

Surname		Other Names	
Centre Number		Candidate Number	
Candidate Signature			

Leave blank
-------------

General Certificate of Secondary Education  
June 2004



**BIOLOGY  
HIGHER TIER**

**3411/H**

Monday 7 June 2004 1.30 pm to 3.45 pm

**H**

**In addition to this paper you will require:**  
a ruler.  
You may use a calculator.

For Examiner's Use			
Number	Mark	Number	Mark
1		9	
2		10	
3		11	
4		12	
5		13	
6		14	
7		15	
8		16	
		17	
		18	
		19	
		20	
Total (Column 1)	→		
Total (Column 2)	→		
TOTAL			
Examiner's Initials			

Time allowed: 2 hours 15 minutes

**Instructions**

- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want marked.

**Information**

- The maximum mark for this paper is 135.
- Mark allocations are shown in brackets.
- You are reminded of the need for good English and clear presentation in your answers.

Answer **all** questions in the spaces provided.

- 1 (a) (i) What name is given to an enzyme which catalyses the breakdown of protein?

.....  
(1 mark)

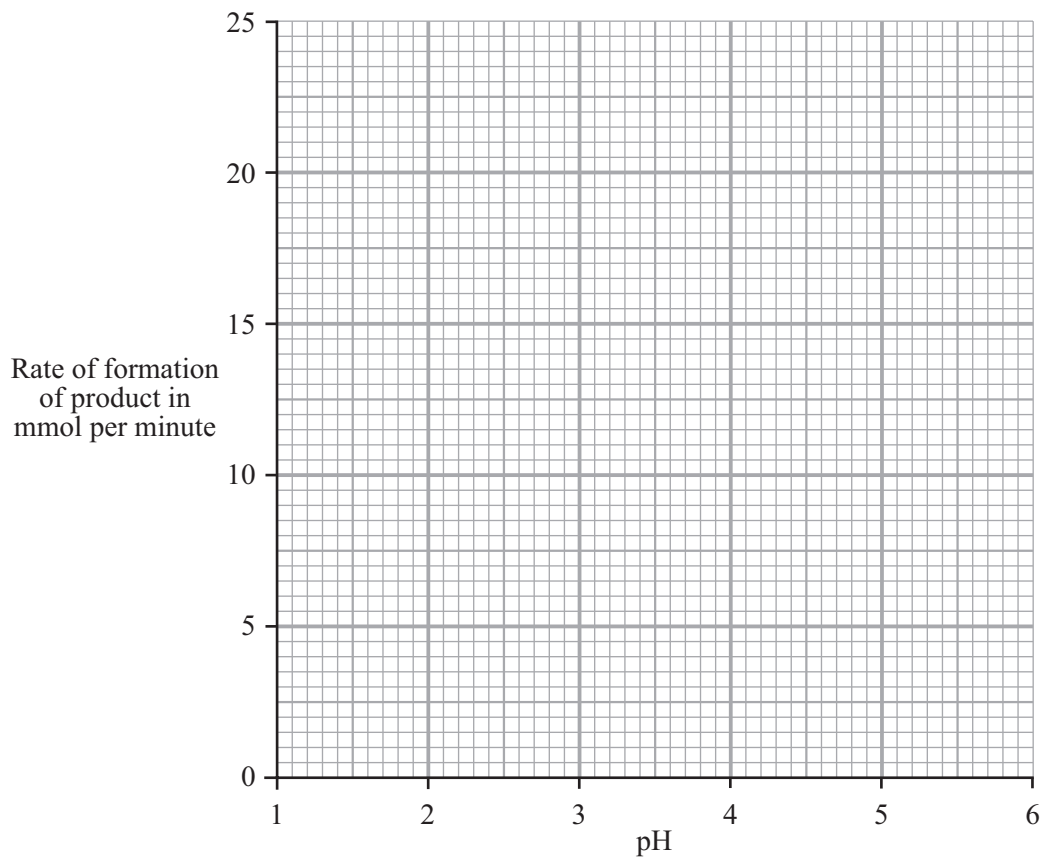
- (ii) What product is formed when protein is broken down by the enzyme?

.....  
(1 mark)

The table shows the effect of pH on the activity of an enzyme which catalyses the breakdown of protein.

<b>pH</b>	1.0	2.0	3.0	4.0	5.0
<b>Rate of formation of product in mmol per minute</b>	10.5	23.0	10.5	2.5	0.0

- (b) Draw a graph of the data in the table.



(3 marks)

(c) The enzyme is produced by the human digestive system.

(i) At what pH does this enzyme work best? .....  
(1 mark)

(ii) Suggest which part of the digestive system produces this enzyme.  
.....  
(1 mark)

(d) Why is it necessary to break down proteins in the digestive system?

.....  
.....  
.....  
.....  
.....  
.....  
.....  
(3 marks)

10

**TURN OVER FOR THE NEXT QUESTION**

**Turn over** ►

2 Hormones are sometimes used to regulate human reproduction.

(a) (i) What is a hormone?

.....  
.....

(1 mark)

(ii) How are hormones transported around the body?

.....  
.....

(1 mark)

(b) Describe the benefits and possible problems that may result from the use of hormones to regulate human reproduction. You should refer to fertility drugs and contraceptives in your answer.

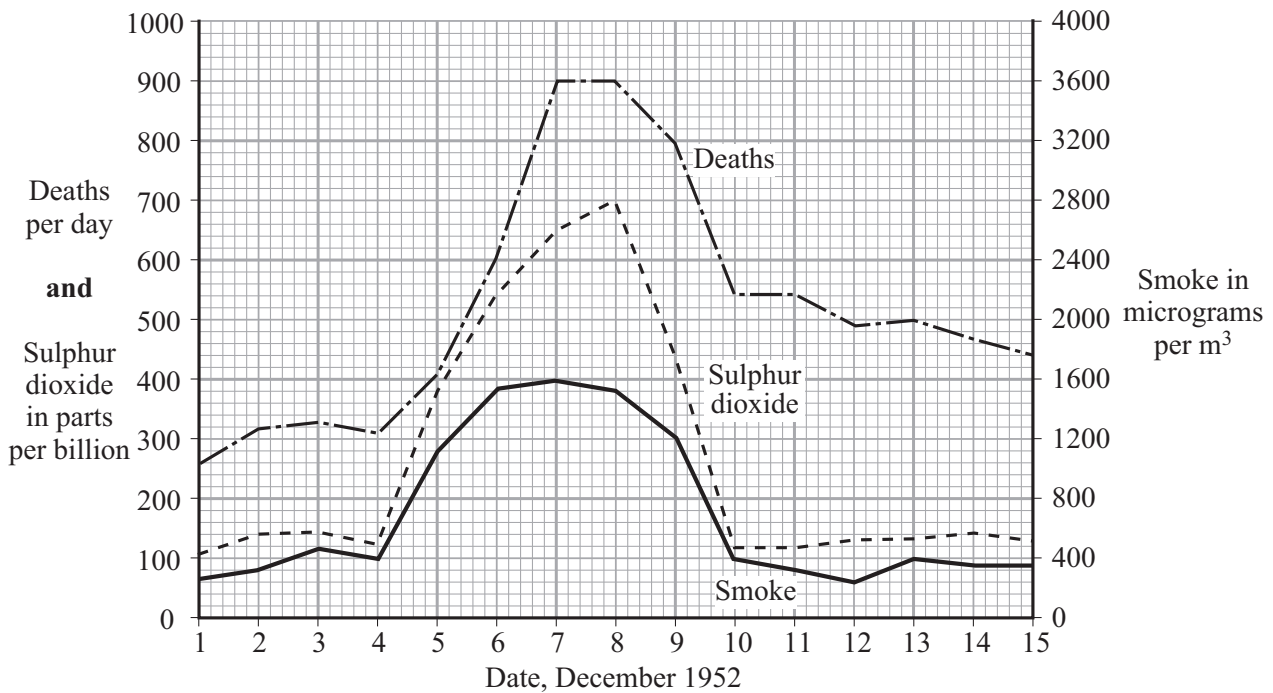
*To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.*

.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....

