

Human Biology
UNIT: 4HB1
PAPER: 01

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

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.

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.

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 a human eye.**
- (i) On the next page draw one line from each structure to its correct function.**
(3 marks)

(continued on the next page)

1(a)(i) continued.

STRUCTURE

FUNCTION

structure X

transmits
electrical
impulses to
the brain

structure Y

refracts light rays

structure Z

protects the eye
from pathogens

detects light rays

controls the
shape of the lens

controls the size
of the pupil

(continued on the next page)

Turn over

1(a) continued.

(ii) Most humans have stereoscopic vision.

**Which of these statements occurs because of stereoscopic vision?
(1 mark)**

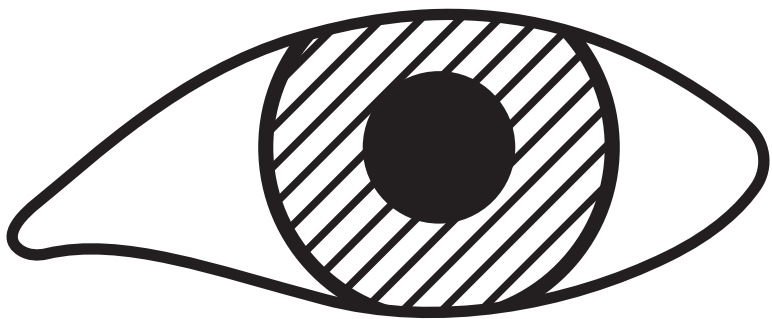
- ☐ **A being able to judge depth**
- ☐ **B being able to see in colour**
- ☐ **C having a wide field of view**
- ☐ **D to be able to see near and far objects**

(continued on the next page)

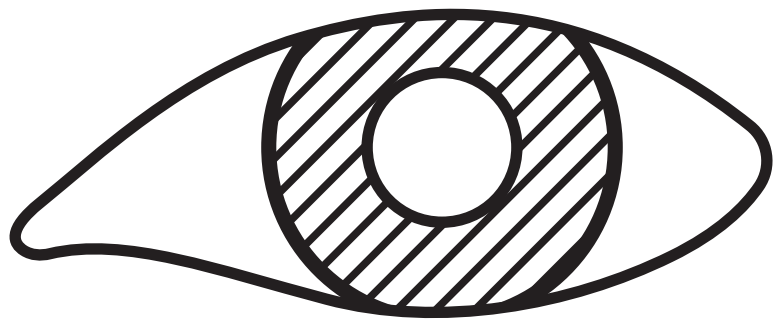
1 continued.

(b) The diagram shows a healthy eye and an eye with a cataract.

Healthy eye



Eye with cataract



**(i) Describe the cause of cataracts.
(2 marks)**

(continued on the next page)

Turn over

1(b) continued.

**(ii) State one treatment for cataracts.
(1 mark)**

**(iii) It is estimated that 39 million
people in the world are blind.**

**Of these people, 43% are blind
because of cataracts.**

**Determine the estimated number
of people who are blind because
of cataracts.
(2 marks)**

number of people = _____

1(b) continued.

(iv) Some people are blind because of a vitamin deficiency.

**Name the vitamin that is needed to prevent this type of blindness.
(1 mark)**

(Total for Question 1 = 10 marks)

Turn over

2 (a) A human sperm cell has a tail, a mid-piece containing organelles and a head with a nucleus.

**(i) Give the function of the tail.
(1 mark)**

**(ii) Which of these, found in the mid-piece, release energy?
(1 mark)**

☐ **A chromosomes**

☐ **B endoplasmic reticulum**

☐ **C mitochondria**

☐ **D ribosomes**

(continued on the next page)

Turn over

2(a) continued.

(iii) The process of meiosis is involved in the production of sperm.

**Explain the importance of meiosis in sperm production.
(3 marks)**

Answer lines continue on the next page.

Turn over

2(a)(iii) continued.

(continued on the next page)

2 continued.

- (b) (i) Look at the diagram for Question 2(b)(i) in the Diagram Booklet. Complete the genetic diagram to show how the sex of a person is determined by the chromosomes in the nucleus of the egg and the nucleus of the sperm.
(3 marks)**

(continued on the next page)

2(b) continued.

