

Biology

UNIT: 4BI1

Science (Double Award) 4BI1/4SD0

PAPER: 1B

Total Marks

Tuesday 16 May 2023 – Morning

Time: 2 hours

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

Surname					
Other names					
Centre Number					
Candidate Number					

YOU MUST HAVE

Ruler, calculator

YOU WILL BE GIVEN

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.

INFORMATION

The total mark for this paper is 110.

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 (a) All living organisms share characteristics.

(i) State two characteristics that all living organisms share.

(2 marks)

1 _____

2 _____

(continued on the next page)

1(a) continued.

(ii) Some organisms are pathogens.

**Which of these organisms can cause a
bacterial disease in humans?
(1 mark)**

- ☐ **A Chlorella**
- ☐ **B Lactobacillus bulgaricus**
- ☐ **C Mucor**
- ☐ **D Pneumococcus**

(b) Viruses are pathogens but not living organisms.

**(i) Describe the effect of a named virus that
infects plants.
(2 marks)**

Answer space continues on the next page.

1(b)(i) continued.

**(ii) Give three differences between the structure of viruses and bacteria.
(3 marks)**

1

2

3

(Total for Question 1 = 8 marks)

Turn over

2 Look at the diagram for Question 2 in the Diagram Booklet. It shows part of a food web from an ecosystem.

**(a) (i) Using the information in the food web, draw on the blank page for Question 2(a)(i) in the Diagram Booklet a food chain that contains five trophic levels and includes the birds.
(2 marks)**

**(ii) Describe how the bacteria and fungi obtain energy from the organic matter.
(3 marks)**

Answer space continues on the next page.

2(a)(ii) continued.

(b) A pesticide gets into this ecosystem.

The pesticide kills small and large arthropods.

**Explain how this affects the population of birds
and the population of worms that eat roots.
(3 marks)**

Answer space continues on the next page.

2(b) continued.

(c) Scientists use three different traps to collect some soil animals.

These traps are a basket trap, a pitfall trap, and a cul-de-sac trap.

The number of animals collected by each trap are counted each day.

The animals collected are classified into three types: springtails, mites and large arthropods.

(continued on the next page)

2(c) continued.

Look at the graph for Question 2(c) in the Diagram Booklet. It shows the scientists' results.

Discuss the number of each animal type collected by the three traps.

**Refer to the scientists' results in your answer.
(5 marks)**

Answer space continues on the next page.

2(c) continued.

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

(Total for Question 2 = 13 marks)

- 3 Look at the diagram for Question 3(a) in the Diagram Booklet. The diagram shows a plant cell with some structures labelled.**

**(a) (i) Which structure is the cell vacuole?
(1 mark)**

☐ A P

☐ B R

☐ C S

☐ D T

**(ii) Which structure is the site of photosynthesis?
(1 mark)**

☐ A P

☐ B Q

☐ C R

☐ D T

(continued on the next page)

3(a) continued.

**(iii) Which structure is the cell wall?
(1 mark)**

☐ **A P**

☐ **B Q**

☐ **C S**

☐ **D T**

(iv) Structure U is the site of protein synthesis in the cell.

**What is the name of structure U?
(1 mark)**

☐ **A chloroplast**

☐ **B mitochondrion**

☐ **C ribosome**

☐ **D starch granule**

(continued on the next page)

3 continued.

(b) A cell is shaped like a cube.

Each side has a length of 0.053 mm.

Calculate the surface area to volume ratio of this cell.

**Give your answer in the form $n : 1$
(3 marks)**

surface area to volume ratio =

_____ : 1

(continued on the next page)

3 continued.

(c) Animal cells, unlike plant cells, do not have a cell wall.

**(i) Explain how this difference affects red blood cells when placed in distilled water.
(3 marks)**

Answer space continues on the next page.

3(c)(i) continued.

**(ii) Explain how this difference affects red blood cells when placed in a concentrated salt solution.
(2 marks)**

(Total for Question 3 = 12 marks)

Turn over

- 4 Look at the diagram for Question 4(a) in the Diagram Booklet. It shows a human reflex response to touching a hot object.**

Some of the structures in the reflex arc are labelled.

- (a) (i) Give the name of this reflex response.
(1 mark)**

- (ii) Draw an arrow on the diagram to show the direction of the nerve impulse at point X.
(1 mark)**

- (iii) Which structure detects the stimulus?
(1 mark)**

☐ A E

☐ B F

☐ C H

☐ D K

(continued on the next page)

4(a) continued.

**(iv) Which structure is the motor neurone?
(1 mark)**

☐ **A F**

☐ **B G**

☐ **C I**

☐ **D K**

(continued on the next page)

4 continued.

(b) (i) A neurone is $1 \cdot 10$ m in length.

