

Biology

UNIT: 4BI1

Science (Double Award) 4BI1/4SD0

PAPER: 1B

Total Marks

Monday 6 November 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 – 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 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.

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 Look at the diagram for Question 1 in the Diagram Booklet. The food web comes from a woodland ecosystem.

**(a) (i) Which organism is the producer?
(1 mark)**

☐ **A caterpillar**

☐ **B earthworm**

☐ **C oak tree**

☐ **D stoat**

(continued on the next page)

1(a) continued.

**(ii) Which organism is a secondary consumer?
(1 mark)**

☐ **A caterpillar**

☐ **B earthworm**

☐ **C fox**

☐ **D ladybird**

**(iii) Which organism is both a secondary and a
tertiary consumer?
(1 mark)**

☐ **A blackbird**

☐ **B earthworm**

☐ **C fox**

☐ **D stoat**

(continued on the next page)

1 continued.

(b) A farmer is using a pesticide in fields next to the woodland.

The pesticide is reducing the numbers of greenfly and caterpillars in the woodland.

**(i) Explain what effect this may have on the blackbirds in the woodland.
(3 marks)**

Answer space continues on the next page.

1(b)(i) continued.

(continued on the next page)

1(b) continued.

- (ii) Describe a different method the farmer could use to reduce the number of greenfly on his crops.
(3 marks)**

Answer space continues on the next page.

1(b)(ii) continued.

(Total for Question 1 = 9 marks)

- 2 A student investigates the effect of different concentrations of sucrose on potato tissue.**

Look at the table for Question 2(a) in the Diagram Booklet. The student first makes a series of sucrose solutions using this dilution table.

- (a) Complete the table by writing the volume of distilled water for test tube 2.
(1 mark)**

2 continued.

(b) This is the student's method.

Step 1 cut six equal-size cylinders of potato each 5cm in length

Step 2 dry the cut surfaces using filter paper

Step 3 measure the mass of each cylinder

Step 4 place one cylinder of potato in each of the six test tubes containing

- **20 cm³ of 1 molar (1·0 mole per litre) sucrose solution**
- **20 cm³ of 0·8 molar sucrose solution**
- **20 cm³ of 0·6 molar sucrose solution**
- **20 cm³ of 0·4 molar sucrose solution**
- **20 cm³ of 0·2 molar sucrose solution**
- **20 cm³ of distilled water**

Step 5 put a bung in each test tube and leave the test tubes for one hour

Step 6 remove the cylinders from each test tube

Step 7 dry the cylinders with filter paper

Step 8 measure the mass of each cylinder again

(continued on the next page)

Turn over

2(b) continued.

**Explain the reason for step 7 in the student's method.
(2 marks)**

(continued on the next page)

2 continued.

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

- (i) Calculate the percentage change in mass for the 0·4 mole per litre sucrose solution.
(2 marks)**

percentage change = _____%

(continued on the next page)

2(c) continued.

- (ii) Comment on the effect of the different concentrations of sucrose on the potato tissue.
(5 marks)**

Answer space continues on the next page.

2(c)(ii) continued.

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(Total for Question 2 = 10 marks)

- 3 (a) Look at the diagram for Question 3(a) in the Diagram Booklet. A student investigates the differences between inhaled and exhaled air using this apparatus.**
- (i) They use solution X to compare the concentration of carbon dioxide in inhaled and exhaled air.**

**Give the name of solution X.
(1 mark)**

(continued on the next page)

3(a) continued.

- (ii) Explain the changes that will take place in solution X in test tube A and in test tube B.
(3 marks)**

Answer space continues on the next page.

3(a)(ii) continued.

(continued on the next page)

3(a) continued.

- (iii) Other than concentration of carbon dioxide, state one other difference between exhaled air and inhaled air.
(1 mark)**

(continued on the next page)

3 continued.

- (b) Another student investigated the effect of the duration of exercise on their breathing rate.**

These are their results.

Duration of exercise in seconds	Breathing rate in breaths per minute
0	22
30	26
60	28
90	32
120	35
150	38
180	42
210	40
240	40

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

(continued on the next page)

Turn over

3(b) continued.

- (ii) Look at the grid for Question 3(b)(ii) in the Diagram Booklet. Plot a line graph to show the effect of duration of exercise on breathing rate.**

**Join the points with straight lines.
(5 marks)**

(continued on the next page)

3(b) continued.

