

Biology
PAPER 2
Higher Tier

Total Marks

Friday 9 June 2023 – Afternoon

Time: 1 hour 45 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

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 100.

The marks for EACH question are shown in brackets – use this as a guide as to how much time to spend on each question.

In questions marked with an ASTERISK (*), marks will be awarded for your ability to structure your answer logically, showing how the points that you make are related or follow on from each other where appropriate.

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. Write your answers in the spaces provided.

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 Figure 1 for Question 1(a) in the Diagram Booklet. It shows a stream flowing near a fertiliser factory.**

The factory burns coal as a source of energy.

The factory releases waste into the stream and sulfur dioxide into the air.

Samples of water were taken at five points, A, B, C, D and E, as shown on Figure 1.

Look at Figure 2 for Question 1(a) in the Diagram Booklet. It shows the oxygen concentration in the water at the five points along the stream.

(continued on the next page)

1 continued.

- (a) (i) Calculate how many times greater the oxygen concentration is at point E than at point A.
(1 mark)**

_____ times greater

- (ii) State how the oxygen concentration changes from point A to point E.
(1 mark)**

(continued on the next page)

1(a) continued.

**(iii) Which indicator species would be most likely to be seen in the water at point A?
(1 mark)**

☐ **A freshwater shrimp**

☐ **B lichen**

☐ **C sludgeworm**

☐ **D stonefly**

**(iv) Explain where the biodiversity will be highest in the stream.
(3 marks)**

Answer space continues on the next page.

Turn over

1(a)(iv) continued.

(b) Look at Figure 3 for Question 1(b) in the Diagram Booklet. It shows rose leaves infected with blackspot fungus.

State why rose plants growing near this factory are not infected with blackspot fungus.

(1 mark)

(Total for Question 1 = 7 marks)

Turn over

2 People with diabetes cannot always control the concentration of glucose in their blood.

(a) Two people eat identical meals.

One person has diabetes, the other person does not have diabetes.

Look at Figure 4 for Question 2(a) in the Diagram Booklet. It shows the concentration of glucose in the blood of these two people after eating the meals.

**(i) Calculate the maximum increase in the concentration of glucose in the blood of the person with diabetes.
(1 mark)**

_____ mmol per dm³

(continued on the next page)

Turn over

2(a) continued.

- (ii) Water moved out of the red blood cells of the person with diabetes when the concentration of glucose in the blood was above 15mmol per dm³.**

**Explain why water moved out of the red blood cells of the person with diabetes.
(2 marks)**

(continued on the next page)

2 continued.

(b) The pancreas produces a hormone that causes the concentration of glucose in the blood to decrease.

**(i) Name this hormone.
(1 mark)**

**(ii) State how this hormone is transported from the pancreas to its target organs.
(1 mark)**

**(iii) Which is the target organ for the hormone that controls the concentration of glucose in the blood?
(1 mark)**

- ☐ **A kidney**
- ☐ **B pancreas**
- ☐ **C liver**
- ☐ **D lung**

(continued on the next page)

Turn over

2 continued.

**(c) Explain how type 2 diabetes can be controlled.
(3 marks)**

(Total for Question 2 = 9 marks)

3 Respiration occurs in cells.

**(a) Why do cells respire?
(1 mark)**

☐ **A to produce nitrogen**

☐ **B to release oxygen**

☐ **C to produce glucose**

☐ **D to release energy**

(b) An athlete runs every day as part of their training.

**(i) Explain why the breathing rate of the athlete increases when running.
(2 marks)**

Answer space continues on the next page.

3(b)(i) continued.

(continued on the next page)

3(b) continued.

- (ii) When the athlete is running, their muscle cells use both aerobic respiration and anaerobic respiration.**

**State TWO differences between aerobic respiration and anaerobic respiration.
(2 marks)**

1 _____

2 _____

(continued on the next page)

Turn over

3 continued.

- (c) Bromothymol blue (BTB) solution is an indicator of pH.**

Look at Figure 5 for Question 3(c) in the Diagram Booklet. It shows the colour of BTB at different pH levels.

When air is passed through green BTB, for one minute, the solution stays green.

When a person breathes out through a straw into BTB for one minute the solution turns yellow.

- (i) Explain why the air breathed out turns the BTB solution yellow.
(2 marks)**

(continued on the next page)

Turn over

3(c) continued.

- (ii) A scientist placed pondweed into two sealed test tubes containing green BTB solution.**

Test tube A was kept in the dark.

