

Human Biology

UNIT: 4HB1

PAPER: 01

Total Marks
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Thursday 18 May 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**

**Ruler**

**Candidates may use a 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.**

**Show all the steps in any calculations and state the units.**

**Turn over**

## **INFORMATION**

**The total mark for this paper is 90.**

**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 Look at the list for Question 1 in the Diagram Booklet. Use information from the list to complete the sentences about the movement of molecules.  
(6 marks)**

**Molecules can move in and out of cells by osmosis, diffusion and active transport. Osmosis is the movement of \_\_\_\_\_ across a \_\_\_\_\_ permeable membrane.**

**(continued on the next page)**

**Turn over**

**1 continued.**

**Diffusion allows the passage of molecules**

**\_\_\_\_\_ a concentration**

**gradient. The speed of movement is affected**

**by the surface area to \_\_\_\_\_**

**ratio of the cell. Active transport requires**

**the use of energy stored in the form**

**of \_\_\_\_\_ and allows**

**molecules to move \_\_\_\_\_ a**

**concentration gradient.**

**(Total for Question 1 = 6 marks)**

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**Turn over**

**2 Look at the photograph for Question 2(a) in the Diagram Booklet. It shows alveoli in the lungs. Alveoli are the site of exchange of gasses between the air and the blood.**

**(a) (i) State, in the correct order, the structures that air must pass through from the atmosphere to the alveoli.  
(2 marks)**

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**(continued on the next page)**

**2(a) continued.**

**(ii) State two features, shown in the diagram, that allow the efficient exchange of gases.  
(2 marks)**

**1** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**2** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**(continued on the next page)**

**Turn over**

**2 continued.**

**(b) (i) Which is the percentage  
of carbon dioxide in  
the atmosphere?  
(1 mark)**

☐ **A 0·01**

☐ **B 0·04**

☐ **C 0·10**

☐ **D 0·50**

**(continued on the next page)**

**Turn over**



**2(b) continued.**

- (ii) Look at the table for Question 2(b)(ii) in the Diagram Booklet. It shows the results obtained when a person at rest breathes in air that contains different percentages of carbon dioxide.**

**Calculate the volume of air in  $\text{dm}^3$  breathed in per minute when the person breathes air containing 3.00% carbon dioxide.  
(2 marks)**

$$\text{[1 dm}^3 = 1000 \text{ cm}^3\text{]}$$

**volume of air = \_\_\_\_\_  $\text{dm}^3$**

**2(b) continued.**

- (iii) The air a person breathes in contains 20% oxygen. The body uses 20% of this oxygen.**

**Calculate the volume of oxygen used per minute when the person breathes air containing 1.60% carbon dioxide.  
(3 marks)**

**volume of oxygen = \_\_\_\_\_ cm<sup>3</sup>**

**(continued on the next page)**

**Turn over**

**2(b) continued.**

- (iv) Explain the effect of increasing the percentage of carbon dioxide in the air a person breathes in on the tidal volume and rate of breathing.  
(4 marks)**

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

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**Turn over**

**2(b)(iv) continued.**

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**(Total for Question 2 = 14 marks)**

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- 3 A student investigates a reaction. The reaction is catalysed by an enzyme and produces a gas. The student collects the gas for 10 minutes and measures the volume of the gas. The student repeats this every 10 minutes for one hour.**

**Look at the bar chart for Question 3 in the Diagram Booklet. It shows the student's results.**

- (a) (i) Add a suitable labelled scale to the x-axis.  
(2 marks)**

**(continued on the next page)**

**3(a) continued.**

- (ii) Estimate the total volume of gas produced after 30 minutes.  
(2 marks)**

**volume of gas = \_\_\_\_\_ cm<sup>3</sup>**

**(continued on the next page)**

**Turn over**

**3(a) continued.**

**(iii) Describe the trend shown by the results.  
(3 marks)**

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**Turn over**

**3(a) continued.**

**(iv) Explain the student's results  
obtained in the investigation.  
(3 marks)**

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**(continued on the next page)**

**Turn over**



**3 continued.**

**(b) Explain the effect on the results if the student had added a competitive inhibitor at the start of the investigation.  
(2 marks)**

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**(Total for Question 3 = 12 marks)**

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**Turn over**

**4 The eye contains receptors that can detect light.**

**(a) Name two other senses.  
(2 marks)**

**1** \_\_\_\_\_

\_\_\_\_\_

**2** \_\_\_\_\_

\_\_\_\_\_

**(continued on the next page)**

**4 continued.**

**(b) Look at the table for Question 4(b) in the Diagram Booklet. It shows how the focal length of the eye lens changes as the thickness of the lens changes.**

**(i) Describe the relationship between the thickness of the lens and its focal length.  
(2 marks)**

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**Turn over**

**4(b) continued.**

- (ii) Give the effect on the diameter of the lens as its thickness increases.  
(1 mark)**

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- (iii) A person is looking at a distant object and then looks at a near object.**

**Use the data in the table to explain the changes that occur in the eye so the person is able to form an image of the near object on the retina.  
(4 marks)**

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**Turn over**

**4(b)(iii) continued.**

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**4 continued.**

**(c) Look at the graph for Question 4(c) in the Diagram Booklet. Cone cells are found in the retina of the eye. They detect colour. The graph shows the absorption of different wavelengths of light by three types of cone cell.**