- (ii) The sperm head has to enter the egg cell so the nuclei can fuse.**

**Describe how the sperm head enters the egg cell.
(2 marks)**

(Total for Question 2 = 10 marks)

Turn over

3 (a) Look at the diagram for Question 3(a) in the Diagram Booklet. It represents the effect of bile on a large fat droplet.

**(i) Where is bile produced?
(1 mark)**

☐ **A gall bladder**

☐ **B liver**

☐ **C small intestine**

☐ **D stomach**

(continued on the next page)

3(a) continued.

**(ii) Describe the role of bile in the digestion of fat.
(3 marks)**

(continued on the next page)

Turn over

3 continued.

(b) Three food tests are used on a solution of food.

Look the table for Question 3(b) in the Diagram Booklet. It shows the reagent used and the colour of the food solution after each test.

(continued on the next page)

3(b) continued.

- (i) Describe what the food tests show about the dietary components in the food.
(3 marks)**

(continued on the next page)

Turn over

3(b) continued.

- (ii) Saliva is added to a new sample of the food solution and the mixture is kept at 37 °C for 10 minutes.**

The food tests are then repeated and the solution turns brick red when tested with Benedict's reagent.

**Explain the effect of saliva on the food solution.
(3 marks)**

Answer lines continue on the next page.

Turn over

3(b)(ii) continued.

(continued on the next page)

3 continued.

(c) Food is digested as it moves along the alimentary canal.

This process is helped by a diet containing fibre.

**Explain how food is moved along the alimentary canal and how fibre helps this process.
(5 marks)**

Answer lines continue on the next 2 pages.

Turn over

3(c) continued.

3(c) continued.

(Total for Question 3 = 15 marks)

- 4 Typhoid is caused by **Salmonella typhi** bacteria.

These bacteria are spread by houseflies.

(a) Look at the image for Question 4 in the Diagram Booklet. It shows **Salmonella typhi**, magnified 60 000 times.

- (i) Each bacterium is surrounded by cell structure Y.

Identify cell structure Y.
(1 mark)

(continued on the next page)

4(a) continued.

(ii) Bacterium X has a length of 55 mm.

Calculate the actual length of the bacterium in micrometres (μm).

**[1 mm = 1000 μm]
(2 marks)**

actual length = _____ μm

(continued on the next page)

4 continued.

(b) A team of scientists found that the legs of houseflies have hundreds of different species of bacteria on them.

(i) Flies in towns and cities carry more bacteria than flies that are found in the countryside.

**Suggest a reason for this observation.
(1 mark)**

(continued on the next page)

4(b) continued.

- (ii) One species of bacterium identified is *Helicobacter pylori* which causes stomach ulcers.**

**Explain how houseflies could increase the transmission of *Helicobacter pylori*.
(3 marks)**

Answer lines continue on the next page.

Turn over

4(b)(ii) continued.

(continued on the next page)

4 continued.

(c) Look at diagram for Question 4(c) in the Diagram Booklet. It shows the levels of typhoid across the world.

**(i) Give reasons for the global distribution of typhoid.
(2 marks)**

4(c) continued.

- (ii) Some strains of bacteria that cause typhoid are resistant to antibiotics.**

**Discuss how resistance to antibiotics develops and the effect this has on the treatment of typhoid.
(5 marks)**

Answer lines continue on the next 2 pages.

Turn over

4(c)(ii) continued.

4(c)(ii) continued.

(Total for Question 4 = 14 marks)

5 (a) A student reads that as people get older their ability to hear high frequency sounds decreases.

**(i) Describe an investigation a student could do to show if this is correct.
(3 marks)**

Answer lines continue on the next page.

5(a)(i) continued.

**(ii) Give a reason why hearing loss occurs as people get older.
(1 mark)**

(continued on the next page)

Turn over

5 continued.

(b) Glue ear is a condition that can affect children and causes hearing loss.

Look at diagram for Question 5(b) in the Diagram Booklet. Fluid accumulates in the middle ear, as shown in the diagram.

As the child grows, the slope of the Eustachian tube increases and the fluid drains.

**(i) Explain how the fluid in the middle ear causes hearing loss.
(3 marks)**

Answer lines continue on the next page.

Turn over

5(b)(i) continued.

**(ii) Explain why children with
glue ear get more bacterial ear
infections than other children.
(2 marks)**

Answer lines continue on the next page.

Turn over

5(b)(ii) continued.

