

**Biology**  
**UNIT: 4BI1**  
**PAPER: 2B**

Total Marks
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**Friday 9 June 2023 – Afternoon**

**Time: 1 hour 15 minutes**

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

<b>Surname</b>					
<b>Other names</b>					
<b>Centre Number</b>					
<b>Candidate Number</b>					

**YOU MUST HAVE**

**Calculator, ruler**

**YOU WILL BE GIVEN**

**Diagram Booklet, Text 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.**

**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.**

**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.**

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## 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 for Question 1 in the Text Booklet. Use the information in the passage and your own knowledge to answer the questions that follow.

(a) Which of these processes produces ATP?  
(lines 11 to 12)  
(1 mark)

- ☐ A active transport
- ☐ B diffusion
- ☐ C respiration
- ☐ D transpiration

(continued on the next page)

**1 continued.**

- (b) (i) Explain why intensive farming and deforestation would cause an increase in populations of dinoflagellates. (lines 17 to 21) (3 marks)**

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**(continued on the next page)**

**1(b) continued.**

- (ii) Explain why oxygen levels decrease after a series of glowing events. (lines 20 to 24)  
(2 marks)**

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**(continued on the next page)**

**1 continued.**

**(c) Which type of bacteria converts ammonia into nitrates?  
(1 mark)**

- ☐ **A decomposer**
- ☐ **B denitrifying**
- ☐ **C nitrifying**
- ☐ **D nitrogen fixing**

**(continued on the next page)**

**1 continued.**

- (d) (i) Each of the 15 copepods ate glowing dinoflagellates at a mean rate of 40 dinoflagellates per hour.**

**Calculate the mean rate at which each copepod ate dinoflagellates that were not glowing. (lines 33 to 38)  
(2 marks)**

**mean rate = \_\_\_\_\_  
dinoflagellates per hour**

**(continued on the next page)**



**1(d) continued.**

- (ii) Explain how natural selection could have resulted in the evolution of dinoflagellates that glow. (lines 28 to 32)  
(4 marks)**

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**1(d)(ii) continued.**

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**1 continued.**

- (e) Explain why using dinoflagellates for street lighting would help to reduce pollution.  
(lines 39 to 47)  
(3 marks)**

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**(Total for Question 1 = 16 marks)**

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**2 A student uses this method to investigate water uptake and water loss by a plant shoot.**

- **pour 100 cm<sup>3</sup> of water into a measuring cylinder**
- **place a plant shoot into the measuring cylinder**
- **cover the surface of the water with oil**
- **place the measuring cylinder and plant shoot on a balance and record the total mass**
- **shine light on the plant shoot using a lamp**
- **record the volume of the water in the measuring cylinder after four days, and after eight days**
- **record the total mass of the measuring cylinder and plant shoot after four days, and after eight days**

**(continued on the next page)**

**2 continued.**

**Look at the diagram for Question 2 in the Diagram Booklet. It shows the student's apparatus.**

**(a) State the reason for using the oil.**  
**(1 mark)**

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**(b) The table shows the student's results.**

	<b>Volume of water in measuring cylinder in cm<sup>3</sup></b>	<b>Total mass of measuring cylinder and plant shoot in g</b>
<b>START (DAY 1)</b>	<b>100</b>	<b>175</b>
<b>DAY 4</b>	<b>75</b>	<b>165</b>
<b>DAY 8</b>	<b>65</b>	<b>155</b>

**(continued on the next page)**

2(b) continued.

- (i) The volume of water taken up by the plant shoot is equal to the change in volume of water in the measuring cylinder. This is called the water uptake.

Calculate, in  $\text{cm}^3$  per day, the mean rate of water uptake by the plant shoot during the eight days.

(2 marks)

mean rate = \_\_\_\_\_  $\text{cm}^3$   
per day

(continued on the next page)

**2(b) continued.**

- (ii) Comment on the changes in total mass of the measuring cylinder and plant shoot, compared with the changes in volume of water in the measuring cylinder.  
(4 marks)**

**[1 cm<sup>3</sup> of water has a mass of 1 g]**

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**2(b) continued.**

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- (c) Explain why the rate of water loss would be different if a working fan is placed in front of the plant shoot.  
(3 marks)**

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**(Total for Question 2 = 10 marks)**

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**Turn over**



**3 Look at the diagram for Question 3 in the Diagram Booklet. It shows part of a human nephron.**

**(a) Which structure is the proximal convoluted tubule?  
(1 mark)**

☐ **Structure A**

☐ **Structure B**

☐ **Structure C**

☐ **Structure D**

**(continued on the next page)**

**3 continued.**

**(b) The hollow space inside a blood vessel is called the lumen.**

**(i) The blood vessel labelled X has a lumen with a radius of 100  $\mu\text{m}$ .**

**Use this formula to calculate the cross-sectional area, in  $\text{mm}^2$ , of the lumen of this blood vessel.**

**(2 marks)**

$$\text{area of circle} = \pi \times (\text{radius})^2$$

$$[\pi = 3.14]$$

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

**cross-sectional area =**

**\_\_\_\_\_  $\text{mm}^2$**

**3(b) continued.**

- (ii) The lumen of blood vessel X is wider than the lumen of blood vessel Y.**

**Explain why this difference in the width of the lumen of the two blood vessels is important for kidney function.**

**(2 marks)**

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**3 continued.**

- (c) Protein is often found in the urine of people who have high blood pressure.**

**Describe how urine could be tested for protein.  
(2 marks)**

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**(Total for Question 3 = 7 marks)**

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- 4 (a) Look at the diagram for Question 4(a) in the Diagram Booklet. It shows a cross-section through part of a plant leaf.

