

Biology
UNIT: 4BI1
PAPER: 2B

Total Marks

Time: 1 hour 15 minutes

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

Text Booklet, 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.

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.

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

(a) In 2021, the world's population was 7 900 000 000.

Calculate the number of people in the world who have chronic kidney disease (Lines 1 to 3).

Give your answer in standard form.
(2 marks)

number of people = _____

(continued on the next page)

Turn over

1 continued.

(b) Urea is an excretory product that is released by the kidneys.

Give the name of an excretory product that is released by the lungs.

(1 mark)

(continued on the next page)

1 continued.

- (c) Explain two ways that the dialyser is designed to increase the rate of removal of urea from the blood (Lines 7 to 18). (4 marks)**

1 _____

2 _____

1 continued.

- (d) (i) The haemofilter in the bioartificial kidney filters the blood (Lines 21 to 23).**

**Where does ultrafiltration occur in a nephron?
(1 mark)**

- ☐ **A Bowman's capsule**
- ☐ **B collecting duct**
- ☐ **C distal convoluted tubule**
- ☐ **D loop of Henle**

(continued on the next page)

1(d) continued.

- (ii) The cells in the bioreactor absorb glucose from the filtrate in a way that is similar to the cells in a nephron (Lines 23 to 27).**

**Describe how the nephron absorbs glucose back into the blood from the filtrate.
(2 marks)**

(continued on the next page)

1(d) continued.

- (iii) The bioartificial kidney is connected to blood vessels and to the tube that transports urine to the bladder in the same way as the human kidney.

Which row of the table is correct?
(1 mark)

	Blood vessel bringing blood into bioartificial kidney	Tube transporting urine to bladder
<input type="checkbox"/> A	renal artery	ureter
<input type="checkbox"/> B	renal artery	urethra
<input type="checkbox"/> C	renal vein	ureter
<input type="checkbox"/> D	renal vein	urethra

(continued on the next page)

1 continued.

- (e) Explain how the pituitary gland and the nephron cells in the bioreactor will respond in a patient who is dehydrated (Lines 32 to 34).
(3 marks)**

Answer space continues on the next page.

1(e) continued.

(Total for Question 1 = 14 marks)

2 (a) Look at the diagram for Question 2(a) in the Diagram Booklet. It shows a human eye.

**(i) Which labelled structure is the cornea?
(1 mark)**

☐ **Structure A**

☐ **Structure B**

☐ **Structure C**

☐ **Structure D**

**(ii) Explain the changes in structure X as a person moves from a room where the light is dim to a room where the light is bright.
(2 marks)**

2 continued.

- (b) A student investigates if using one eye or using two eyes is better for judging the distance of objects.**

Look at the diagrams for Question 2(b) in the Diagram Booklet. The student uses the plastic block shown in the diagram. The block has a grid where six different coloured pins can be placed as shown in the diagrams.

This is the student's method.

- place one pin into the lines of each column and row so that each pin is a different distance from the front of the grid**
- ask a volunteer to close one eye**
- hold the grid in front of the volunteer so they can see the coloured pins but not the grid**
- ask the volunteer to call out the colour of the pins in order of distance, from nearest to furthest**
- record the number of pins that the volunteer identifies correctly**
- repeat eight more times, each time moving the pins to different positions in the grid**

(continued on the next page)

Turn over

2(b) continued.

The student does the experiment again with both eyes open.

- (i) Give the independent variable for the student's investigation.
(1 mark)**

- (ii) Give one variable that the student should control.
(1 mark)**

(continued on the next page)

2(b) continued.

(iii) Table 1 below shows the student's results.

Look at Table 2 for Question 2(b)(iii) in the Diagram Booklet. Complete Table 2 by determining the mode and the median for the data shown in Table 1.

(2 marks)

TABLE 1

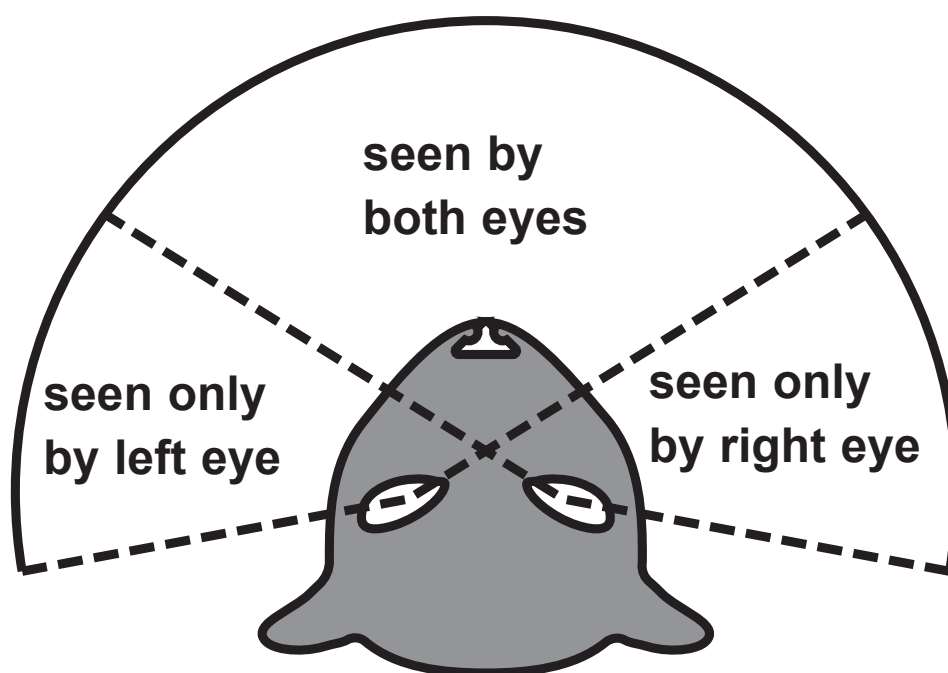
Trial number	Number of correctly identified pins	
	Using one eye	Using both eyes
1	1	6
2	1	6
3	3	4
4	0	6
5	2	6
6	2	6
7	3	3
8	3	4
9	0	6