(4 marks)



3 In December 1952, there was a thick fog in London. The graph shows changes in the amounts of sulphur dioxide and smoke in the air and the number of people dying during this period.



(a) Describe **one** human activity which releases sulphur dioxide into the air.

.....  
(1 mark)

(b) Human deaths during this period were caused mainly by lung diseases.

(i) Why were the lungs particularly affected?

.....  
(1 mark)

(ii) Give evidence from the graph which suggests that sulphur dioxide might have caused these deaths.

.....  
.....  
(1 mark)

(iii) Does the graph prove that sulphur dioxide caused these deaths? Explain your answer.

.....  
.....  
(1 mark)

4 Hepatitis B is a liver disease caused by a virus. The virus is found in body fluids such as blood, saliva and urine. Diagram 1 shows the structure of the virus in cross section.

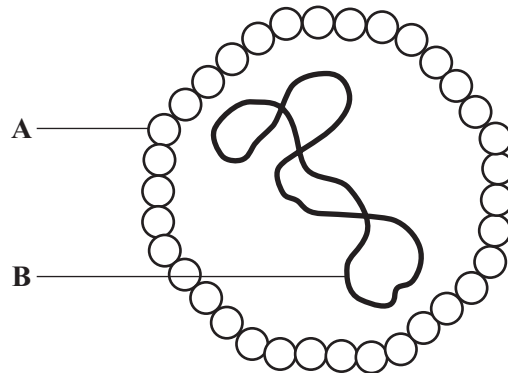


Diagram 1

(a) Name structures **A** and **B**.

**A:** .....

**B:** .....

(2 marks)

(b) The human body has several natural defences against viruses. Some of these prevent viruses from entering the body. Others act once the viruses have entered.

(i) Give **two** ways in which the body stops viruses from entering.

1.....

2.....

(2 marks)

(ii) Diagram 2 shows a white blood cell attacking a group of viruses.

Complete diagram 2 by drawing the 2nd stage.

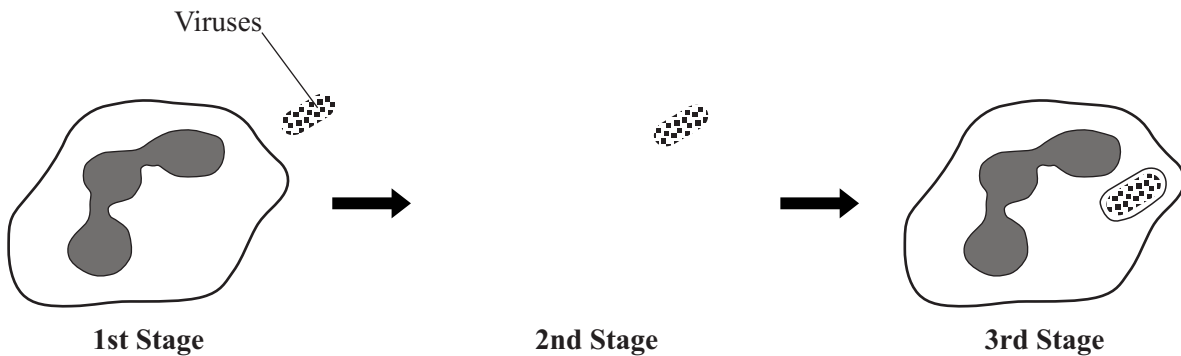


Diagram 2

(1 mark)

(iii) What type of chemical is released by some white blood cells to attack viruses?

.....  
(1 mark)

(c) Hepatitis B is more likely to be spread among people who share needles when they inject drugs. Use information given at the beginning of this question to explain why this is so.

.....  
.....  
.....  
.....  
(2 marks)

8

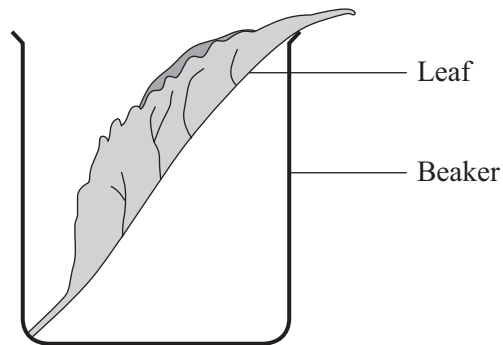
**TURN OVER FOR THE NEXT QUESTION**

**Turn over** ►

- 5 Four leaves were removed from the same plant. Petroleum jelly (a waterproofing agent) was spread onto some of the leaves, as follows:

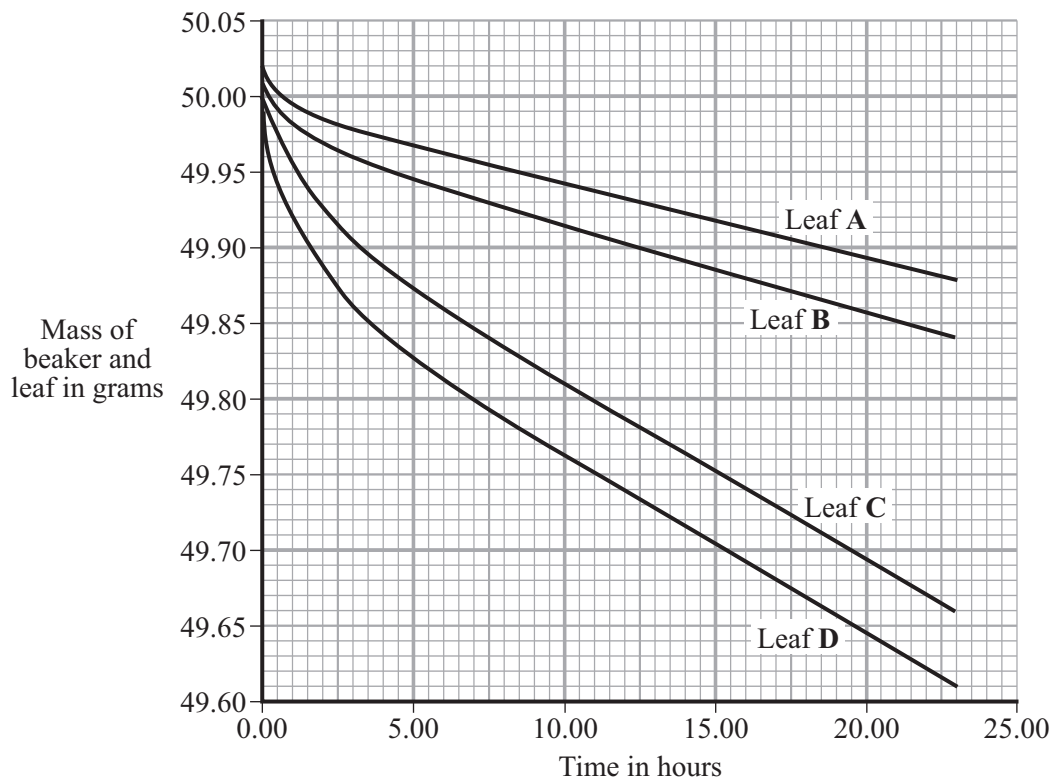
- Leaf **A**: on both surfaces  
 Leaf **B**: on the lower surface only  
 Leaf **C**: on the upper surface only  
 Leaf **D**: none applied

Each leaf was then placed in a separate beaker, as shown in diagram 1.



