

Biology

Unit: 4BI1

Science (Double Award) 4SD0

Paper: 1BR

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

Calculator, ruler

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 Lactobacillus is a type of bacterium used to make yoghurt.**

Look at the diagram for Question 1(a)(i) in the Diagram Booklet. It shows a single Lactobacillus bacterium.

- (a) (i) What is the function of ribosomes?
(1 mark)**

- ☐ **A photosynthesis**
- ☐ **B protein synthesis**
- ☐ **C respiration**
- ☐ **D storage of cell sap**

(continued on the next page)

1(a) continued.

- (ii) Which row of the table gives the components that are found in all bacteria and in all eukaryotic cells?
(1 mark)

	Cytoplasm	Cell surface membrane	Cell wall
<input type="checkbox"/> A	YES	YES	YES
<input type="checkbox"/> B	YES	YES	NO
<input type="checkbox"/> C	NO	YES	NO
<input type="checkbox"/> D	NO	YES	YES

(continued on the next page)

1(a) continued.

(iii) **Lactobacillus** cells do not burst when placed in distilled water.

Red blood cells burst when placed in distilled water.

Explain why the **Lactobacillus** cells do not burst but the red blood cells do burst.
(3 marks)

(continued on the next page)

Turn over

1 continued.

- (b) Describe how **Lactobacillus** bacteria produce yoghurt from milk.
(3 marks)

(Total for Question 1 = 8 marks)

- 2 Look at the photograph for Question 2(a) in the Diagram Booklet. It shows some seeds called lentils.**

Lentils are a good source of protein and are often eaten as part of a balanced diet.

- (a) Describe how lentils are transported from the mouth to the stomach after being eaten.
(2 marks)**

(continued on the next page)

2 continued.

- (b) The recommended daily amount (RDA) of a nutrient is the mass of that nutrient required by an individual each day.**

Look at the table for Question 2(b) in the Diagram Booklet. It shows some nutrients found in lentils. It also shows the percentage of each RDA for 16-year-old humans provided by 50 g of lentils.

- (i) Give one component of a balanced diet that is not shown in the table.
(1 mark)**

(continued on the next page)

2(b) continued.

- (ii) Lentils do not contain large amounts of vitamin C and calcium.**

State the long-term effect of a dietary shortage of vitamin C and of calcium.

(2 marks)

vitamin C

calcium

(continued on the next page)

2(b) continued.

- (iii) Calculate the mass, in grams, of lentils that a 16-year-old needs to eat, each day, to provide their RDA of protein.**

**Give your answer to two significant figures.
(2 marks)**

mass of lentils needed each day =

_____ g

(continued on the next page)

2(b) continued.

- (iv) Describe how protein is digested in the human alimentary canal.
(3 marks)**

(Total for Question 2 = 10 marks)

3 Look at the diagram for Question 3(a) in the Diagram Booklet. It shows a forest food web.

**(a) (i) How many secondary consumers are there in this food web?
(1 mark)**

☐ **A 1**

☐ **B 2**

☐ **C 3**

☐ **D 4**

**(ii) Which term describes all the organisms in the food web together with their environment?
(1 mark)**

☐ **A community**

☐ **B ecosystem**

☐ **C habitat**

☐ **D population**

(continued on the next page)

3(a) continued.

(iii) The fox receives 1% of the energy present in the oak tree.

The fox receives 0.04% of the energy present in the grass.

Explain why a higher proportion of the energy reaches the fox from the oak tree than reaches the fox from the grass.

(3 marks)

Answer lines continue on the next page.

3(a)(iii) continued.

(continued on the next page)

3 continued.

(b) A student uses this method to estimate the total area of the woodland floor that is covered by grass.

- randomly place a 0.25m^2 quadrat in one location of the woodland
- estimate the percentage of the quadrat that is covered by grass
- repeat at one other location
- calculate the mean percentage covered by grass for both quadrats
- measure the total area of the woodland floor
- calculate the total area of the woodland covered by grass.

**(i) State why the student placed the quadrats randomly at each location.
(1 mark)**

(continued on the next page)

3(b) continued.