**(iii) Describe the effect of duration of exercise on breathing rate.
(2 marks)**

(continued on the next page)

3(b) continued.

- (iv) Give one way the student could improve the reliability of their investigation.
(1 mark)**

(Total for Question 3 = 14 marks)

- 4 Look at the diagram for Question 4 in the Diagram Booklet. It shows two samples of blood seen using a high power microscope.**

One sample is of normal blood and the other sample is from a patient with a blood condition.

- (a) State two differences between the normal blood sample and the sample from the patient with the blood condition.**
(2 marks)

1 _____

2 _____

4 continued.

- (b) The line P–Q shown on the diagram has an actual length of $25\mu\text{m}$.

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

Calculate the magnification of the diagram.
(2 marks)

magnification = \times _____

(continued on the next page)

4 continued.

- (c) In a healthy person 1 cm^3 of blood contains 5.0×10^9 red blood cells.

An adult has 5.0 litres (5.0 dm^3) of blood in their body.

Calculate the number of red blood cells in the body of a healthy adult.

Give your answer in standard form.

[$1 \text{ dm}^3 = 1000 \text{ cm}^3$]
(2 marks)

number _____

(continued on the next page)

4 continued.

- (d) Using the information from the diagram and your own knowledge, comment on the likely effect of the blood condition on the patient.
(4 marks)**

Answer space continues on the next page.

4(d) continued.

[illegible]

(Total for Question 4 = 10 marks)

- 5 Guinea pigs have either long hair or short hair. The hair length is controlled by one gene with two alleles.**

Look at the photograph for Question 5 in the Diagram Booklet. It shows a guinea pig with long hair and a guinea pig with short hair.

- (a) State what is meant by the term ALLELE.
(1 mark)**

(continued on the next page)

5 continued.

(b) A breeder did the following crosses.

Cross 1 a male long-haired guinea pig with a female short-haired guinea pig, this produces five offspring all with short hair

Cross 2 a male short-haired guinea pig with a female long-haired guinea pig, this produces four offspring all with short hair

Cross 3 a male short-haired offspring from cross 1 with a female short-haired offspring from cross 2, this produces some offspring with long hair and some offspring with short hair

(continued on the next page)

5(b) continued.

- (i) Draw a genetic diagram to show the parents, gametes and all possible genotypes and phenotypes of the offspring from cross 3. (4 marks)**

(continued on the next page)

5(b) continued.

- (ii) Calculate the probability that the first offspring born from cross 3 is a male with short hair.
(2 marks)**

probability = _____

(continued on the next page)

5(b) continued.

- (iii) Some short-haired guinea pigs are homozygous and some short-haired guinea pigs are heterozygous.**

**Explain how a breeder could use a cross to determine the genotype of a short-haired guinea pig.
(2 marks)**

(continued on the next page)

Turn over

5 continued.

- (c) Guinea pigs stay completely still and do not move when they sense danger.**

Describe how this behaviour has evolved by natural selection.

(4 marks)

Answer space continues on the next page.

5(c) continued.

(Total for Question 5 = 13 marks)

- 6** Look at the diagram for Question 6 in the Diagram Booklet. It shows a human reflex arc with some structures labelled. It is the withdrawal reflex, which allows a person to remove their hand from a hot object quickly.

(a) (i) Which structure is the sensory receptor?
(1 mark)

☐ **A L**

☐ **B P**

☐ **C Q**

☐ **D S**

(ii) Which structure is the cell body of the relay neurone?
(1 mark)

☐ **A L**

☐ **B N**

☐ **C M**

☐ **D P**

(continued on the next page)

Turn over

6(a) continued.

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

☐ A L

☐ B M

☐ C R

☐ D S

**(iv) Which structure is the effector?
(1 mark)**

☐ A L

☐ B M

☐ C Q

☐ D S

(continued on the next page)

6 continued.

(b) A nerve impulse travels at 50 metres per second.

- (i) Calculate the time taken for an impulse to travel 180 cm.
(2 marks)**

time = _____ seconds

(continued on the next page)

6(b) continued.

- (ii) The length of the nerve pathway in the withdrawal reflex arc is 180 cm.**

The time a person takes to remove their hand away from a hot object is called the response time.

Explain why the actual response time is different from the time taken for a nerve impulse to travel 180 cm.

(4 marks)

Answer space continues on the next page.

6(b)(ii) continued.