**Diagram 1**

Each beaker was weighed at intervals. The results are shown in the graph.





(a) Give evidence from the graph in answering the following questions.

(i) Which surface (upper or lower) loses water most rapidly?.....

Evidence.....

.....  
(1 mark)

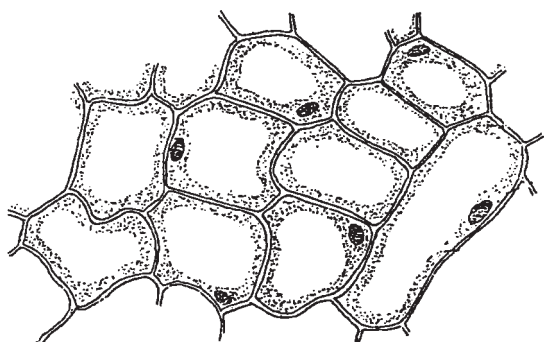
(ii) Is water lost from both surfaces of the leaf? .....

Evidence.....

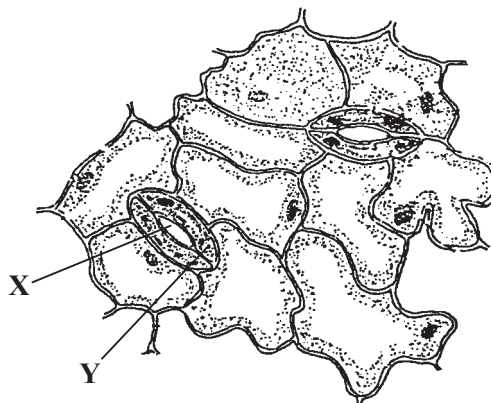
.....  
(1 mark)

(b) Diagram 2 shows the appearance of each surface of the leaf as seen through a microscope.

**Upper Surface of Leaf**



**Lower Surface of Leaf**



**Diagram 2**

(i) Name space X and cell Y.

X:.....

Y:.....

(2 marks)

(ii) Use information in diagram 2 to explain why the results are different for leaves B and C.

.....  
.....  
.....  
.....

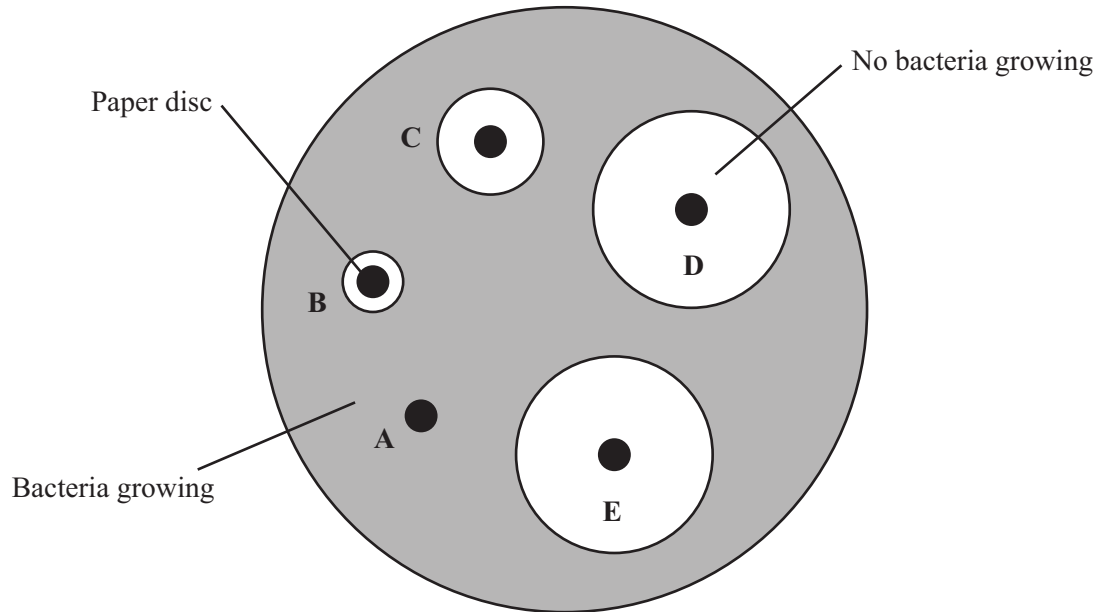
(2 marks)



Turn over ►

- 6 An investigator placed paper discs containing different concentrations of an antibiotic onto a culture of bacteria in a petri dish.

After an incubation period of two days, the dish looked like this.



- (a) Explain why there are areas around some of the paper discs where no bacteria are growing.

.....

.....

(2 marks)

- (b) The concentration of the antibiotic on the paper discs is given in the table, along with the diameter of the circles where no bacteria are growing.

Disc	Concentration of the antibiotic in units	Diameter of circle where no bacteria are growing, in mm
A	0	0
B	2	8
C	4	14
D	6	26
E	10	26

What effect does an increase in the concentration of the antibiotic have on the growth of the bacteria?

.....  
.....  
.....

(2 marks)

(c) When students carry out this experiment, they need to take several safety precautions.

The precautions include:

- passing inoculating loops through a flame
- sealing the lid of the petri dish with tape
- incubating at a maximum temperature of 25 °C.

Explain why each of these precautions is necessary.

*To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.*

.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....

(5 marks)

(d) Scientists are concerned that many bacteria are developing resistance to antibiotics.

Suggest **two** ways by which this problem could be limited.

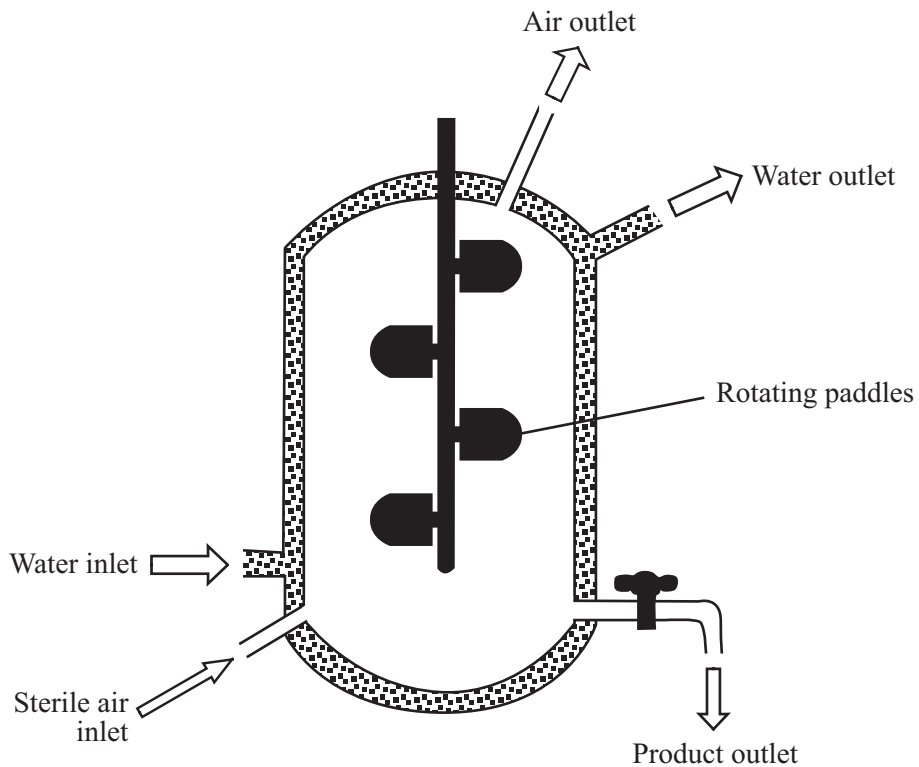
.....  
.....  
.....  
.....

