Paper Reference(s)

6104/01

Edexcel GCE

Biology

Biology (Human)

Advanced

Unit 4A Core and Option

Microbiology and Biotechnology

Wednesday 24 January 2007 – Morning

Time: 1 hour 30 minutes

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
1	
2	
3	
4	
5	
Paper 11 Total	
6	
7	
8	
9	
Paper 12 Total	
Total	

Materials required for examination	**Items included with question papers**
Ruler	Nil

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, initial(s) and signature.
The paper reference is shown above. Check that you have the correct question paper.
Answer ALL questions in the spaces provided in this booklet.
Show all the steps in any calculations and state the units. Calculators may be used.
Include diagrams in your answers where these are helpful.

Information for Candidates

The marks for the individual questions and parts of questions are shown in round brackets: e.g. (**2**).
The total mark for this question paper is 70.

Advice to Candidates

You will be assessed on your ability to organise and present information, ideas, descriptions and arguments clearly and logically, taking into account your use of grammar, punctuation and spelling.

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Answer ALL questions in the spaces provided.

1. The diagram below shows a vertical section through a human brain.
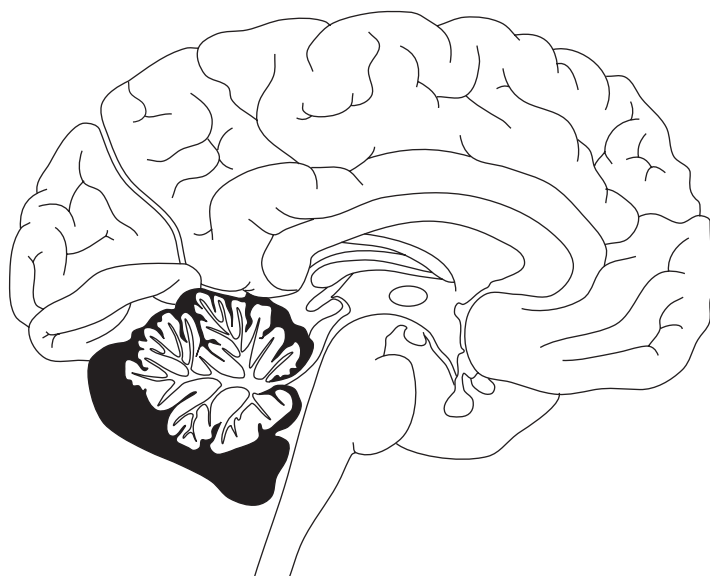
(a) On the diagram, draw an arrow to show the position of the **hypothalamus**.

(1)

(b) The forebrain, midbrain and hindbrain are the three main regions of the human brain.

State in which region of the brain the hypothalamus is found.

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(1)

(c) Give **two** functions of the hypothalamus.

1 ....

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2 ....

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(2) Q1

(Total 4 marks)

2. The diagram below shows a section through part of a mammalian retina.
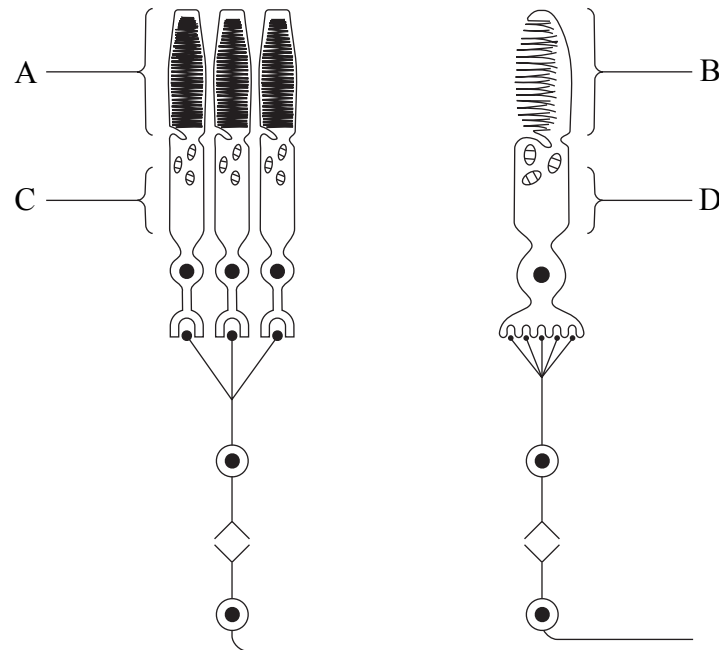
(a) (i) State which of the parts labelled A, B, C or D, contains **iodopsin**.

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(1)

(ii) There are three different forms of iodopsin. State how many different forms of iodopsin would be present in the cells shown in the diagram.

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(1)

(b) Explain how **rhodopsin** is involved in the conversion of light energy into electrical energy.

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(4)

Q2

(Total 6 marks)

3. The diagram below shows a kidney tubule (nephron).

(start of proximal convoluted tubule) A

C (start of distal convoluted tubule)

