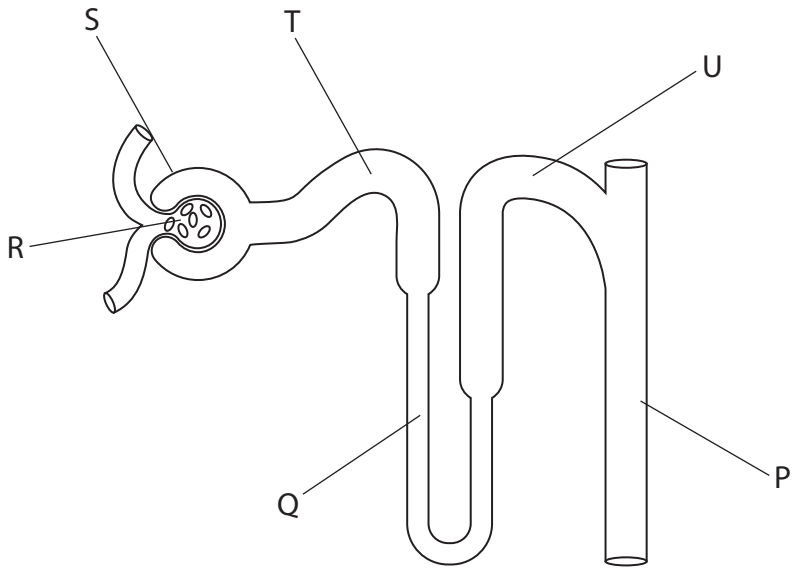
3 The diagram shows a nephron from a human kidney with some structures labelled.



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

(1)

- ☒ **A** P
- ☒ **B** R
- ☒ **C** S
- ☒ **D** T

(ii) Which structure is the loop of Henle?

(1)

- ☒ **A** P
- ☒ **B** Q
- ☒ **C** S
- ☒ **D** U

(iii) Which structure is affected by ADH?

(1)

- ☒ **A** P
- ☒ **B** Q
- ☒ **C** S
- ☒ **D** T

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

Explain what happens to glucose in the kidney.

(3)

(ii) Describe how a sample of urine could be tested for glucose.

(2)

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

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

(2)

(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)

(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)

(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.

Yeast strain	Mutation rate × 10^8 per division per cell	
	mitosis	meiosis
5160	6.53	45.4
	4.86	29.6
5207	5.90	132.6
	5.03	43.2
5209	0.21	2.20
	0.28	1.42

(i) Calculate the mean mutation rate for strain 5207 during meiosis.

(2)

mean rate = ... × 10^8 per division per cell

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

(1)

.....

.....

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

(4)

(Total for Question 4 = 13 marks)

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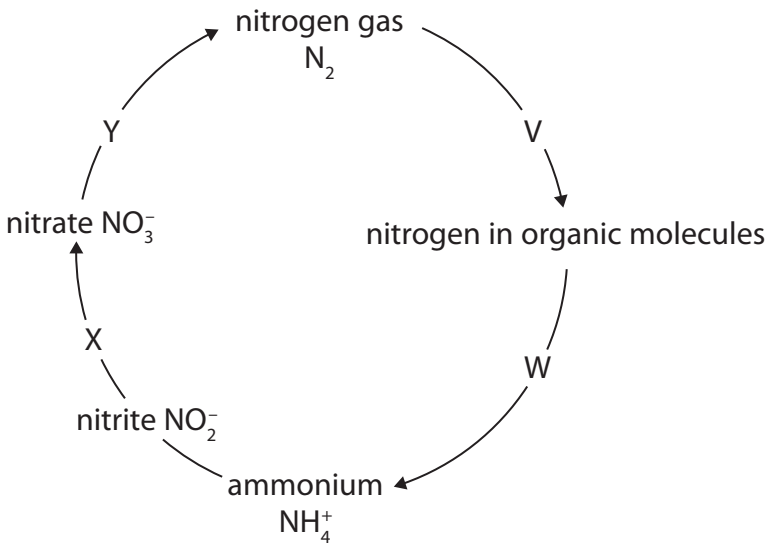
5 The diagram shows the nitrogen cycle with some processes labelled.



(a) (i) Explain why plants need nitrate ions.

(2)

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.....

.....

.....

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

(3)

V .....

X .....

Y .....