(2 marks)

Turn over ►

7 The diagram shows a simple fermenter.

The fermenter contains a nutrient solution and a microorganism that makes a protein for human use.



(a) Explain the difference between the water entering through the inlet and the water leaving through the outlet.

.....  
 .....  
 (2 marks)

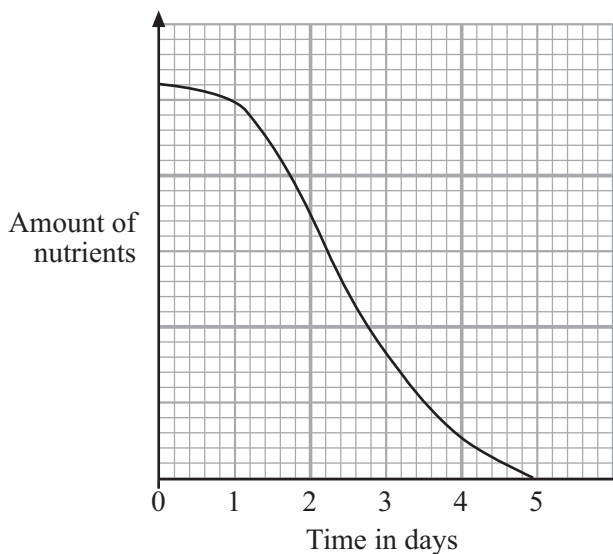
(b) Why is it necessary for air to be passed into the fermenter?

.....  
 .....  
 (2 marks)

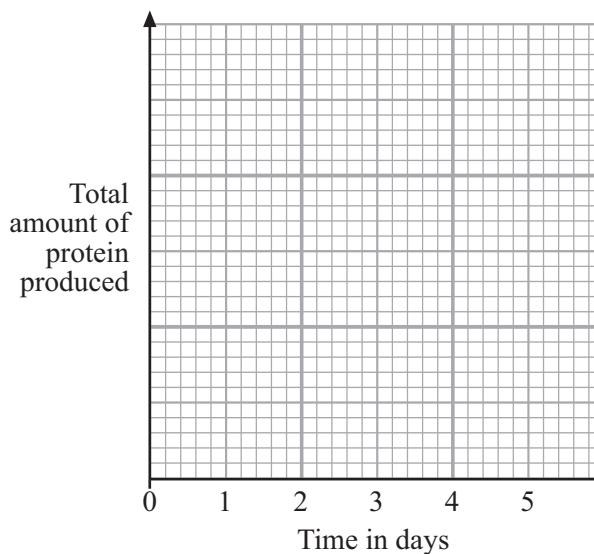
(c) Suggest **two** conditions in the fermenter that could be continuously monitored.

.....  
 .....  
 (2 marks)

- (d) Graph A shows how the amount of nutrients available for the microorganism changes over a five-day period.



**Graph A**



**Graph B**

Sketch a curve on graph B to show how the total amount of protein produced would change over the same five days. (2 marks)

- (e) Yeast can be used to produce ethanol in the fermenter.

Suggest **one** way in which the design of a fermenter to produce ethanol would need to be different from the one shown in the diagram.

.....  
 .....

(1 mark)

9

**TURN OVER FOR THE NEXT QUESTION**

**Turn over** ►

8 Each autumn, many trees lose their leaves.

- (a) Describe how carbon compounds in the leaves can be recycled so that they can be used again by the trees.

*To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.*

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(4 marks)

- (b) Give **two** environmental conditions which speed up the processes that you have described in part (a).

1 .....

2 .....

(2 marks)



9 (a) Each day, a boy ate food containing 12 000 kilojoules of energy. The boy's body used 80 per cent of this energy to maintain his core temperature.

(i) Name the process which releases energy from food.

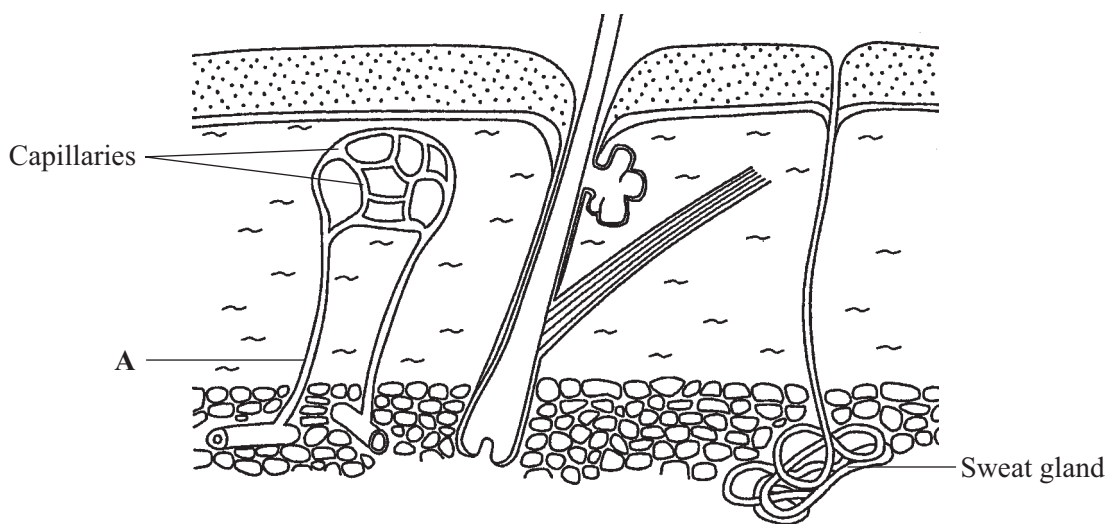
.....  
(1 mark)

(ii) Calculate the amount of energy that the boy would use each day to maintain his core body temperature. Show clearly how you work out your final answer.

.....  
.....

Amount of energy used each day = ..... kJ  
(2 marks)

(b) The diagram shows a section through human skin.



Explain how structure A helps to cool the body on a hot day.

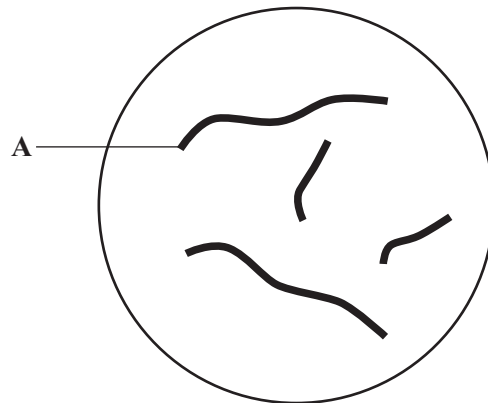
.....  
.....  
.....  
.....  
.....  
(3 marks)

(c) Body temperature is monitored and controlled by the thermoregulatory centre. Where in the body is the thermoregulatory centre?