- (ii) Explain how the student could improve their method, to obtain a more reliable estimate of the total area of woodland covered by grass. (2 marks)**

(continued on the next page)

3(b) continued.

(iii) Look at the diagram for Question 3(b)(iii) in the Diagram Booklet. It shows the dimensions of the woodland.

The student finds the mean percentage of the two quadrats covered by grass is 65%.

**Use this value to calculate the total area of the woodland floor covered by grass.
(3 marks)**

total area covered by grass =

_____ m²

(Total for Question 3 = 11 marks)

Turn over

4 Yeast is a fungus that can respire anaerobically.

**(a) (i) What substance is the cell wall of a yeast cell made of?
(1 mark)**

☐ **A cellulose**

☐ **B chitin**

☐ **C glycogen**

☐ **D starch**

(continued on the next page)

4(a) continued.

- (ii) Which row of the table shows the substances produced by yeast during anaerobic respiration?
(1 mark)

	Ethanol	Carbon dioxide	Lactic acid
<input type="checkbox"/> A	YES	YES	NO
<input type="checkbox"/> B	YES	NO	NO
<input type="checkbox"/> C	NO	YES	YES
<input type="checkbox"/> D	NO	NO	YES

(continued on the next page)

4 continued.

- (b) Look at the diagram for Question 4(b) in the Diagram Booklet. It shows the apparatus a student is using to investigate the effect of temperature on anaerobic respiration by yeast.**

This is the student's method.

- place yeast cells and glucose solution into a test tube**
- keep the test tube at a temperature of 25°C**
- cover the yeast and glucose solution with paraffin oil**
- count the number of bubbles produced each minute for 20 minutes**
- repeat at a temperature of 37°C**

The student draws a graph to show the total number of bubbles that have been produced by the end of each minute for the 20-minute period.

Look at the graph for Question 4(b) in the Diagram Booklet. The graph shows the student's results.

(continued on the next page)

4(b) continued.

- (i) State the function of the paraffin oil.
(1 mark)**

- (ii) Describe a method the student could use to
keep the temperature of the yeast and glucose
mixture constant.
(2 marks)**

(continued on the next page)

4(b) continued.

- (iii) Calculate the rate of bubble production from 0 minutes to 8 minutes when the yeast is at 37 °C.
(2 marks)**

rate of bubble production =

_____ bubbles per minute

(continued on the next page)

4(b) continued.

- (iv) Explain the change in the total number of bubbles produced from 0 minutes to 20 minutes at 25°C.
(2 marks)**

(continued on the next page)

4(b) continued.

- (v) Explain the difference in the rate of bubble production between 0 and 10 minutes at 37°C compared with 25°C.
(3 marks)**

(continued on the next page)

4(b) continued.

**(vi) Describe how the student could modify the experiment to give more accurate results.
(2 marks)**

(Total for Question 4 = 14 marks)

- 5 Look at the diagram for Question 5(a) in the Diagram Booklet. It shows the structure of a human heart, with two chambers labelled W and Z and two blood vessels labelled X and Y.

- (a) (i) Which row of the table correctly identifies chambers W and Z?
(1 mark)

	W	Z
<input type="checkbox"/> A	left atrium	right ventricle
<input type="checkbox"/> B	left ventricle	right atrium
<input type="checkbox"/> C	right atrium	left ventricle
<input type="checkbox"/> D	right ventricle	left atrium

(continued on the next page)

5(a) continued.

- (ii) Give two differences between the composition of the blood in X and Y.
(2 marks)**

(continued on the next page)

5 continued.

- (b) A scientist investigates the effect of exercise on the heart rate of two people.**

One person is a trained athlete and the other is an untrained volunteer.

The heart rates of both individuals are measured at rest (0 minutes). Both individuals then exercise for six minutes and then rest for another six minutes.

Look at the table for Question 5(b) in the Diagram Booklet. It shows the heart rates of the untrained volunteer and the trained athlete at rest, during and after exercise.

- (i) The cardiac output is the volume of blood pumped out by the left ventricle in one minute.**

The stroke volume is the volume of blood pumped out by the left ventricle in one beat.