(i) What is the name of the cell labelled P?  
(1 mark)

☐ A cuticle

☐ B guard

☐ C palisade

☐ D stoma

(continued on the next page)

**4(a) continued.**

- (ii) Explain how part Q is adapted for photosynthesis in the leaf.  
(3 marks)**

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**4 continued.**

**(b) A student uses this method to investigate the effect of temperature on the rate of gas exchange in leaves.**

- **pour 10 cm<sup>3</sup> of hydrogen-carbonate indicator into each of six test tubes**
- **hang a leaf in five of the test tubes**
- **place a bung in each test tube**
- **place the five tubes with leaves into separate water baths at temperatures of 15°C, 20°C, 25°C, 30°C, 35°C, and 40°C**
- **place the tube with no leaf in a water bath at 25°C**
- **place all tubes in bright sunlight**
- **record the time taken for each of the hydrogen-carbonate indicator solutions to change from orange to red**

**(continued on the next page)**

**4(b) continued.**

**The student repeats the experiment two more times.**

**Look at the diagram for Question 4(b) in the Diagram Booklet. It shows one of the tubes with a leaf.**

- (i) State the independent variable.  
(1 mark)**

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**4(b) continued.**

**(ii) The species and size of leaf were the same in each tube.**

**Give a reason for controlling one other named factor.**

**(2 marks)**

**factor**

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**reason**

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**4(b) continued.**

**(iii) State the function of the tube with no leaf.  
(1 mark)**

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4 continued.

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

Temperature in °C	Time taken for indicator in tubes with leaves to change from orange to red in minutes			
	1	2	3	mean
15	50	40	40	43
20	35	40	35	37
25	25	30	25	
30	10	10	15	12
35	15	10	10	12

(continued on the next page)

**4(c) continued.**

- (i) Calculate the mean time taken for the indicator to change from orange to red at 25°C.**

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

**mean time = \_\_\_\_\_ minutes**

**(continued on the next page)**

**4(c) continued.**

- (ii) Explain the effect of increasing the temperature on the mean time taken for the indicator to change from orange to red.  
(3 marks)**

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**4 continued.**

- (d) In another experiment, the student places a test tube containing a leaf and hydrogen-carbonate indicator in a 25°C water bath.**

**The student then places all this apparatus in the dark for one hour.**

**Explain why the indicator solution changes from orange to yellow.**

**(2 marks)**

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**(Total for Question 4 = 15 marks)**

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**5 Hormones control the menstrual cycle.**

- (a) (i) Name the gland that produces FSH.  
(1 mark)**
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- (ii) Look at the graph for Question 5(a)(ii) in the Diagram Booklet. It shows the changes in four hormones during the human menstrual cycle.**

**Which line represents the hormone progesterone?  
(1 mark)**

☐ line A

☐ line B

☐ line C

☐ line D

**(continued on the next page)**

**5(a) continued.**

- (iii) Describe the roles of FSH and LH in the menstrual cycle.  
(4 marks)**

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**FSH**

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**5(a)(iii) continued.**

**LH**

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5 continued.

(b) Reproductive hormones can be used as contraceptives to prevent pregnancy.

The table gives information about three different methods of hormonal contraception.

Method	Description	Percentage effectiveness in preventing pregnancy (%)
oral tablets	<ul style="list-style-type: none"> <li>tablets taken every day at same time</li> </ul>	91 to 99
injection	<ul style="list-style-type: none"> <li>injection into muscle by medical professional</li> <li>injection is repeated every 12 weeks</li> </ul>	94 to 99
implant	<ul style="list-style-type: none"> <li>plastic rod containing hormones is surgically placed under skin of upper arm</li> <li>can last for up to three years and then needs replacing</li> </ul>	94 to 99

(continued on the next page)

Turn over

**5(b) continued.**

**Discuss the advantages and disadvantages of the three methods of contraception shown in the table. (5 marks)**

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**Turn over**

**5(b) continued.**

[illegible]

**(Total for Question 5 = 11 marks)**

- 6 Look at the photograph for Question 6(a) in the Diagram Booklet. It shows a plant called a snapdragon.**

**Selective breeding has been used to produce snapdragons with brightly coloured flowers.**

- (a) (i) Describe how selective breeding can produce snapdragon plants with brightly coloured flowers.  
(2 marks)**

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**6(a) continued.**

- (ii) Micropropagation is often used to make copies of a snapdragon plant.**

**Describe the process of micropropagation.  
(3 marks)**

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**6 continued.**

- (b) Scientists investigate the effect of exposing snapdragon explants to increasing amounts of ionising radiation.**

**This is the scientists' method.**

- take a snapdragon plant and use micropropagation to produce many explants**
- expose groups of explants to different amounts of ionising radiation**
- grow the explants into plants and record the number of differences in their phenotypes compared with the original plant**
- take samples of each of the plants and measure the number of differences in DNA nucleotides of each plant compared with the original plant**

**(continued on the next page)**

**6(b) continued.**

- (i) Give the reason why micropropagation is used to produce the plants to be tested.  
(1 mark)**

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- (ii) What term is given to all the DNA in an organism?  
(1 mark)**

- ☐ **A gene**
- ☐ **B genome**
- ☐ **C genotype**
- ☐ **D nucleoid**

**(continued on the next page)**



**6(b) continued.**

**(iii) Look at the graph for Question 6(b)(iii) in the Diagram Booklet. It shows the scientists' results.**

**Discuss the effects that increasing the amount of ionising radiation has on the snapdragons.  
(4 marks)**

**Answer space continues on the next page.**

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**6(b) continued.**

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**(Total for Question 6 = 11 marks)**

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**TOTAL FOR PAPER = 70 MARKS**  
**END OF PAPER**