.....  
(1 mark)

Turn over ►

10 Diagram 1 shows the nucleus of a cell at the start of meiosis.

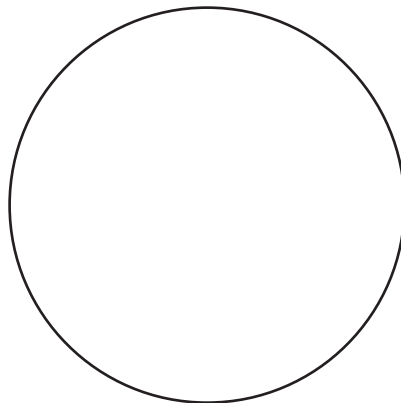


**Diagram 1**

(a) Name structure A. .... (1 mark)

(b) During meiosis, the nucleus shown in diagram 1 will divide twice to form four nuclei.

Complete diagram 2 to show the appearance of one of these nuclei.



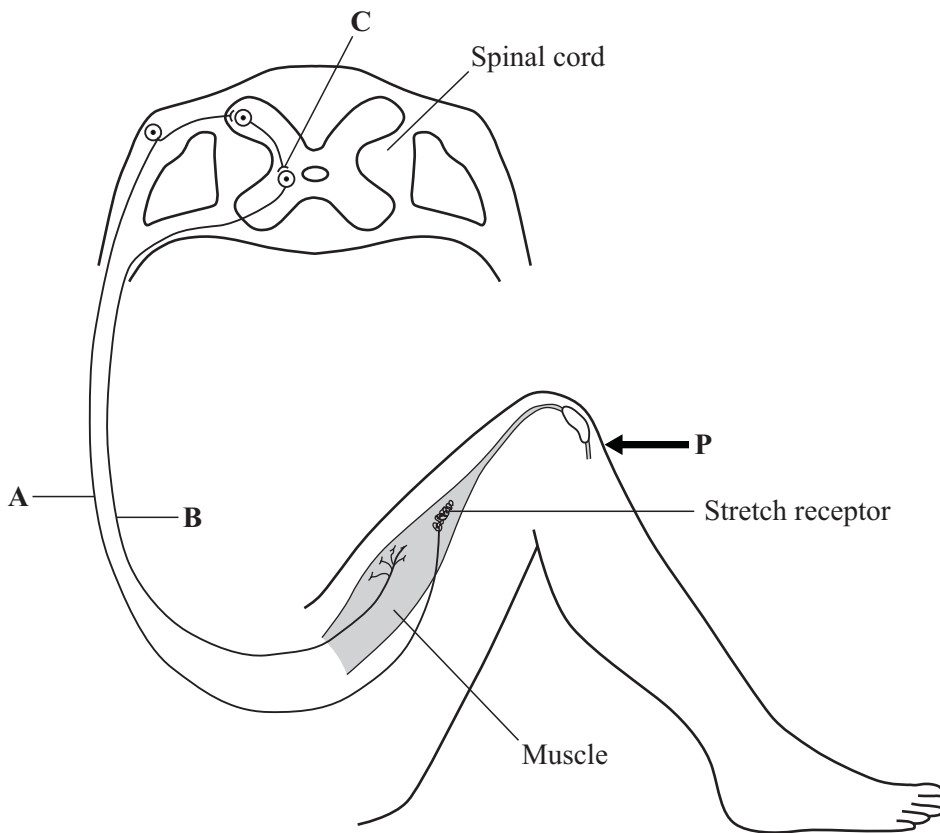
**Diagram 2**

(2 marks)





- 11 The diagram shows the nervous pathway which is used to coordinate the knee-jerk reflex. When the person is hit at point **P**, the lower leg is suddenly raised.



- (a) (i) Name the type of neurone labelled **A**. .....  
(1 mark)
- (ii) **On the diagram**, draw arrows next to the neurones labelled **A** and **B** to show the direction in which an impulse moves in each neurone.  
(1 mark)
- (b) How is information passed across the synapse at **C**?  
.....  
(1 mark)
- (c) **On the diagram**, label the effector with the letter **X**.  
(1 mark)

**12** The vole is a small, mouse-like animal. Voles found on some cold islands to the north of Scotland are much larger than voles found in warmer areas such as southern France. Explain how natural selection may have caused the northern voles to be larger in size.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

*(5 marks)*

5

13 Huntington’s disease is an inherited condition which is caused by a *dominant allele*. The effects of the disease do not appear until the person with the allele is 30 to 40 years old.

(a) What is meant by each of the following:

(i) *allele*;.....  
.....  
(1 mark)

(ii) *dominant*?.....  
.....  
(1 mark)

(b) A man and his wife are both 45 years old. The man is now suffering from Huntington’s disease, but his wife is not a sufferer. They have one child who is now 14 years old.

(i) What system of the body is affected by Huntington’s disease?  
.....  
(1 mark)

(ii) The man is heterozygous for Huntington’s disease. Draw a genetic diagram and use it to find the probability that the child will develop Huntington’s disease.

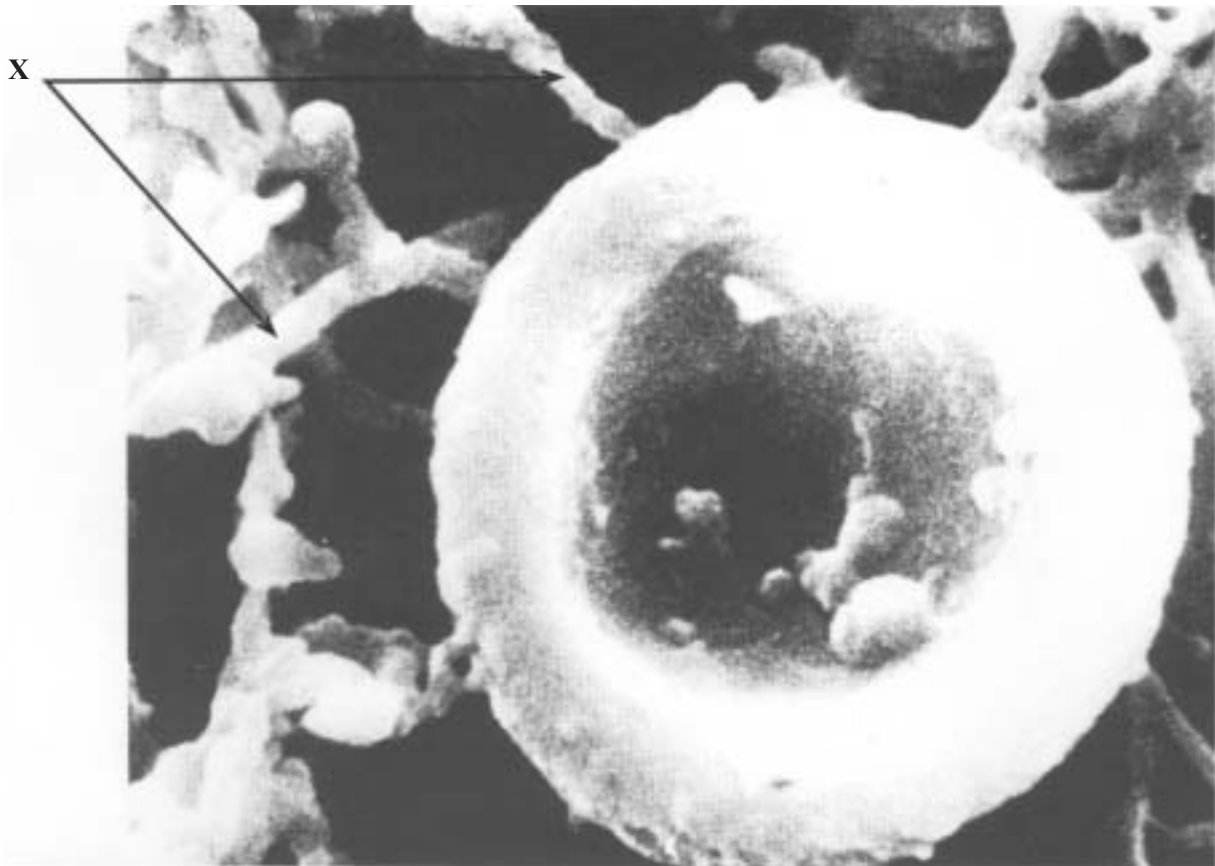
Use the following symbols: **H** = allele for Huntington’s disease  
**h** = unaffected allele

Probability = .....  
(5 marks)

8

Turn over ►

- 14 The photograph shows a red blood cell in part of a blood clot. The fibres labelled X are produced in the early stages of the clotting process.