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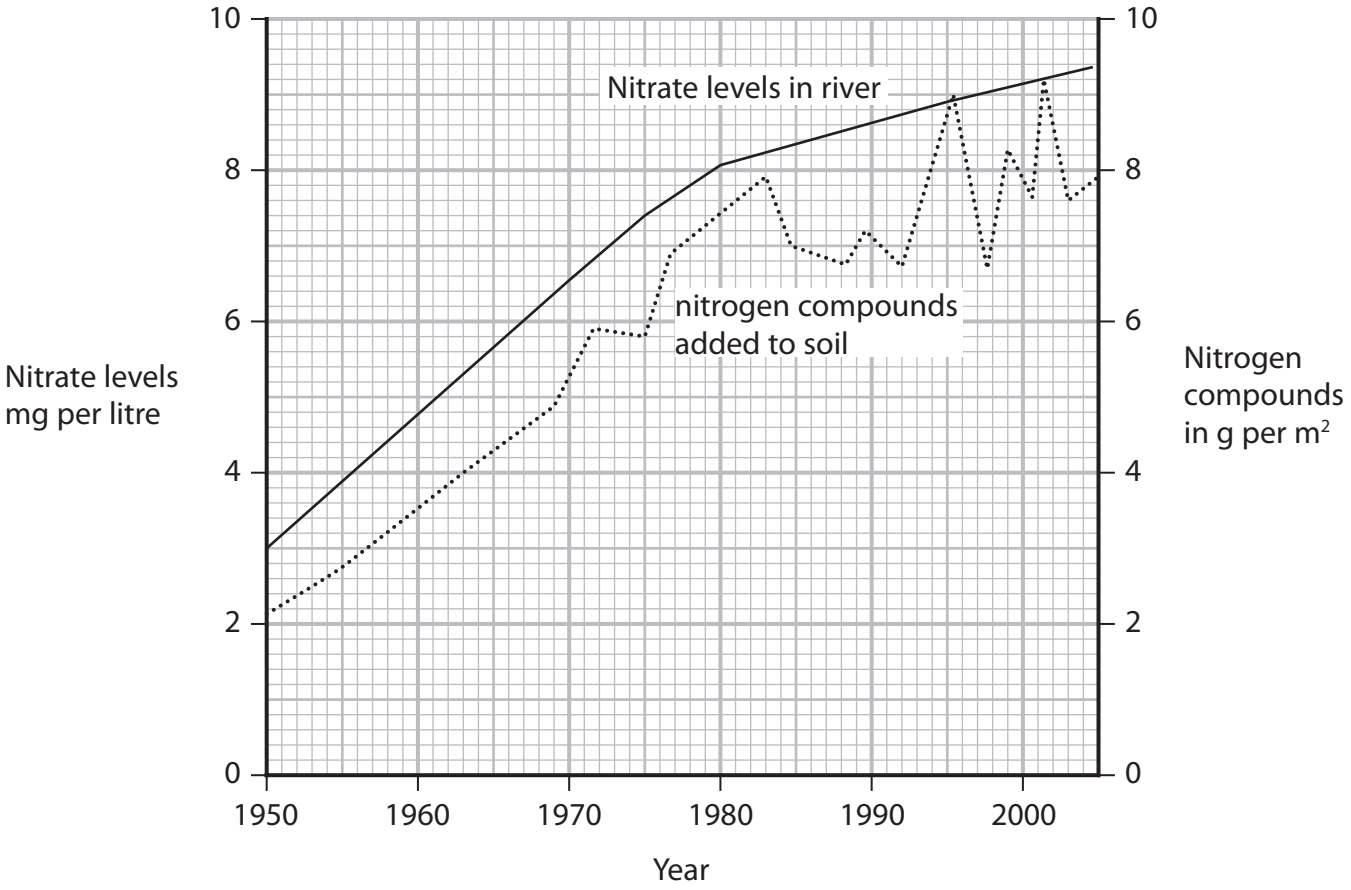
(b) Scientists measure the dissolved nitrate levels in a river that passes through farmland.

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

The graph shows how the nitrate levels in the river and the nitrogen compounds applied to the farmland changed from 1950 to 2005.



(Source: Graph: Trends in Nitrate Levels in Maumee River | U.S. Geological Survey (usgs.gov))

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

(4)

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

(3)

(Total for Question 5 = 12 marks)

6 (a) Describe how stem cells are different from other cell types.

(2)

(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)

(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)

(Total for Question 6 = 7 marks)

TOTAL FOR PAPER = 70 MARKS

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