The speed of the nerve impulse in this neurone is 120 metres per second.

Calculate the time, in seconds, for the impulse to pass along the neurone.

**Give your answer in standard form.
(2 marks)**

time _____ s

(continued on the next page)

4(b) continued.

- (ii) Describe how the impulse passes from neurone to neurone in the reflex arc.
(2 marks)**

(continued on the next page)

4 continued.

(c) Pain has a survival function.

If a person damages their ankle, they sense pain.

**(i) Explain how sensing pain benefits
an organism.
(2 marks)**

(continued on the next page)

4(c) continued.

(ii) Some medicines are used to reduce pain.

These medicines work by preventing communication between the injured ankle and the brain.

**Explain which components of the nervous system may be affected by these medicines.
(4 marks)**

Answer space continues on the next page.

4(c)(ii) continued.

(Total for Question 4 = 14 marks)

5 Red blood cells and white blood cells are two of the components found in human blood.

**(a) State two other components of blood.
(2 marks)**

1 _____

2 _____

(b) Some white blood cells destroy pathogens.

Look at the diagram for Question 5(b) in the Diagram Booklet. It shows four stages in this process.

**Describe what is happening in each stage of this process.
(4 marks)**

Answer space continues on the next page.

5(b) continued.

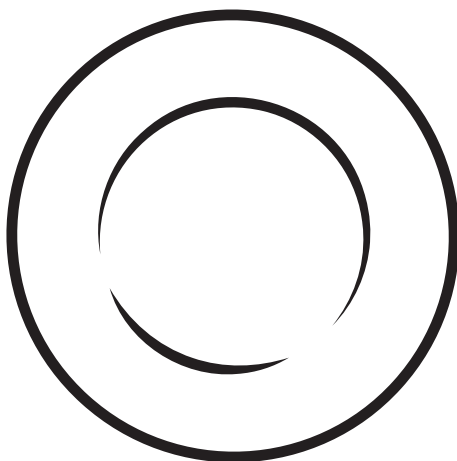
This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

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Turn over

5 continued.

(c) The image shows a human red blood cell.



(i) The actual diameter of this human red blood cell is $8.1\text{ }\mu\text{m}$.

Determine the magnification of the image.

[$1\text{ mm} = 1000\text{ }\mu\text{m}$]

(3 marks)

magnification = _____

5(c) continued.

- (ii) Patients with reduced numbers of red blood cells are described as anaemic.**

In an investigation, scientists measure the percentage oxygen saturation of the blood and the rate of tissue deoxygenation. The rate of tissue deoxygenation is a measure of how fast oxygen is lost from the tissues.

They use four groups of patients.

- non-anaemic patients with normal blood flow**
- anaemic patients with normal blood flow**
- non-anaemic patients with slow blood flow**
- anaemic patients with slow blood flow**

Look at the table for Question 5(c)(ii) in the Diagram Booklet. It shows the scientists' results.

(continued on the next page)

5(c)(ii) continued.

Discuss the relationships between anaemia, blood flow, percentage oxygen saturation of blood and rate of tissue deoxygenation.

**You should refer to data in the table and use your biological knowledge in your answer.
(5 marks)**

Answer space continues on the next 2 pages.

5(c)(ii) continued.

[illegible]

5(c)(ii) continued.

(Total for Question 5 = 14 marks)

- 6 Look at the diagrams for Question 6 in the Diagram Booklet.**

Many characteristics of pea plants are genetically controlled.

One of these characteristics is flower position.

Flower position can either be axial or terminal.

In a first cross, scientists crossed pea plants with axial flowers with pea plants with terminal flowers.

This first cross produced 1120 offspring plants.

All of these offspring plants had axial flowers.

- (a) Use a genetic diagram on the blank page for Question 6(a) in the Diagram Booklet to show the genotypes of the parent plants, the gametes they produce and the genotypes of the offspring plants. (3 marks)**

(continued on the next page)

6 continued.

- (b) The scientists allowed the offspring from the first cross to self-fertilise.**

This second cross produced 858 second generation plants. 608 of the plants had axial flowers and the other plants had terminal flowers.

- (i) Calculate the ratio of plants with axial flowers to plants with terminal flowers.**

**Give your answer in the form $n:1$
(2 marks)**

ratio = _____ : 1

(continued on the next page)

6(b) continued.

- (ii) Explain why the ratio of plants with axial flowers to plants with terminal flowers is different from the expected ratio.
(3 marks)**

Answer space continues on the next page.

6(b)(ii) continued.

- (c) Scientists want to discover if plants with axial flowers produce more seeds than plants with terminal flowers.**

Design an investigation to discover whether plants with axial flowers produce more seeds than plants with terminal flowers.

Include experimental details in your answer and write in full sentences.