[illegible]

(Total for Question 6 = 10 marks)

- 7 Biologists classify organisms into different groups. Two of these groups are bacteria and fungi.**

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

Bacteria are small _____ celled organisms. They have a cell membrane and a cell _____, made of peptidoglycan.

Some bacteria are able to use the energy from the

Sun to carry out _____ but other

bacteria are _____ and feed on dead and decaying organisms.

Bacterial cells do not have a nucleus but most of their genetic material is contained in a circular

_____ of DNA. They also have small

circles of DNA called _____ in their cytoplasm.

(continued on the next page)

7(a) continued.

Some bacteria are used by humans in food production. An example is using

_____ to make yoghurt.

Other bacteria, such as *Pneumococcus*, cause disease and so are called _____.

(continued on the next page)

7 continued.

- (b) A microscopic single-celled fungus, yeast, is used in the production of bread.**

**Describe how yeast is used to produce bread.
(4 marks)**

Answer space continues on the next page.

7(b) continued.

(Total for Question 7 = 12 marks)

- 8 Look at the diagram for Question 8 in the Diagram Booklet. It shows the female reproductive system and the male reproductive system with some structures labelled.**

**(a) (i) Which structure produces gametes?
(1 mark)**

☐ A R

☐ B S

☐ C U

☐ D X

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

☐ A R

☐ B S

☐ C W

☐ D X

(continued on the next page)

8(a) continued.

**(iii) In which structure does the placenta usually develop?
(1 mark)**

☐ **A R**

☐ **B S**

☐ **C W**

☐ **D X**

(continued on the next page)

8 continued.

- (b) Some males have an operation called a vasectomy. This means that they do not release sperm.**

This involves cutting and sealing the sperm ducts (vas deferens) inside the man's scrotum.

- (i) Look again at the diagram for Question 8 in the Diagram Booklet. On the diagram draw two lines to show where the cuts are made. (1 mark)**

(continued on the next page)

8(b) continued.

- (ii) Explain why this operation can be used as a permanent way of preventing pregnancy.
(2 marks)**

(continued on the next page)

8 continued.

- (c) Female sterilisation is another operation that can be used as a permanent way of preventing pregnancy. This involves cutting and sealing the fallopian tubes (oviducts).**

Scientists compared female and male sterilisation, looking at the outcomes of the operations.

Look at the table for Question 8(c) in the Diagram Booklet. It shows their data.

The scientists concluded that male sterilisation should be recommended for most couples considering a permanent way of preventing pregnancy.

**Discuss this conclusion using data from the table.
(4 marks)**

Answer space continues on the next page.

8(c) continued.

(Total for Question 8 = 10 marks)

9 Farmers and scientists have worked together for the last 50 years to develop crop plants and farm animals with desired characteristics.

(a) Explain why selective breeding with crop plants is easier and quicker than selective breeding with farm animals.

(3 marks)

(continued on the next page)

9 continued.

- (b) Selective breeding in cattle has been used to improve features such as higher milk yield, longer life and increased muscle mass.**

**Describe how selective breeding can be used to improve milk yield in dairy cattle.
(4 marks)**

Answer space continues on the next page.

9(b) continued.

(continued on the next page)

9 continued.

(c) Scientists and farmers are also selecting animals based on behaviour and temperament.

**(i) Suggest why an animal with a calmer temperament may be more suitable for the farmer on a dairy farm.
(2 marks)**

(continued on the next page)

Turn over

9(c) continued.

- (ii) Cattle behaviour is also affected by the hormone adrenaline. When cattle are more stressed, they have higher levels of adrenaline.**

The effect of adrenaline on the cattle nervous system is similar to the effect of adrenaline in humans.

**Describe the production of adrenaline and its effects on the body.
(4 marks)**

Answer space continues on the next page.

9(c)(ii) continued.

(continued on the next page)

9(c) continued.

- (iii) Stress in cattle can also affect their reproductive system, leading to damage to the placenta.**

**Describe the role of the placenta in reproduction.
(3 marks)**

Answer space continues on the next page.

9(c)(iii) continued.

(Total for Question 9 = 16 marks)

10 Plants absorb light energy for photosynthesis.

Some colours of light result in a higher rate of photosynthesis than other colours of light.

Devise an investigation to discover which colour of light results in a higher rate of photosynthesis.

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

(6 marks)

Answer space continues on the next 2 pages.

10 continued.

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10 continued.

(Total for Question 10 = 6 marks)

TOTAL FOR PAPER = 110 MARKS
END OF PAPER