

Biology

UNIT: 4BI1

Science (Double Award) 4BI1/4SD0

PAPER: 1B

Total Marks

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 The human body has different hormones that are produced by endocrine glands.

(a) Look at the diagram for Question 1(a) in the Diagram Booklet. It labels some of the endocrine glands in the body.

**(i) Which gland produces insulin?
(1 mark)**

☐ **A**

☐ **B**

☐ **C**

☐ **D**

**(ii) Which gland produces progesterone?
(1 mark)**

☐ **A**

☐ **B**

☐ **C**

☐ **D**

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Turn over

1 continued.

(b) The human body has two systems of communication, nervous and hormonal.

(i) Students research the speed of nervous and hormonal communication.

They find this data

- hormones travel at a speed of 420 centimetres per minute**
- nerve impulses travel at a speed of 55 metres per second**

Determine the ratio of the speed of nervous communication to the speed of hormonal communication.

(3 marks)

Give your answer in the form $n:1$

ratio = _____

1 continued.

- (ii) Describe three other differences between the nervous system and the hormonal system.
(3 marks)**

(continued on the next page)

Turn over

1 continued.

(Total for Question 1 = 8 marks)

2 Biologists classify organisms into different groups. One group of organisms is fungi.

**(a) Complete the passage about fungi by writing a suitable word or words in each blank space.
(4 marks)**

**Fungi do not carry out photosynthesis. Their
body is usually organised into a mycelium
made from thread-like structures called**

_____.

Fungal cell walls are made of

_____.

Fungi feed by extracellular secretion of

_____ onto food material

and absorption of the organic products. This is

known as _____ nutrition.

(continued on the next page)

2 continued.

- (b) A student investigates the effect of temperature on the rate of anaerobic respiration in yeast.**

The student measures the rate of gas produced in cm³ per minute.

Look at the graph for Question 2(b) in the Diagram Booklet. It shows their results.

- (i) Name the gas produced by yeast during anaerobic respiration.
(1 mark)**

- (ii) Explain the effect that increasing temperature has on the rate of gas production by the yeast.
(3 marks)**

(continued on the next page)

Turn over

2 continued.

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2 continued.

- (iii) Describe how the student could measure the rate of gas production in this experiment.
(2 marks)**

(Total for Question 2 = 10 marks)

- 3 (a) Vital capacity is the maximum volume of air that a person can force out of their lungs in one breath.**

Look at the graph for Question 3(a) in the Diagram Booklet. It shows the relationship between vital capacity and age for a large number of people.

The vital capacity plotted is the median value for each age.

- (i) State what is meant by the term MEDIAN.
(1 mark)**

(continued on the next page)

3 continued.

- (ii) Give a reason why the median is used rather than the mean.
(1 mark)**

(continued on the next page)

3 continued.

**(iii) Describe the relationship between vital capacity and age shown by the graph.
(2 marks)**

(continued on the next page)

3 continued.

**(iv) Explain why vital capacity changes with age.
(2 marks)**

(continued on the next page)

3 continued.

(v) Age is not the only variable that can change vital capacity.

Give two other variables that can affect a person's vital capacity.

(2 marks)

1 _____

2 _____

(continued on the next page)

3 continued.

- (b) Describe a method you could use to demonstrate the effect of exercise on breathing rate in students. (3 marks)**

(continued on the next page)

Turn over

3 continued.

(Total for Question 3 = 11 marks)

4 Scientists collect data from a grassland ecosystem.

For each trophic level they determine

- **the mean number of organisms in a square metre**
- **the mean dry mass of these organisms in a square metre**

Look at the table for Question 4 in the Diagram Booklet. It shows the scientists' data.

- (a) (i) Draw a labelled pyramid of numbers for this data.
(2 marks)**

4 continued.

- (ii) Describe how you could collect data to find the mean number of producers per square metre in the ecosystem.
(3 marks)**

(continued on the next page)

4 continued.