The cardiac output of a resting human is 4900 cm^3 per minute.

(continued on the next page)

5(b)(i) continued.

Calculate the stroke volume of the trained athlete when at rest when their cardiac output is 4900 cm^3 per minute.

Use this formula.

**cardiac output = stroke volume \times heart rate
(2 marks)**

stroke volume = _____ cm^3

(continued on the next page)

Turn over

5(b) continued.

- (ii) Plot a graph on the grid in the Diagram Booklet to show the heart rate of the untrained volunteer and the trained athlete when resting and during exercise from 0 minutes (when at rest) to 12 minutes.**

Use a ruler to join the points with straight lines.

(5 marks)

(continued on the next page)

5(b) continued.

(iii) Explain why the trained athlete can run faster than the untrained volunteer.

Use the information in the table to support your answer.

(4 marks)

Answer lines continue on the next page.

5(b)(iii) continued.

(Total for Question 5 = 14 marks)

- 6 Variegated leaves have areas that are green and areas that are white.**

A student uses this method to investigate the effect of light on photosynthesis in a variegated leaf.

- **place a plant in the dark for 24 hours**
- **wrap a strip of black paper across a leaf**
- **shine light on the plant for 24 hours**
- **remove the black paper**
- **use iodine solution to test the leaf for starch**

Look at the diagram for Question 6(a) in the Diagram Booklet. It shows the apparatus the student uses.

- (a) Complete the balanced chemical symbol equation for photosynthesis.**
(2 marks)



(continued on the next page)

6 continued.

- (b) (i) State why the plant was placed in the dark for 24 hours.
(1 mark)**

(continued on the next page)

6(b) continued.

- (ii) Look at Diagram 1 for Question 6(b)(ii) in the Diagram Booklet. It shows the position of the black paper on the leaf.**

Complete Diagram 2 in the Diagram Booklet to show where the variegated leaf would appear black after testing with iodine solution.

(2 marks)

(continued on the next page)

6 continued.

- (c) The student observes that the leaves on different ivy plants seem to be different sizes depending on the amount of sunlight the plants receive.**

Design an investigation to test whether the amount of sunlight received by ivy plants affects the size of their leaves.

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

(6 marks)

Answer lines continue on the next 2 pages.

6(c) continued.

[illegible]

Turn over

6(c) continued.

(Total for Question 6 = 11 marks)

- 7 Look at the diagram for Question 7(a) in the Diagram Booklet. It shows the human female reproductive system.**

**(a) (i) Where does fertilisation normally occur?
(1 mark)**

☐ **A**

☐ **B**

☐ **C**

☐ **D**

(continued on the next page)

7(a) continued.

- (ii) State how oestrogen and progesterone affect structure C during the menstrual cycle.
(2 marks)**

oestrogen

progesterone

(continued on the next page)

7 continued.

- (b) In vitro fertilisation (IVF) is used to help some people have children.**

Eggs are mixed with sperm in a laboratory.

Embryos are then transferred into a uterus.

- (i) Describe how an embryo forms after the eggs and sperm have been mixed together.
(2 marks)**

(continued on the next page)

7(b) continued.

- (ii) If more than one embryo is transferred to a uterus, IVF can result in multiple births, such as twins or triplets. Pregnancies that produce more than one baby can be a health risk.**

In the United Kingdom, since 2007, the recommendations for the number of embryos transferred are

- a person under 40 should have only one embryo placed into their uterus**
- a person over 40 may have two embryos placed into their uterus**

Look at the graph for Question 7(b)(ii) in the Diagram Booklet. It shows the percentage of IVF treatments that led to multiple births from 1993 to 2019.

Look at the table for Question 7(b)(ii) in the Diagram Booklet. It shows the success rates for IVF in the United Kingdom in 2019 for people of different age groups.

Discuss the effects of limiting the number of embryos transferred.

(continued on the next page)

7(b)(ii) continued.

**Use the information in the table and the graph
to support your answer.
(5 marks)**

Answer lines continue on the next 2 pages.

7(b)(ii) continued.

[illegible]

Turn over

7(b)(ii) continued.