**(i) Determine the wavelength of light at which a red detecting cone absorbs most light.  
(1 mark)**

**wavelength of light = \_\_\_\_\_nm**

**(continued on the next page)**

**Turn over**

**4(c) continued.**

- (ii) Determine the maximum difference in the wavelengths of the light that can be absorbed by blue detecting cones.  
(2 marks)**

**difference in wavelengths =**  
**\_\_\_\_\_nm**

**(continued on the next page)**

**Turn over**

**4(c) continued.**

- (iii) Suggest why it is better to have three types of cone rather than just one type of cone.  
(2 marks)**

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**(Total for Question 4 = 14 marks)**

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- 5 Pit latrines can be used to get rid of urine and faeces. They can be used where the soil is permeable to water and are always placed downhill from wells.**

**Look at the diagram for Question 5 in the Diagram Booklet. It shows a pit latrine.**

- (a) (i) Explain why a pit latrine should be placed downhill from a well.  
(2 marks)**

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**(continued on the next page)**

**5(a) continued.**

- (ii) Give the reason why pit latrines must be placed in soil that is permeable to water.  
(1 mark)**

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**(continued on the next page)**

**5(a) continued.**

- (iii) Explain why, when a pit latrine is not in use, the latrine should have a cover and why the cover should have a long handle.  
(5 marks)**

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

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**Turn over**

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

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**Turn over**

**5 continued.**

**(b) The concrete slab shown in the diagram is washed regularly with an antibacterial solution.**

**A scientist wants to investigate two antibacterial solutions to see which solution is more effective.**

**Design an investigation the scientist could use to find out which of the two antibacterial solutions is more effective.**

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

**Answer space continues on the next 2 pages.**

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**Turn over**

**5(b) continued.**

[illegible]

**Turn over**

**5(b) continued.**

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

**(Total for Question 5 = 15 marks)**

**Turn over**

**6 Look at the diagram for Question 6(a) in the Diagram Booklet. It shows a white blood cell engulfing a bacterium and the stages that follow.**

**(a) (i) State the name of the process used by white blood cells to engulf bacteria.  
(1 mark)**

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**(ii) Describe what is happening at stages 1, 2 and 3 shown in the diagram.  
(3 marks)**

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

**stage 1**

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**Turn over**



**6(a)(ii) continued.**

**stage 2**

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**stage 3**

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**(continued on the next page)**

**6(a) continued.**

**(iii) Suggest the function of the structures labelled X.  
(2 marks)**

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**6 continued.**

**(b) A student observes a prepared slide of blood under a light microscope.**

**Look at the diagram for Question 6(b) in the Diagram Booklet. The student draws this diagram of what could be seen.**

**(i) Describe how the slide of human blood could be prepared.  
(3 marks)**

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

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**Turn over**

**6(b)(i) continued.**

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**6(b) continued.**

**(ii) Discuss the accuracy of the student's diagram.  
(4 marks)**

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

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**Turn over**

**6(b)(ii) continued.**

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**6(b) continued.**

- (iii) Explain why the student would be advised to use a prepared slide rather than making one from their own blood.  
(2 marks)**

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

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**Turn over**

**6(b)(iii) continued.**

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**(Total for Question 6 = 15 marks)**

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- 7 A method that shows whether a person's kidneys are working correctly is to measure the volume of filtrate produced by the kidneys in one minute. This is known as the glomerular filtration rate (GFR).**

**A person with healthy kidneys has a GFR of over  $100\text{ cm}^3$  per minute.**

**The GFR of a person whose kidneys were not working correctly was measured once a year for nine years.**

**(continued on the next page)**

**7 continued.**

**The table shows the results.**

<b>Year</b>	<b>GFR in cm<sup>3</sup> per minute</b>
<b>2011</b>	<b>80</b>
<b>2012</b>	<b>75</b>
<b>2013</b>	<b>79</b>
<b>2014</b>	<b>79</b>
<b>2015</b>	<b>67</b>
<b>2016</b>	<b>60</b>
<b>2017</b>	<b>50</b>
<b>2018</b>	<b>45</b>
<b>2019</b>	<b>35</b>

- (a) (i) Look at the grid for Question 7(a) (i) in the Diagram Booklet and plot a line graph of the data on the grid.  
(4 marks)**

**(continued on the next page)**

**Turn over**

**7(a) continued.**

- (ii) Explain why it is not possible to determine from the data when the person's kidneys stopped working correctly.  
(2 marks)**

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**(continued on the next page)**

**7(a) continued.**

- (iii) A person needs dialysis if the GFR falls to  $15\text{ cm}^3$  per minute.**

**Use the data to estimate when the person will probably need to start dialysis.  
(2 marks)**

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**(continued on the next page)**

**Turn over**

**7(a) continued.**

**(iv) Discuss the accuracy of  
this estimate.  
(3 marks)**

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**Turn over**

**7 continued.**

**(b) During the early stages when a person's kidneys are not working correctly, they are advised to control the amount of protein in their diet.**

**Explain why the protein in their diet should be controlled.  
(3 marks)**

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

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**Turn over**

**7(b) continued.**

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**(Total for Question 7 = 14 marks)**

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**TOTAL FOR PAPER = 90 MARKS**  
**END OF PAPER**