- (a) Suggest how the fibres labelled X help in blood clot formation.

.....  
(1 mark)

- (b) The average diameter of a real red blood cell is 0.008 millimetres.  
On the photograph, the diameter of the red blood cell is 100 millimetres.

Use the formula to calculate the magnification of the photograph.

$$\text{Diameter on photograph} = \text{Real diameter} \times \text{Magnification}$$

.....  
.....  
.....

Magnification = .....  
(2 marks)

(c) Some blood capillaries have an internal diameter of approximately 0.01 millimetres.

(i) Use information given in part (b) to explain why only one red blood cell at a time can pass through a capillary.

.....  
(1 mark)

(ii) Explain the advantages of red blood cells passing through a capillary one at a time.

.....  
.....  
.....  
.....  
.....  
.....  
(3 marks)

(d) Cigarette smoke contains carbon monoxide. Explain how this would affect the normal functioning of red blood cells in a person who smokes cigarettes.

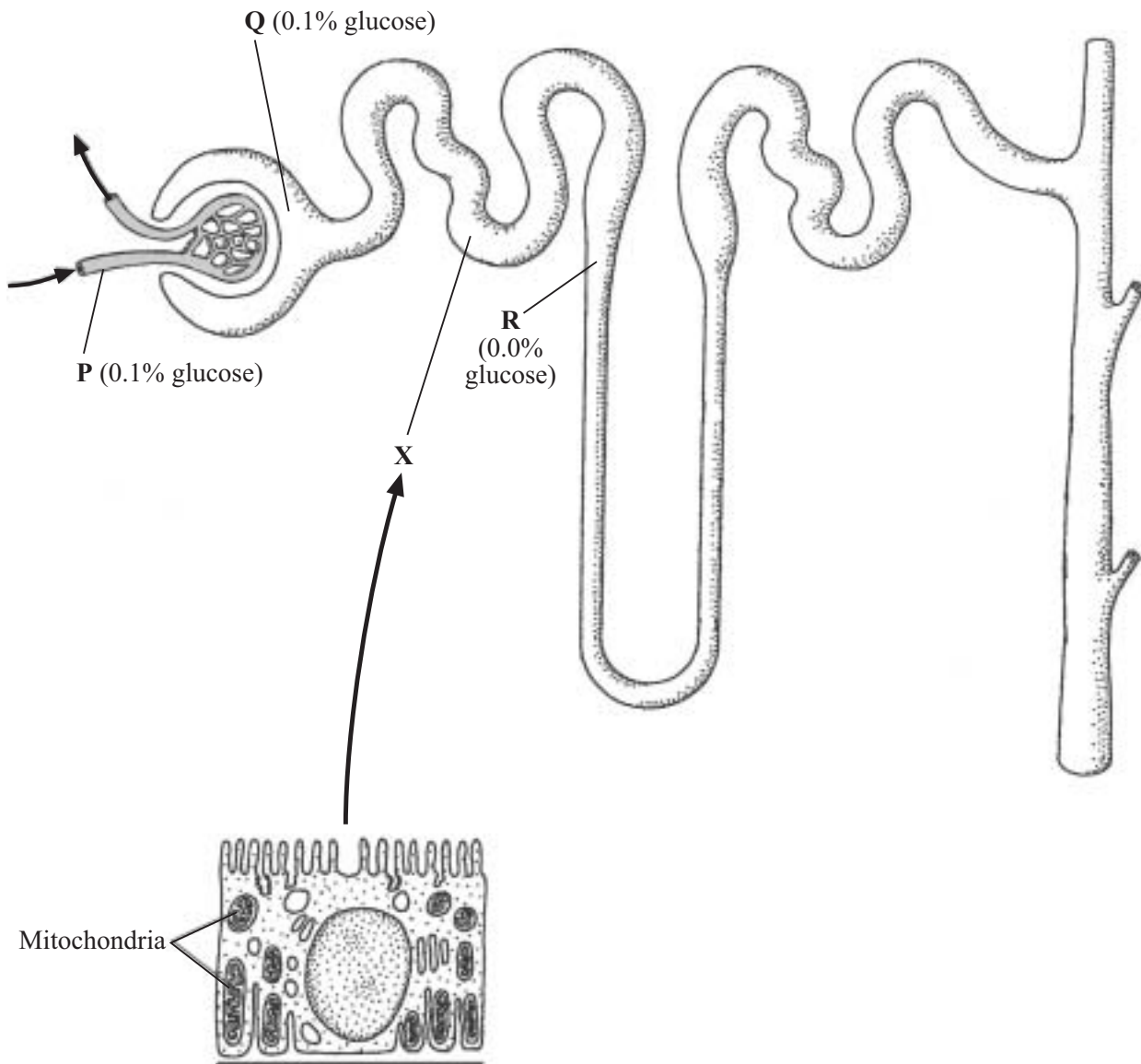
.....  
.....  
.....  
.....  
.....  
.....  
(3 marks)

10

**TURN OVER FOR THE NEXT QUESTION**

**Turn over** ►

15 The diagram shows the structure of a kidney tubule.



Cell in wall of Region X.

All of these cells have  
**large numbers** of mitochondria.

- (a) Give the full name of the process which takes place in the mitochondria.

.....  
(2 marks)

- (b) The concentration of glucose in the blood at **P**, and in the fluid at **Q**, is 0.1 per cent. The concentration of glucose in the fluid at **R** is 0.0 per cent.

Use information from the diagram, and your own biological knowledge, to explain the change in glucose concentration from point **P** through to point **R**.