Test tube B was kept in the light.

All other conditions were kept the same.

Look at Figure 6 for Question 3(c)(ii) in the Diagram Booklet. It shows these test tubes at the start of the investigation.

Look at Figure 7 for Question 3(c)(ii) in the Diagram Booklet. It shows the colour of the BTB solution after 5 hours.

Explain the results for tube A and tube B shown in Figure 7.

(2 marks)

Answer space continues on the next page.

Turn over

3(c)(ii) continued.

(Total for Question 3 = 9 marks)

- 4 (a) A student wanted to make a jacket to wear in cold weather.**

The student compared the insulation properties of wool as a natural material with polyester as a synthetic material.

Each material was wrapped around a beaker containing hot water as shown in Figure 8. Look at Figure 8 for Question 4(a) in the Diagram Booklet.

The temperature was recorded every 2 minutes for 12 minutes.

- (i) Which part of the body controls the regulation of body temperature?
(1 mark)**

- ☐ **A kidney**
- ☐ **B pituitary gland**
- ☐ **C hypothalamus**
- ☐ **D pancreas**

(continued on the next page)

4(a) continued.

(ii) State ONE variable that should be controlled in this investigation.

(1 mark)

(iii) Describe a control that could be used for this investigation.

(2 marks)

(continued on the next page)

Turn over

4 continued.

(b) Look at Figure 9 for Question 4(b) in the Diagram Booklet. The results for this investigation are shown in Figure 9.

**(i) Compare and contrast the temperature changes for wool and polyester in this investigation.
(2 marks)**

(continued on the next page)

4(b) continued.

- (ii) State ONE improvement to this investigation that would make the results more comparable. (1 mark)**

- (c) (i) Wearing an insulated jacket may cause a person to sweat.**

Explain how sweating helps to regulate temperature in humans. (2 marks)

(continued on the next page)

Turn over

4(c) continued.

(ii) Sweat contains urea.

State where and how urea is produced in the human body.

(2 marks)

(Total for Question 4 = 11 marks)

- 5 A student investigated the effect of light intensity on the photosynthesis of pondweed.**

A light source was placed at different distances from the pondweed.

The bubbles produced were counted for 2 minutes.

Look at Figure 10 for Question 5 in the Diagram Booklet. It shows the apparatus that was used.

- (a) (i) State why the student included a water bath in the apparatus.
(1 mark)**

(continued on the next page)

5(a) continued.

- (ii) State TWO variables that should be controlled when completing this investigation.
(2 marks)**

1 _____

2 _____

(continued on the next page)

5 continued.

(b) Look at Figure 11 for Question 5(b) in the Diagram Booklet. It shows the results of this investigation.

(i) The light intensity was calculated using the inverse square law for photosynthesis.

Calculate the light intensity at a distance of 25 cm from the lamp.

Include the equation for the inverse square law in your answer.

(3 marks)

_____ arbitrary units

(continued on the next page)

Turn over

5(b) continued.

- (ii) Explain how the student could improve this investigation to get a more accurate measurement of the gas produced.
(2 marks)**

- (c) Look again at Figure 10 for Question 5 in the Diagram Booklet. Devise a plan to show that temperature is a limiting factor in photosynthesis.**

**Use the apparatus shown in Figure 10.
(3 marks)**

Answer space continues on the next page.

5(c) continued.

(Total for Question 5 = 11 marks)

6 Gas exchange happens in the alveoli in the lungs.

Look at Figure 12 for Question 6(a) in the Diagram Booklet. It shows an alveolus and a capillary.

(a) (i) Name the gas used in respiration that moves from the alveolus into the capillary.

(1 mark)

(ii) Name the gas produced by respiration that moves from the capillary into the alveolus.

(1 mark)

(continued on the next page)

6(a) continued.

(iii) The capillary wall is only one cell thick.

**Explain how gases move from the alveolus to the capillary.
(3 marks)**

(continued on the next page)

Turn over

6(a) continued.

- (iv) Explain the advantages of red blood cells passing one at a time through this narrow capillary.
(3 marks)**

(continued on the next page)

6 continued.

- (b) The average number of alveoli in each human lung is 280 million.**

The surface area of 1 million alveoli is 0.25m^2 .

**Calculate the total surface area of a human lung.
(2 marks)**

(Total for Question 6 = 10 marks)

7 Look at Figure 13 for Question 7 in the Diagram Booklet. It shows part of a food web of organisms found in the cold Antarctic Ocean.