(continued on the next page)

Turn over

2(b) continued.

- (iv) The field of view is the area that an animal can see with their eyes. The diagram shows the field of view for a cat.



Explain why predators, such as cats, have two forward facing eyes.

Use the information in the diagram above and Table 2 in the Diagram Booklet to support your answer.
(3 marks)

Answer space continues on the next page.

2(b)(iv) continued.

(Total for Question 2 = 10 marks)

- 3 Hair colour in cattle is controlled by one gene with two alleles. The allele for white hair, C^W , is codominant with the allele for red hair, C^R .

Heterozygous cattle are a pale red colour called roan.

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

- (b) (i) Complete the table by giving the genotypes of red cattle, white cattle, and roan cattle.
(1 mark)

Cattle hair colour	Genotype
red	
white	
roan	

(continued on the next page)

3(b) continued.

(ii) Two roan-coloured cattle are mated.

Determine the probability that the calf produced is a male calf with roan-coloured hair.

**Include a genetic diagram in your answer.
(4 marks)**

probability = _____

3 continued.

- (c) (i) In a group of cattle, there are cattle with white-, red-, and roan- coloured hair. Height of cattle is also a genetically controlled characteristic. In the same group, there is a greater variation of heights compared with hair colour.**

**Explain why there is a greater variation in height of the cattle than there is in hair colour.
(2 marks)**

(continued on the next page)

3(c) continued.

- (ii) Describe how a farmer could use selective breeding to increase the height of cattle.
(2 marks)**

(Total for Question 3 = 10 marks)

- 4 Scientists have genetically modified soya plants so that the soya beans they produce contain less saturated fat.**

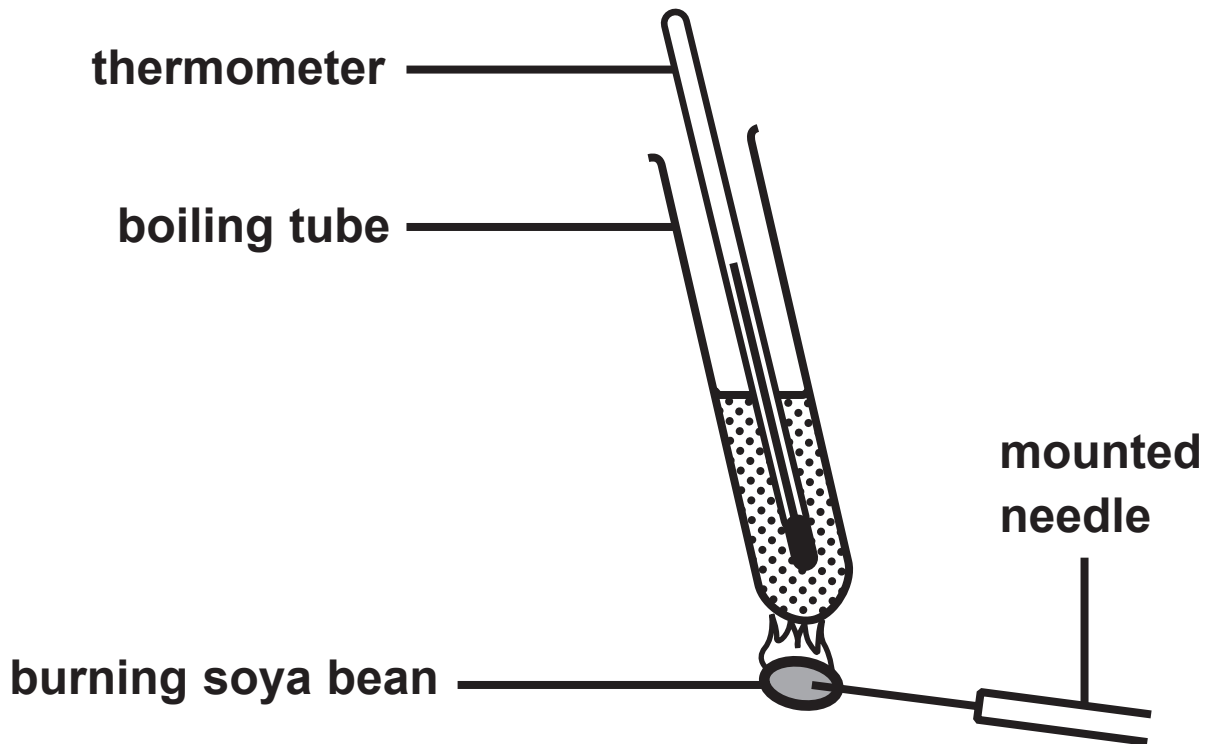
The scientists produced one transgenic soya plant. Micropropagation was then used to make multiple copies of this transgenic soya plant.