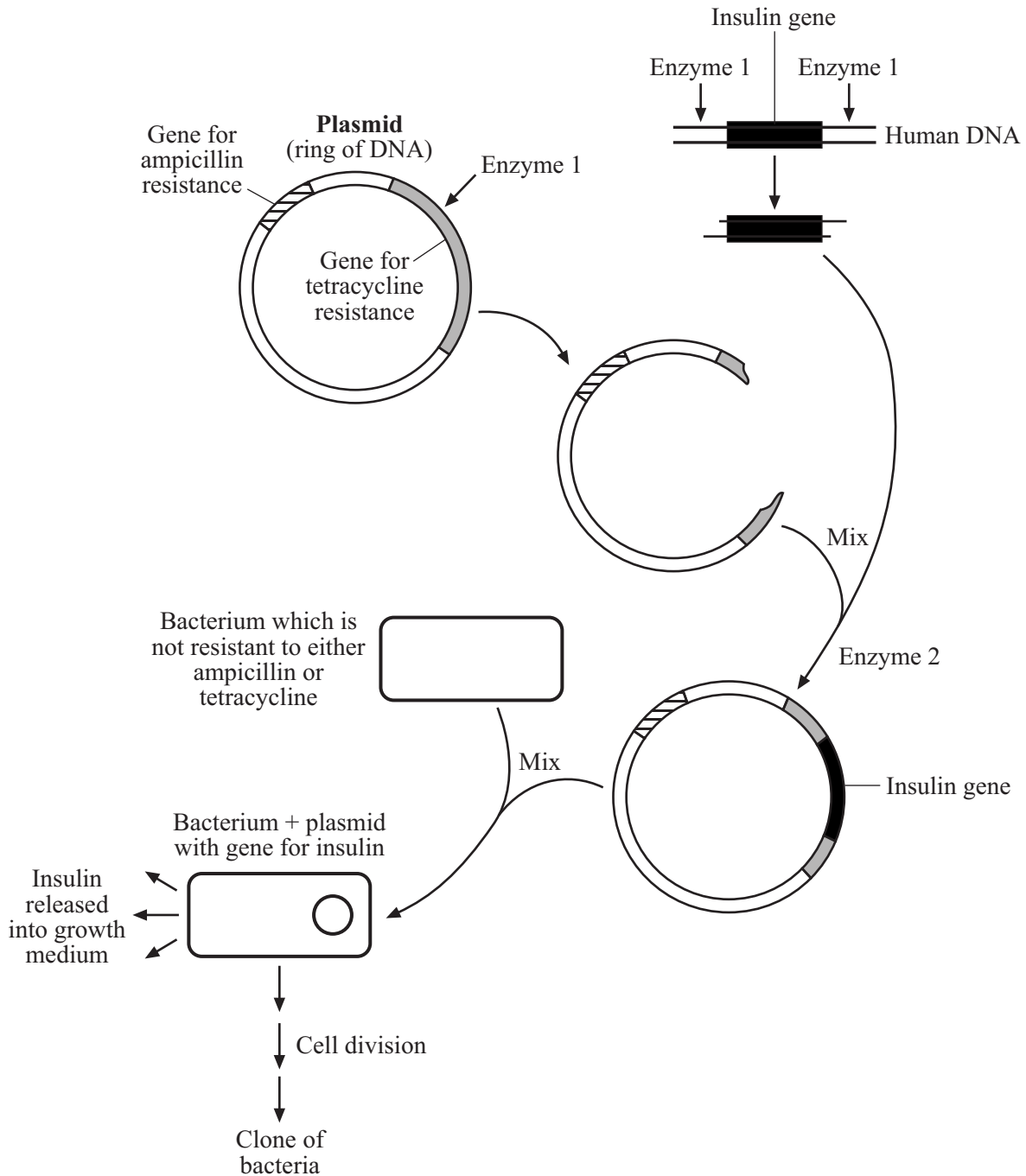
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
(5 marks)

○  
7

**TURN OVER FOR THE NEXT QUESTION**

**Turn over** ►

- 16 The diagram shows how genetic engineering can be used to produce human insulin from bacteria. Ampicillin and tetracycline are two types of antibiotic. Study the diagram carefully and answer the questions.





In experiments like these, some bacteria take up the plasmid (ring of DNA) containing the insulin gene. Other bacteria fail to take up a plasmid, or they take up an unmodified plasmid (a ring of DNA which has not been cut open and which does not contain the insulin gene).

- (a) Complete the table by putting a tick (✓) in the correct boxes to show which bacteria would be able to multiply in the presence of ampicillin and which bacteria would be able to multiply in the presence of tetracycline.

	Bacterium can multiply in the presence of	
	Ampicillin	Tetracycline
Bacterium + plasmid with the insulin gene		
Bacterium without a plasmid		
Bacterium with an unmodified plasmid		

(3 marks)

- (b) The bacterium with the plasmid containing the insulin gene multiplies by cell division to form a clone of bacteria.

Will **all** the bacteria in this clone be able to produce insulin? Explain your answer.

.....

.....

.....

.....

.....

.....

.....

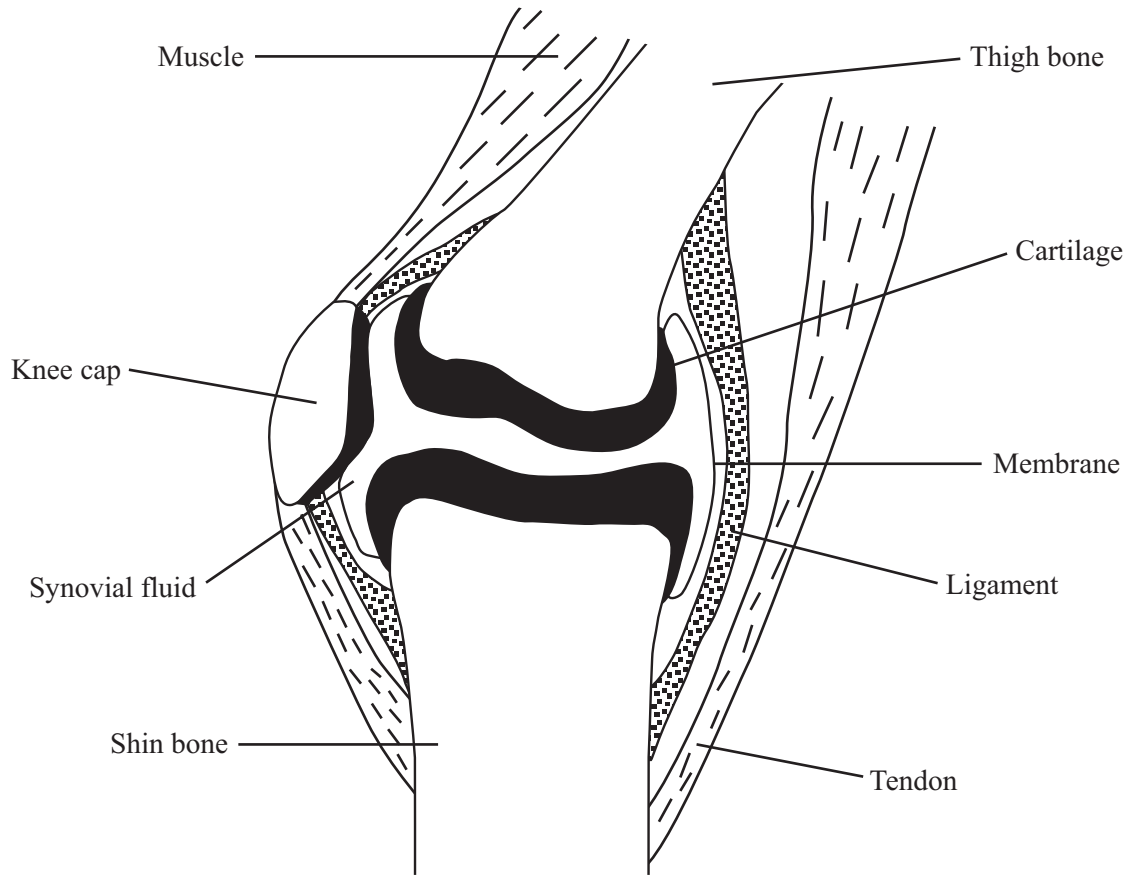
(3 marks)