**(a) Which term describes phytoplankton in this food web?
(1 mark)**

☐ **A consumer**

☐ **B producer**

☐ **C predator**

☐ **D prey**

(b) Humans are removing large numbers of cod from the Antarctic Ocean.

**(i) State why the removal of cod could lead to a decrease in the numbers of squid and penguins.
(1 mark)**

7(b) continued.

- (ii) Explain why the removal of cod could lead to an increase in the numbers of squid and penguins.
(2 marks)**

(continued on the next page)

7 continued.

(c) Look at Figure 14 for Question 7(c) in the Diagram Booklet. It shows information about the biomass of some organisms in one part of the Antarctic Ocean.

**(i) Look at the blank grid for Question 7(c)(i) in the Diagram Booklet. On the grid, draw and label a pyramid of biomass for this food chain.
(2 marks)**

(ii) Seals are mammals.

**Explain why the conversion of biomass from phytoplankton to shrimps is more efficient than the conversion of biomass from cod to seals.
(2 marks)**

(continued on the next page)

Turn over

7 continued.

(d) Cod are being overfished in the Antarctic Ocean.

Suggest TWO actions that could be taken by humans to increase the number of cod in the Antarctic Ocean.

(2 marks)

1 _____

2 _____

(Total for Question 7 = 10 marks)

8 Look at Figure 15 for Question 8(a) in the Diagram Booklet. It shows the changes in the levels of the hormones of the menstrual cycle.

(a) (i) The maximum concentration of oestrogen is just before ovulation.

**Which is the maximum concentration of oestrogen?
(1 mark)**

☐ **A 8 ng / ml**

☐ **B 210 pg / ml**

☐ **C 320 pg / ml**

☐ **D 900 ng / ml**

(continued on the next page)

8(a) continued.

- (ii) Explain how TWO of the hormones shown in Figure 15 cause ovulation.
(3 marks)**

(continued on the next page)

8(a) continued.

- (iii) State the number of days for the first menstruation shown in Figure 15.
(1 mark)**

(continued on the next page)

8(a) continued.

(iv) Explain how the levels of each hormone in the woman shown in Figure 15 would be different, if she was pregnant.
(4 marks)

Answer space continues on the next page.

[illegible]

8(a)(iv) continued.

(Total for Question 8 = 9 marks)

9 Look at Figure 16 for Question 9(a) in the Diagram Booklet. It shows a photomicrograph of two stomata in a leaf.

(a) (i) The length of one guard cell in this image is 6 mm.

**Convert the length of this guard cell into micrometres (μm).
(1 mark)**

(continued on the next page)

9(a) continued.

(ii) The image has been magnified 150×.

Calculate the actual size of the guard cell.

**Give your answer in standard form in mm.
(3 marks)**

_____mm

(continued on the next page)

9 continued.

(b) Explain the role of denitrifying bacteria in the nitrogen cycle.

(2 marks)

(continued on the next page)

9 continued.

***(c) Describe how carbon is cycled through the biotic and abiotic components of an ecosystem.
(6 marks)**

Answer space continues on the next 2 pages.

[illegible]

Turn over

9(c) continued.

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Turn over

9(c) continued.

(Total for Question 9 = 12 marks)

10 Blood is filtered in the kidney.

Look at Figure 17 for Question 10 in the Diagram Booklet. It shows the diameter of some molecules found in human blood.

**(a) (i) Which part of the nephron is the site of ultrafiltration?
(1 mark)**

- ☐ **A distal convoluted tubule**
- ☐ **B collecting duct**
- ☐ **C glomerulus**
- ☐ **D loop of Henle**

(continued on the next page)

10(a) continued.

(ii) Molecule Z is a protein.

**Explain why protein is not usually found
in urine.**

(2 marks)

(continued on the next page)

10(a) continued.

(iii) Haemolytic anaemia is a disease that causes red blood cells to burst.

Haemoglobin is not found in the urine of people who do not have haemolytic anaemia.

The diameter of a haemoglobin molecule is 5.5 nm.

**Explain why haemoglobin can be found in the urine of people with haemolytic anaemia.
(3 marks)**

Answer space continues on the next page.

10(a)(iii) continued.

***(b) Describe how the water content of the blood is controlled in the nephron.
(6 marks)**

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10(b) continued.

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10(b) continued.

(Total for Question 10 = 12 marks)

TOTAL FOR PAPER = 100 MARKS
END OF PAPER