- (b) The mass of organisms at each trophic level is called the biomass.**

The percentage of biomass in the producers that is transferred to the primary consumers is 4.5%.

- (i) Calculate the percentage of biomass in the secondary consumers that is transferred to the tertiary consumers.
(1 mark)**

percentage = _____%

(continued on the next page)

4 continued.

(ii) Comment on the energy transfers in this ecosystem.

**In your answer, refer to data from the table and the percentages of biomass transferred.
(4 marks)**

4 continued.

(Total for Question 4 = 10 marks)

5 Look at the diagram for Question 5(a) in the Diagram Booklet. It shows a wind-pollinated flower with some structures labelled W, X and Y.

**(a) (i) Describe how structures W, X and Y are adapted for wind pollination.
(3 marks)**

(continued on the next page)

Turn over

5 continued.

(ii) Structures W, X and Y are adapted for wind pollination.

**Give two other differences between wind-pollinated flowers and insect-pollinated flowers.
(2 marks)**

1

2

(continued on the next page)

Turn over

5 continued.

- (b) Wind-pollinated flowers often cause an allergic response in people. This is known as hay fever.**

Most people in the United Kingdom who get hay fever have the symptoms from April to September.

Look at the graph for Question 5(b) in the Diagram Booklet. It shows the changes in total pollen count for three different plant types from March to September during one year in the United Kingdom.

As part of an investigation into pollen allergy, five people keep a diary of their hay fever symptoms. They do this for the same year as the pollen count.

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

Using the data in the table and the information from the graph, discuss the likely causes of the allergic responses in each person.

(5 marks)

5 continued.

[illegible]

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Turn over

5 continued.

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5 continued.

- (c) The allergic response to pollen is part of the body's immune response.**

**Explain what is meant by the term
IMMUNE RESPONSE.**

(2 marks)

(Total for Question 5 = 12 marks)

- 6 Look at the diagram for Question 6 in the Diagram Booklet. It shows a plant cell in distilled water and a plant cell in a concentrated solution of sodium chloride.**

**(a) (i) Which structure is labelled M?
(1 mark)**

☐ **A cell membrane**

☐ **B cell wall**

☐ **C nucleus**

☐ **D vacuole**

**(ii) Which structure is labelled N?
(1 mark)**

☐ **A cell membrane**

☐ **B cell wall**

☐ **C cytoplasm**

☐ **D vacuole**

(continued on the next page)

6 continued.

- (b) (i) Give the name of the liquid found in the gap labelled O in the cell in the concentrated solution of sodium chloride.
(1 mark)**

- (ii) Explain the differences in the appearance of the cell in distilled water and the cell in the concentrated solution of sodium chloride.
(4 marks)**

6 continued.

(continued on the next page)

6 continued.

- (c) Describe an experiment you could do to show how different concentrations of sodium chloride solution affect the appearance of plant cells. (4 marks)**

(Total for Question 6 = 11 marks)

- 7 (a) Look at the diagram for Question 7(a) in the Diagram Booklet. It shows the human heart with four chambers and four blood vessels labelled.**

- (i) Which blood vessel brings deoxygenated blood to the heart?
(1 mark)**

☐ **A U**

☐ **B V**

☐ **C W**

☐ **D X**

- (ii) Which chamber pumps oxygenated blood away from the heart?
(1 mark)**

☐ **A S**

☐ **B T**

☐ **C Y**

☐ **D Z**

(continued on the next page)

7 continued.

- (iii) Explain the difference in the wall of chamber S and the wall of chamber Z.
(3 marks)**

(continued on the next page)

Turn over

7 continued.

(continued on the next page)

7 continued.

(b) Humans need a balanced diet for healthy growth and development.

Give the function of three different components of a balanced diet.

(3 marks)

1 _____

2 _____

(continued on the next page)

Turn over

7 continued.

3 _____

(continued on the next page)

7 continued.

- (c) Scientists investigated the link between body mass and coronary heart disease in a population in Australia.**

The scientists recorded the number of heart attacks in a population of 850 people for a period of 20 years.