(6 marks)

Answer space continues on the next 2 pages.

Turn over

6(c) continued.

[illegible]

Turn over

6(c) continued.

(Total for Question 6 = 14 marks)

- 7 Look at the diagram for Question 7 in the Diagram Booklet. Lipase digests lipid into fatty acids and glycerol. The fatty acids change the pH of the solution.**

A student uses this method to investigate the effect of temperature on the activity of lipase.

- STEP 1 label a test tube with the temperature (20 °C)**
- STEP 2 add 5 drops of phenolphthalein indicator to the test tube**
- STEP 3 add 5 cm³ of milk to the test tube**
- STEP 4 add 7 cm³ of sodium carbonate solution to the test tube (the contents of the test tube will now be pink)**
- STEP 5 place a thermometer in the test tube**
- STEP 6 place the test tube in a water bath at 20 °C for 5 minutes**
- STEP 7 place a beaker containing lipase in the same water bath for 5 minutes**

(continued on the next page)

7 continued.

STEP 8 replace the thermometer with a glass rod

STEP 9 measure out 1 cm^3 of lipase from the beaker in the water bath

STEP 10 add the lipase to the test tube, stir the contents and record the time until the contents lose their pink colour

The student repeats this method for five more temperatures, 25°C , 30°C , 35°C , 40°C and 45°C .

(a) State why the student leaves the test tube and the beaker in the water bath for 5 minutes in steps 6 and 7.

(1 mark)

(continued on the next page)

7 continued.

- (b) (i) Give the dependent variable in this investigation.
(1 mark)**

- (ii) State one variable the student controls in their investigation.
(1 mark)**

- (c) Suggest the purpose of the phenolphthalein indicator in the investigation.
(1 mark)**

(continued on the next page)

7 continued.

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

Temperature in °C	Time taken for contents to lose the pink colour in seconds
20	385
25	340
30	300
35	250
40	275
45	360

Look at the grid for Question 7(d) in the Diagram Booklet. Plot a line graph to show the effect of temperature on the time taken for the contents of the test tube to lose the pink colour.

**Use a ruler to join your points with straight lines.
(5 marks)**

(continued on the next page)

7 continued.

- (e) Explain why increasing temperature affects the time taken for the contents of the test tube to lose the pink colour.
(4 marks)**

Answer space continues on the next page.

7(e) continued.

(Total for Question 7 = 13 marks)

- 8 Yeast can be used in experiments to investigate the effect of different concentrations of glucose solution on the rate of anaerobic respiration.**

Look at the diagram for Question 8 in the Diagram Booklet. It shows apparatus used to measure the rate of anaerobic respiration in yeast.

- (a) Give the function of the water bath.
(1 mark)**

- (b) Liquid A can be used to identify the gas released during anaerobic respiration by the yeast.**

**Explain which substance can be used as liquid A.
(2 marks)**

Answer space continues on the next page.

8(b) continued.

- (c) A student wants to accurately measure the rate of anaerobic respiration in yeast using this apparatus.**

State what additional apparatus they would require.

(1 mark)

(continued on the next page)

8 continued.

- (d) The process of anaerobic respiration is sometimes referred to as fermentation.**

Industrial fermenters are used to grow microorganisms. These microorganisms produce penicillin, an antibiotic that is used to treat bacterial infections.

- (i) Explain how named conditions in an industrial fermenter are controlled.
(4 marks)**

Answer space continues on the next page.

8(d)(i) continued.

(ii) Some antibiotics are becoming less effective at controlling bacterial infections.

Explain how bacteria have evolved so that antibiotics are less effective.

(4 marks)

Answer space continues on the next page.

8(d)(ii) continued.

(Total for Question 8 = 12 marks)

9 Genetically modified bacteria are used to produce the hormone insulin.

- (a) Explain how these genetically modified bacteria are produced.
(4 marks)**

Answer space continues on the next page.

9(a) continued.

(continued on the next page)

9 continued.

**(b) Explain the role of insulin in the human body.
(2 marks)**

(continued on the next page)

9 continued.

(c) Some people are unable to produce insulin.

This condition is called diabetes mellitus.

People with diabetes mellitus control the condition by using insulin injections, controlling their diet, and monitoring how much they exercise.

**(i) Explain why the insulin is injected rather than taken by mouth.
(2 marks)**

(continued on the next page)

9(c) continued.

- (ii) State why people with diabetes mellitus need to monitor how much they exercise.
(1 mark)**

- (iii) State how people with diabetes mellitus may need to modify their diet compared with people who do not have diabetes mellitus.
(1 mark)**

(Total for Question 9 = 10 marks)

**TOTAL FOR PAPER = 110 MARKS
END OF PAPER**

Source information:

Question 5(c) adapted from:
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