(Total for Question 7 = 10 marks)

8 Look at the diagram for Question 8(a) in the Diagram Booklet. It shows the carbon cycle.

**(a) (i) Which letter in the diagram represents respiration?
(1 mark)**

☐ **A T**

☐ **B X**

☐ **C Y**

☐ **D Z**

**(ii) Give the name of the process labelled W.
(1 mark)**

(continued on the next page)

8 continued.

- (b) Carbon dioxide, methane, and nitrous oxide are three greenhouse gases.**

Look at the table for Question 8(b) in the Diagram Booklet. It shows a comparison of these greenhouse gases.

The Global Warming Potential (GWP) is the ratio of the heat absorbed by a greenhouse gas in the atmosphere relative to the heat absorbed by the same mass of carbon dioxide gas.

- (i) Name one other greenhouse gas.
(1 mark)**

(continued on the next page)

8(b) continued.

- (ii) Evaluate the information in the table to identify which of these gases is likely to contribute most to global warming.
(5 marks)**

Answer lines continue on the next page.

8(b)(ii) continued.

[illegible]

(Total for Question 8 = 8 marks)

9 Scientists have developed transgenic crop plants that are resistant to herbicides (weedkillers).

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

**(ii) Suggest why growing herbicide-resistant crop plants is beneficial to farmers.
(2 marks)**

(continued on the next page)

9 continued.

- (b) Look at the photograph for Question 9(b) in the Diagram Booklet. It shows a weed called Palmer amaranth that is often found in fields growing soybeans.**

Palmer amaranth is a weed that has become resistant to many different herbicides.

In some populations of Palmer amaranth plants, a recessive allele (r) makes the plants resistant to herbicide. A dominant allele (R) makes the plants not resistant to herbicide.

- (i) Give the possible genotypes of Palmer amaranth plants that are not resistant to herbicides.**

(1 mark)

(continued on the next page)

9(b) continued.

- (ii) A Palmer amaranth plant that is resistant to herbicides is crossed with a Palmer amaranth plant that is heterozygous for herbicide resistance.**

Draw a genetic diagram below to show the genotypes of the parents, the gametes they produce, and the genotypes and the phenotypes of the offspring.

(3 marks)

(continued on the next page)

Turn over

9(b) continued.

- (iii) Give the probability of the cross in
(b)(ii) producing a plant that is resistant
to herbicide.
(1 mark)**

(continued on the next page)

9(b) continued.

- (iv) Explain how Palmer amaranth plants have evolved to become resistant to herbicides in areas where herbicides are used frequently. (4 marks)**

Answer lines continue on the next page.

9(b)(iv) continued.

(continued on the next page)

9(b) continued.

- (v) In plants such as Palmer amaranth, where the allele for herbicide resistance is recessive, no non-resistant weeds occur after five years of using herbicides.**

In other plants, where the allele for herbicide-resistance is dominant, some non-resistant weeds occur after five years of using herbicides.

Explain this difference in the number of non-resistant weeds after five years of using herbicides.

(2 marks)

(Total for Question 9 = 14 marks)

10 Look at the diagram for Question 10(a) in the Diagram Booket. It shows the structure of a human eye.

**(a) (i) Give the name of structure Z.
(1 mark)**

(continued on the next page)

10(a) continued.

- (ii) Describe how structures X and Y control the shape of a lens when focusing on a near object.
(3 marks)**

(continued on the next page)

10 continued.

(b) A cataract occurs when the lens becomes cloudy.

Severe cataracts are the main cause of blindness around the world.

**(i) Explain why people with cataracts are unable to see clearly.
(2 marks)**

(continued on the next page)

10(b) continued.

- (ii) Exposure to ultraviolet light is thought to be a risk factor for the development of cataracts.**

Look at the table for Question 10(b) in the Diagram Booklet. It shows the results of a 25-year investigation into the effect of different mean hours of sunlight on agricultural workers in one south Asian country.

**Comment on the results of the investigation.
(4 marks)**

Answer lines continue on the next page.

Turn over

10(b)(ii) continued.

[illegible]

(Total for Question 10 = 10 marks)

TOTAL FOR PAPER = 110 MARKS
END OF PAPER