They classified the people as normal mass, overweight or obese.

Look at the table for Question 7(c) in the Diagram Booklet. They calculated rates of heart attacks that allowed a valid comparison to be made between the groups.

Evaluate what the data shows about the relationship between classification of body mass, age and heart attacks.

(5 marks)

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(Total for Question 7 = 13 marks)

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- 8 Fur colour in rats is controlled by a gene with two alleles.**

One allele codes for black fur colour. The other allele codes for agouti fur colour.

Several female rats with agouti coloured fur are mated with several male rats with black coloured fur.

All of the offspring have agouti coloured fur.

- (a) (i) Explain which allele is dominant.
(2 marks)**

(continued on the next page)

8 continued.

- (ii) A male and female rat from these offspring are then mated together in a second cross.**

Some of the offspring of this second cross have agouti coloured fur and some have black coloured fur.

Draw a genetic diagram to show this second cross. Include the genotypes of the parents, the gametes they produce, and the genotypes and the phenotypes of the offspring.

(4 marks)

8 continued.

- (iii) Calculate the probability of any one offspring from this second cross being male with agouti coloured fur.
(2 marks)**

probability = _____

(continued on the next page)

8 continued.

- (b) Scientists observed that genes that control fur colour in rats can affect rat behaviour, such as how tame they are.**

Other genes that control the size of the adrenal glands and the production of neurotransmitters also affect rat behaviour.

Scientists also noticed that coat colour is associated with differences in anatomy and physiology, such as the size of the adrenal glands and the production of neurotransmitters.

- (i) State the name of the type of genetic control where many genes control one phenotype.
(1 mark)**

(continued on the next page)

8 continued.

- (ii) Explain why the size of the adrenal glands and the production of neurotransmitters would affect rat behaviour.
(3 marks)**

(continued on the next page)

Turn over

8 continued.

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8 continued.

(c) Some rats with white fur also have pink eyes.

These rats have pink eyes because they do not have pigment in their irises.

This means that their irises let light pass through, unlike the coloured irises found in other rats.

Explain how this difference in the iris affects vision in the rats with pink eyes.

(3 marks)

(continued on the next page)

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8 continued.

(Total for Question 8 = 15 marks)

9 Selective breeding has been used to develop modern varieties of wheat.

**(a) Describe how scientists could use selective breeding to increase wheat yield.
(3 marks)**

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Turn over

9 continued.

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9 continued.

- (b) During a long-term study of selective breeding, scientists collected data for the mean yield of wheat in tonnes per hectare.**

The table shows the scientists' data.

Year	Mean yield in tonnes per hectare
1840	2·6
1860	2·5
1880	2·4
1900	2·4
1920	2·5
1940	2·6
1960	2·8
1980	4·2
2000	5·3
2020	6·7

- (i) Look at the grid for Question 9(b)(i) in the Diagram Booklet. Plot a line graph to show how the mean yield changes from 1840 to 2020.**

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

9 continued.

- (ii) In 1960, a dwarf variety of wheat replaced the old variety.**

Scientists compared the percentage change in yield for the two varieties.

The percentage change in yield per year from 1840 to 1960 was 0·06% per year.

**Calculate the percentage change in yield per year from 1960 to 2020.
(3 marks)**

percentage change = _____%

(continued on the next page)

9 continued.

(iii) Dwarf wheat has a shorter, thicker stem than the old variety.

Suggest why growing dwarf wheat is an advantage for farmers.

(3 marks)

(continued on the next page)

Turn over

9 continued.

(Total for Question 9 = 14 marks)

10 There is a relationship between the colour of a flower and pollination by insects.

Design an investigation to find out if the colour of a flower affects how attractive it is to pollinators.

**Include experimental details in your answer and write in full sentences.
(6 marks)**

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10 continued.

(Total for Question 10 = 6 marks)

TOTAL FOR PAPER = 110 MARKS
END OF PAPER