

Human Biology
UNIT: 4HB1
PAPER: 02

Total Marks

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, 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 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.**

Turn over

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 (a) Look at the diagram for Question 1(a) in the Diagram Booklet. It shows part of the skeleton.**

(continued on the next page)

1(a) continued.

**(i) Label the clavicle, scapula and vertebral column on the image.
(3 marks)**

(ii) The vertebral column is part of the axial skeleton.

**Describe the functions of the axial skeleton.
(2 marks)**

(continued on the next page)

Turn over

1 continued.

(b) Osteoporosis can affect the vertebral column.

**Describe the symptoms of osteoporosis.
(3 marks)**

Answer lines continue on the next page.

Turn over

1(b) continued.

(Total for Question 1 = 8 marks)

2 (a) Look at the diagram for Question 2(a) in the Diagram Booklet. It shows a section through the heart.

**(i) Name chamber Y.
(1 mark)**

(continued on the next page)

2(a) continued.

**(ii) Explain the function of
structure X.
(2 marks)**

(continued on the next page)

2(a) continued.

(iii) The table lists some properties of blood.

**Add ticks (✓) to those boxes that show the properties of blood in the aorta.
(2 marks)**

Properties of blood	Blood in the aorta
oxygenated	
deoxygenated	
high pressure	
medium pressure	
low pressure	

(continued on the next page)

Turn over

2(a) continued.

**Look at the diagram for Question 2(a)
in the Diagram Booklet.**

**(iv) State where blood in the left side
of the heart has come from.
(1 mark)**

(continued on the next page)

Turn over

2 continued.

(b) In one year in the United Kingdom, there were 173 heart transplants.

Heart transplant operations require hearts to be donated.

Some hearts cannot be used because the donor is too old.

**Give two other reasons why a heart might not be suitable for a transplant.
(2 marks)**

Answer lines continue on the next page.

1 _____

Turn over

2(b) continued.

2 _____

**(c) (i) Which blood component causes blood clotting?
(1 mark)**

- ☐ **A lymphocytes**
- ☐ **B phagocytes**
- ☐ **C platelets**
- ☐ **D red blood cells**

(continued on the next page)

2(c) continued.

- (ii) Look at the diagram for Question 2(c)(ii) in the Diagram Booklet. It summarises part of the process that causes a blood clot.**

Anticoagulant drugs prevent a blood clot forming.

These drugs stop the enzyme thrombin being produced.

**Describe how a lack of thrombin prevents a blood clot forming.
(2 marks)**

Answer lines continue on the next page.

Turn over

2(c)(ii) continued.

(Total for Question 2 = 11 marks)

- 3 Look at the diagram for Question 3 in the Diagram Booklet. A student investigates diffusion using agar cubes and an acid.**

The agar cube contains an alkali and a pH indicator.

The indicator is pink in alkali and colourless in acid.

Acid diffuses into the cube, causing the cube to change from pink to colourless from the edge.

(continued on the next page)

3 continued.

(a) The cube the student placed in the acid had a side length of 2 mm.

(i) Calculate the surface area to volume ratio of the cube.

**Your answer should be in the form $n:1$
(3 marks)**

surface area to volume ratio =

(continued on the next page)

Turn over

3(a) continued.

(ii) The cube took 1 minute and 32 seconds to become colourless.

**Which of these shows the time in seconds?
(1 mark)**

☐

A 62

☐

B 82

☐

C 92

☐

D 102

(continued on the next page)

Turn over

3(a) continued.

**(iii) State what is meant by the
term DIFFUSION.
(1 mark)**

(continued on the next page)

3(a) continued.

**(iv) Explain the effect of increasing the surface area to volume ratio on the time taken for the cube to become colourless.
(2 marks)**

Answer lines continue on the next page.

Turn over

3(a)(iv) continued.

(b) A student wants to investigate the effect of temperature on the rate of diffusion into the agar cube.

(i) Look at the diagram for Question 3 in the Diagram Booklet.

**Describe a method for this investigation using the apparatus shown in the diagram.
(2 marks)**

Answer lines continue on the next page.

3(b)(i) continued.

(continued on the next page)

3(b) continued.

**(ii) Give two variables the student would need to control in their investigation.
(2 marks)**

1 _____

2 _____

(Total for Question 3 = 11 marks)

Turn over

- 4 (a) When blood flows into a network of capillaries, tissue fluid is produced.**

The tissue fluid supplies the surrounding cells with molecules.

Look at the diagram for Question 4(a) in the Diagram Booklet. It shows a network of capillaries and surrounding cells.

- (i) Give two differences between the composition of tissue fluid and the composition of blood entering the capillary network.
(2 marks)**

Answer lines continue on the next page.

1 _____

4(a)(i) continued.

2 _____

**(ii) Describe how tissue fluid
is formed.
(4 marks)**

Answer lines continue on the next page.

4(a)(ii) continued.

(continued on the next page)

4(a) continued.

**(iii) Lymphoedema occurs
when tissue fluid builds up
causing swelling.**

**This is more common in the legs
and arms.**

**One treatment for this
is to increase physical
activity, resulting in more
muscle contraction.**

(continued on the next page)

4(a)(iii) continued.

**Explain why increased muscle contraction could reduce the swelling caused by the build up of tissue fluid.
(2 marks)**

4 continued.

(b) Lymphocytes, found in lymph nodes, produce antibodies in response to specific antigens.

**Explain why the reaction between an antigen and an antibody is specific.
(3 marks)**

Answer lines continue on the next page.

Turn over

4(b) continued.

(Total for Question 4 = 11 marks)

- 5 Some athletes train at high altitudes to improve their performance.**

Performance improves if more energy is released from aerobic respiration.