- (a) Explain why micropropagation was used to produce copies of the transgenic soya plant.
(2 marks)**

(continued on the next page)

4 continued.

- (b) A student uses this equipment to compare the energy content of transgenic soya beans with the energy content of non-transgenic soya beans.



- (i) Describe how the student could use the equipment to make a valid comparison of the energy content of the two types of soya bean. (4 marks)

Answer space continues on the next page.

Turn over

4(b)(i) continued.

- (ii) Give one safety precaution that the student should take when using the apparatus.
(1 mark)**

(continued on the next page)

Turn over

4(b) continued.

(iii) Look at the diagram for Question 4(b)(iii) in the Diagram Booklet. It shows a different type of apparatus that can be used for the investigation.

Explain two reasons why this apparatus will give a more accurate energy value than the apparatus used by the student.

(4 marks)

Answer space continues on the next page.

1 _____

2 _____

Turn over

4(b)(iii) continued.

(Total for Question 4 = 11 marks)

5 (a) Look at the graph for Question 5(a)(i) in the Diagram Booklet. It shows the change in area of rainforest on the Earth from 1990 to 2015.

(i) Determine the mean rate of decrease of rainforest area, in km^2 per year, from 1990 to 2015.

(2 marks)

mean rate of decrease = _____ km^2 per year

(continued on the next page)

5(a) continued.

- (ii) Loss of rainforests causes an increase in atmospheric carbon dioxide gas.**

Explain the negative effects of an increase in atmospheric carbon dioxide gas.

(3 marks)

Answer space continues on the next page.

5(a)(ii) continued.

(continued on the next page)

5 continued.

- (b) Scientists investigated the effect of deforestation on a river. The river flows through a forest, part of which has been deforested.**

Look at the graphs for Question 5(b) in the Diagram Booklet. They show the changes in nitrate concentration and the biodiversity of animals in the river as it flows through the forest.

- (i) Describe the role of microorganisms in the conversion of organic waste into nitrate ions in the river.**
(3 marks)

Answer space continues on the next page.

Turn over

5(b)(i) continued.

- (ii) The number of different animal species living in the river was recorded as a measure of the biodiversity of animals.**

**Give a reason why this may not be a complete measure of biodiversity.
(1 mark)**

(continued on the next page)

5(b) continued.

(iii) Explain the change in the biodiversity of animals along the river.

Use information from the graphs in your answer.

(4 marks)

Answer space continues on the next page.

5(b)(iii) continued.

(Total for Question 5 = 13 marks)

6 Rabies is a dangerous disease caused by a virus.

(a) The rabies virus is a pathogen.

**Which other groups of microorganisms
include pathogens?**

(1 mark)

- ☐ **A bacteria and fungi only**
- ☐ **B bacteria, fungi, and protoctists**
- ☐ **C bacteria and protoctists only**
- ☐ **D fungi and protoctists only**

(continued on the next page)

6 continued.

- (b) Rabies is transmitted to humans when they are bitten by an infected animal. Domestic dogs are dogs kept by people as pets or as working animals. Dogs and some wild animals are known to transfer rabies to humans.**

In the 1940s, a rabies vaccine for animals was introduced in the United States and most domestic dogs were vaccinated.

Look at the graph for Question 6(b) in the Diagram Booklet. It shows the number of cases of human rabies and domestic dog rabies in the United States from 1938 to 2018.

- (i) The immune system of dogs works in a similar way to the immune system of humans.**

Explain how the rabies vaccine prevents dogs from developing rabies.

(3 marks)

Answer space continues on the next page.

6(b)(i) continued.

(continued on the next page)

6(b) continued.

- (ii) Discuss the effects of the use of the rabies vaccine to immunise domestic dogs on the number of cases of rabies in humans.**

Use information from the graph to support your answer.

(4 marks)

Answer space continues on the next page.

6(b)(ii) continued.

(continued on the next page)

6(b) continued.

- (iii) A new RNA vaccine is being developed to treat rabies.**

RNA that codes for parts of the rabies virus protein coat are injected into the body. Cells then take up the RNA and produce the viral proteins.

**Describe how the cells use the RNA to produce the viral proteins.
(4 marks)**

Answer space continues on the next page.

6(b)(iii) continued.

(Total for Question 6 = 12 marks)

TOTAL FOR PAPER = 70 MARKS

END OF PAPER