**(iii) Describe the role of the ear in
maintaining a person's balance.
(3 marks)**

Answer lines continue on the next page.

Turn over

5(b)(iii) continued.

(Total for Question 5 = 12 marks)

- 6 Yoghurt can be produced by incubating milk with a small amount of live yoghurt.**

**The live yoghurt contains
Lactobacillus bacteria.**

Enzymes convert lactose in the milk into lactic acid causing the pH to decrease to around pH 4.4.

In an investigation, the change in pH as yoghurt is produced was measured during 20 hours at three different temperatures.

Look at the graph for Question 6 in the Diagram Booklet. It shows the results.

(continued on the next page)

6 continued.

- (a) (i) Calculate the difference in the time taken to produce yoghurt at 40 °C instead of 20 °C.
(2 marks)**

time = _____ hours

(continued on the next page)

Turn over

6(a) continued.

**(ii) Give two variables that need to be controlled in this investigation.
(2 marks)**

1 _____

2 _____

(continued on the next page)

Turn over

6(a) continued.

**(iii) Describe how this investigation could be improved to find the optimum temperature for the production of yoghurt.
(2 marks)**

(continued on the next page)

Turn over

6(a) continued.

(iv) In some methods to produce yoghurt, the milk is boiled and then cooled before the bacteria are added.

**Give the reason for boiling and the reason for cooling the milk.
(2 marks)**

boiling

cooling

6 continued.

**(b) When yoghurt reaches a pH of 4.4
the bacteria stop fermenting lactose.**

**Explain why bacteria stop fermenting
the lactose at a pH of around 4.4
(2 marks)**

(continued on the next page)

Turn over

6 continued.

**(c) People who are lactose intolerant
can drink lactose-free milk.**

**This can be produced using alginate
beads containing lactase.**

(continued on the next page)

6(c) continued.

Look at the diagram for Question 6(c) in the Diagram Booklet. It shows the equipment needed.

- (i) Describe the advantages of using alginate beads containing lactase rather than a solution of lactase. (2 marks)**

(continued on the next page)

Turn over

6(c) continued.

(ii) The enzyme lactase breaks down lactose into simpler sugars.

**Explain how the structure of the small intestine allows the absorption of these sugars.
(3 marks)**

Answer lines continue on the next page.

Turn over

6(c)(ii) continued.

(Total for Question 6 = 15 marks)

7 People with polycystic kidney disease have cysts on their kidneys.

Cysts are sacs of fluid and they affect the functioning of the kidney.

Polycystic kidney disease is caused by a mutation of a gene.

**(a) Explain how a gene mutation can affect the phenotype of an individual.
(3 marks)**

Answer lines continue on the next page.

7(a) continued.

(continued on the next page)

7 continued.

(b) Polycystic kidney disease can cause kidney failure.

Kidney failure can be treated using dialysis or a transplant.

**(i) Describe the benefits of a transplant rather than dialysis as a treatment for kidney failure.
(2 marks)**

Answer lines continue on the next page.

Turn over

7(b)(i) continued.

(continued on the next page)

7(b) continued.

(ii) In one year in the United Kingdom there were 4733 organ donations.

Of these donations, 3233 were kidney donations.

**Calculate the percentage of organ donations that are kidney donations.
(2 marks)**

percentage = _____ %

(continued on the next page)

Turn over

7(b) continued.

(iii) The number of kidney donations is much higher than the number of other organ donations such as heart or liver.

**Give two reasons for the higher number of kidney donations.
(2 marks)**

1 _____

2 _____

(continued on the next page)

Turn over

7 continued.

(c) Look at the diagram for Question 7(c) in the Diagram Booklet. It shows a family pedigree. Some of the family have polycystic kidney disease.

This disease is caused by a dominant allele that is not sex-linked.

**(i) Determine the ratio of the females shown in the 3rd generation that are affected with polycystic kidney disease.
(1 mark)**

ratio = _____

7(c) continued.

- (ii) Explain the possible genotypes and phenotypes for the offspring of individual A and individual B.**

**Look at the genetic diagram for Question 7(c)(ii) in the Diagram Booklet. You should complete the genetic diagram as part of your answer.
(4 marks)**

Answer lines continue on the next page.

Turn over

7(c)(ii) continued.

(Total for Question 7 = 14 marks)

TOTAL FOR PAPER = 90 MARKS
END OF PAPER