**TURN OVER FOR THE NEXT QUESTION**

**Turn over** ►

17 The diagram shows a human knee joint.



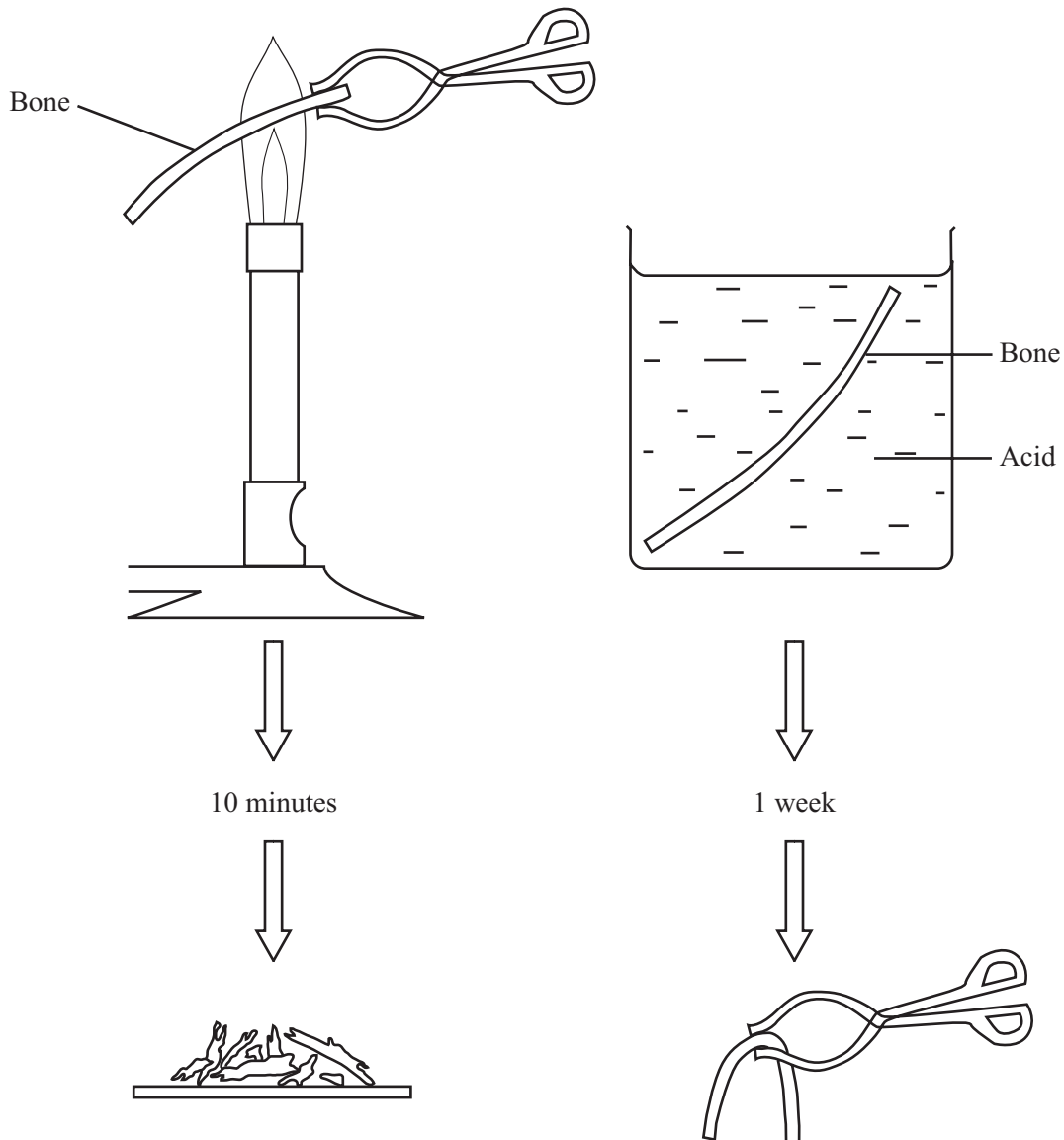
(a) Explain how bone is adapted to its function of supporting the body.

.....  
 .....  
 (2 marks)

(b) Describe the properties of ligaments and tendons, which allow them to carry out their functions.

.....  
 .....  
 .....  
 .....  
 .....  
 (2 marks)

(c) Pieces of bone were treated as shown in the diagrams.



(i) After heating, the piece of bone was dropped on a tile. It broke into pieces. Suggest why the heated bone became brittle.

.....  
 .....

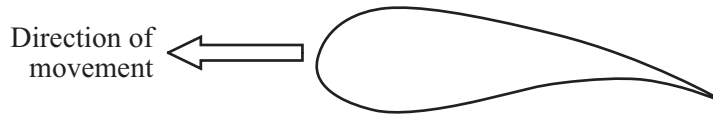
(1 mark)

(ii) Suggest why the bone that was soaked in acid became soft.

.....  
 .....

(1 mark)

18 The diagram shows a side view of a section through a bird's wing.



(a) The wing is an aerofoil shape.

Explain how the aerofoil shape helps the bird to fly.

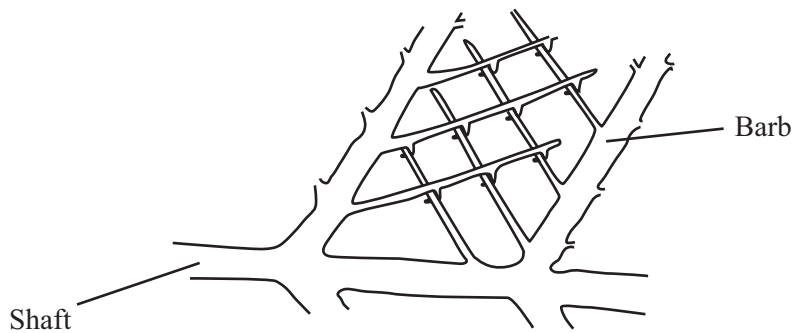
.....

.....

.....

(2 marks)

(b) The feathers in the wing have barbs which interlock with one another. The diagram shows a simplified arrangement of the barbs.



Describe how the shaft and barbs help the bird to fly.

.....

.....

.....

(2 marks)

(c) Explain how the flight feathers in a bird's wing enable the bird to fly.

.....

.....

(1 mark)

19 The saliva of a mosquito may contain parasites that affect humans.

(a) What is a parasite?

.....  
.....

(1 mark)

(b) Suggest how parasites get into mosquito saliva.

.....  
.....  
.....

(2 marks)

(c) Explain how parasites from mosquito saliva can cause illness in humans.

.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....

(3 marks)

6

**TURN OVER FOR THE NEXT QUESTION**

**Turn over** ►

**20** AIDS is a syndrome that prevents the immune system from working properly. In AIDS sufferers, the body is unable to defend itself against pathogens such as those which cause the common cold or flu. AIDS sufferers may die from these diseases.

(a) Explain how lymphocytes in a healthy person recognise pathogens.

.....  
 .....  
 .....  
 (2 marks)

(b) How do lymphocytes in a healthy person bring about immunity to diseases?

.....  
 .....  
 .....  
 .....  
 .....  
 (3 marks)

(c) Explain why a doctor might give antibiotics to an AIDS sufferer, even though they will not affect the virus that causes AIDS.

.....  
 .....  
 .....  
 (2 marks)

(d) A patient with AIDS who has blood group O requires a transfusion.

Complete the table to show which blood groups this patient could be given safely.  
 Use the following symbols:

- ✓ = safe to transfuse  
 ✗ = unsafe to transfuse

Donor blood groups			
A	B	AB	O

(1 mark)

**END OF QUESTIONS**

**THERE ARE NO QUESTIONS PRINTED ON THIS PAGE**

**THERE ARE NO QUESTIONS PRINTED ON THIS PAGE**