- (a) (i) Complete the balanced symbol equation for aerobic respiration.
(2 marks)**

_____ + 6O₂ →

_____ + 6CO₂

(continued on the next page)

5(a) continued.

(ii) Aerobic respiration produces ATP.

**Describe how energy is released
from ATP during exercise.
(2 marks)**

(continued on the next page)

Turn over

5 continued.

(b) The table shows the percentage change in mass of haemoglobin in the blood after different periods of time training at altitude.

Period of time in hours	Percentage change in mass of haemoglobin
0	0
100	0·7
200	2·4
300	4·1
400	5·9
500	6·5
600	7·2

(continued on the next page)

Turn over

5(b) continued.

Look at the grid for Question 5(b) in the Diagram Booklet.

**(i) Plot the results on the grid.
(4 marks)**

**(ii) Draw the curve of best fit.
(1 mark)**

(continued on the next page)

5(b) continued.

**(iii) Discuss how the percentage change in mass of haemoglobin, after training at altitude, could result in an increase in performance during exercise.
(5 marks)**

Answer lines continue on the next page.

Turn over

5(b)(iii) continued.

(Total for Question 5 = 14 marks)

- 6 (a) Look at the passage for Question 6(a) in the Diagram Booklet.**

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

- (i) Describe the benefits of producing iPS cells from a patient's own cells.
(3 marks)**

Answer lines continue on the next page.

Turn over

6(a)(i) continued.

**(ii) Give two possible risks of using stem cells to treat diseases and medical conditions.
(2 marks)**

Answer lines continue on the next page.

1

Turn over

6(a)(ii) continued.

2 _____

(b) One condition that stem cells could be used to treat is age-related macular degeneration (AMD).

This is the main cause of vision loss in people over the age of 50.

Look at the graph for Question 6(b)(i) in the Diagram Booklet. It shows the number of people affected by AMD in some countries.

(continued on the next page)

Turn over

6(b) continued.

Look at the additional graph for Question 6(b)(i) on page 10 of the Diagram Booklet.

- (i) Calculate the difference between the number of women and the number of men affected by AMD in the United Kingdom.
(2 marks)**

difference = _____

(continued on the next page)

Turn over

6(b) continued.

(ii) Look at diagram for Question 6(b)(ii) in the Diagram Booklet. It shows a human eye.

AMD affects the retina of the eye

**Which of these structures is affected by AMD?
(1 mark)**

☐ **A structure W**

☐ **B structure X**

☐ **C structure Y**

☐ **D structure Z**

(continued on the next page)

Turn over

6 continued.

(c) A deficiency of vitamin A can also cause blindness.

A genetically engineered rice product can be used to prevent deficiency of vitamin A.

**Describe how genetic engineering is used to produce this rice product.
(3 marks)**

Answer lines continue on the next page.

Turn over

6(c) continued.

(Total for Question 6 = 11 marks)

7 The renal system is involved in osmoregulation.

**(a) (i) Name the area of the brain that detects the water content of the blood.
(1 mark)**

(ii) The kidneys are part of the renal system.

Look at the table for Question 7(a)(ii) on pages 16 and 17 in the Diagram Booklet.

**Put one tick (✓) in each column of the table to identify the function of different structures in the kidney.
(3 marks)**

(continued on the next page)

Turn over

7 continued.

(b) Look at the table for Question 7(b) in the Diagram Booklet. It shows the percentage composition of two urine samples taken from one person.

Not all of the components are shown.

The first sample was taken at midday and the second sample was taken four hours later.

(continued on the next page)

7(b) continued.

**(i) Describe how urea is produced in the body.
(2 marks)**

(continued on the next page)

Turn over

7(b) continued.

- (ii) The ADH response changes the percentage composition of urine.**

**Explain the ADH response that occurred in the person's body between the first and the second sample being collected.
(5 marks)**

Answer lines continue over the next 2 pages.

Turn over

7(b)(ii) continued.

7(b)(ii) continued.

(Total for Question 7 = 11 marks)

- 8 (a) When women cannot conceive naturally, they can have fertility treatment.

Women having fertility treatment can be given the hormones FSH and LH.

- (i) Give a role of LH in women.
(1 mark)

(continued on the next page)

8(a) continued.

- (ii) Giving birth to twins or triplets is described as a multiple birth.**

**Explain how the use of FSH to treat infertility could increase the chances of a multiple birth.
(3 marks)**

(continued on the next page)

Turn over

8 continued.

(b) Look at the diagram for Question 8(b) in the Diagram Booklet. Some identical twins share a placenta, as shown in the diagram.

(i) Twins that share a placenta are often born with a lower mass than twins that have separate placentas.

Explain why twins sharing a placenta have a lower mass when they are born.

(3 marks)

Answer lines continue on the next page.

Turn over

8(b)(i) continued.

(continued on the next page)

Turn over

8(b) continued.

(ii) Identical twins form when the embryo splits early in pregnancy.

**Explain why the twins are genetically identical.
(2 marks)**

(continued on the next page)

Turn over

8(c) continued.

(c) When babies are young, their growth is monitored using a percentile chart.

Look at the diagram for Question 8(c) in the Diagram Booklet. It shows a percentile chart for baby girls.

**(i) Determine the growth percentile of a six-week-old baby girl with a mass of 5 kg.
(1 mark)**

percentile = _____

(continued on the next page)

Turn over

8(c) continued.

- (ii) Describe how percentile charts are used to identify concerns about the growth of a baby.
(3 marks)**

Answer lines continue on the next page.

Turn over

8(c)(ii) continued.

(Total for Question 8 = 13 marks)

TOTAL FOR PAPER = 90 MARKS
END OF PAPER