(end of proximal convoluted tubule) B
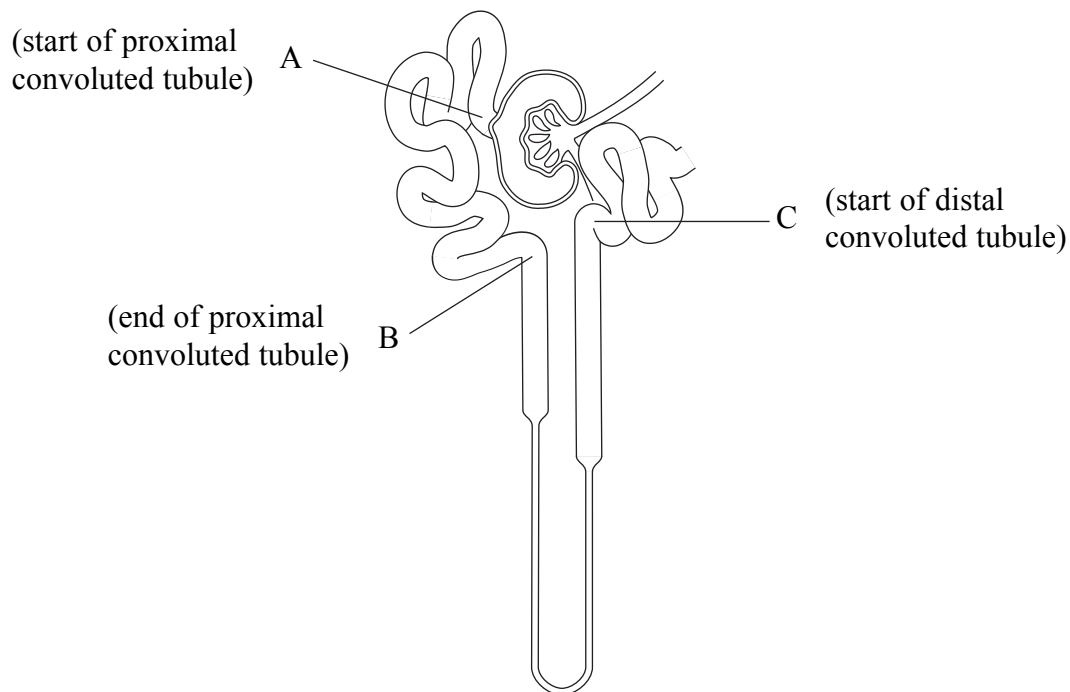
Ultrafiltration in the Bowman's capsule produces a filtrate that contains sodium ions. The sodium ion content of the filtrate changes as it passes along the nephron. The sodium ion content was measured at three points A, B and C along the nephron.

Graph 1 below shows the percentage of sodium ions remaining in the filtrate at points A, B and C.

Graph 1

Percentage of sodium ions remaining (%)

Points along nephron
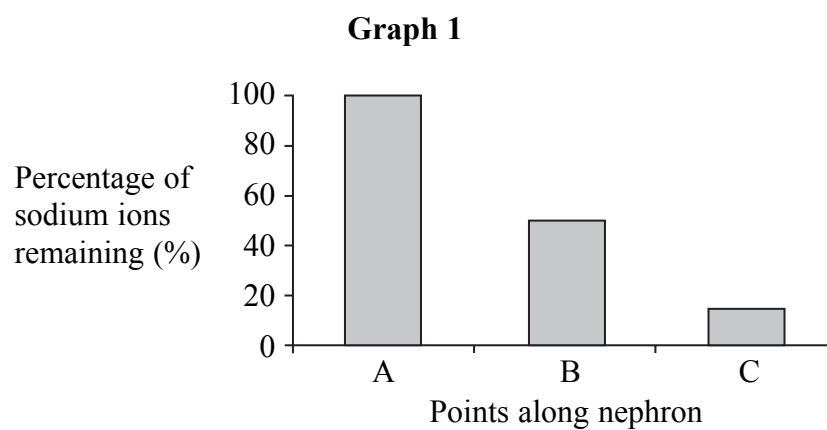
(a) Explain the reasons for the decreases in sodium ion content in the two regions below.

A to B

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B to C

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(3)

(b) Graph 2 shows the **concentration** of sodium ions in the same filtrate at points A, B and C.

Graph 2

Concentration of sodium ions in filtrate /mmol dm^{-3}

160
140
120
100
80
60
40
20
0

A   B   C

Points along nephron
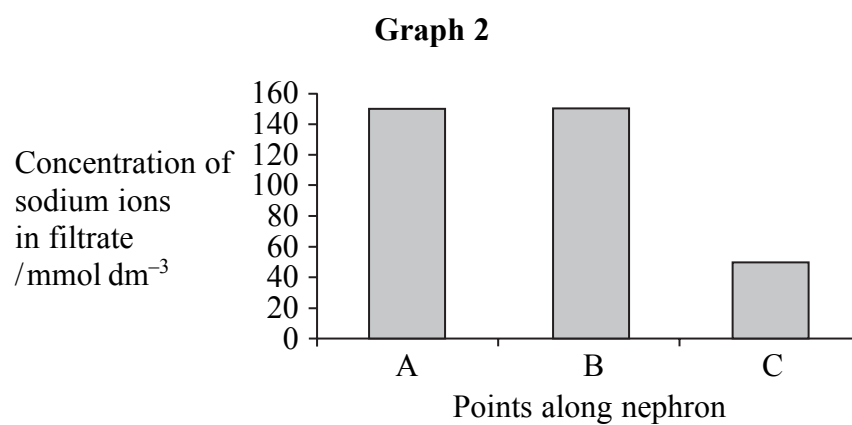
Explain why there is no change in concentration of sodium ions in the filtrate, between points A and B.

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(2)

(c) Describe the effect that an increase in secretion of ADH from the pituitary gland would have on the concentration of sodium chloride in the blood. Explain your answer.

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(3)

Q3

(Total 8 marks)

4. (a) Treatment of insulin-dependent diabetes is by injection of insulin. There are two types of insulin available, basal insulin and bolus insulin. Basal insulin is injected once a day and is absorbed slowly into the body. Bolus insulin is usually injected at each mealtime.

In an investigation, a diabetic person was injected with basal insulin and bolus insulin at the same time. The concentration of each type of insulin in the blood was measured during the 24 hours following the injection. The results are shown in the graph below.

Concentration of insulin / arbitrary units

bolus insulin

basal insulin

Time / hours

Time of injection
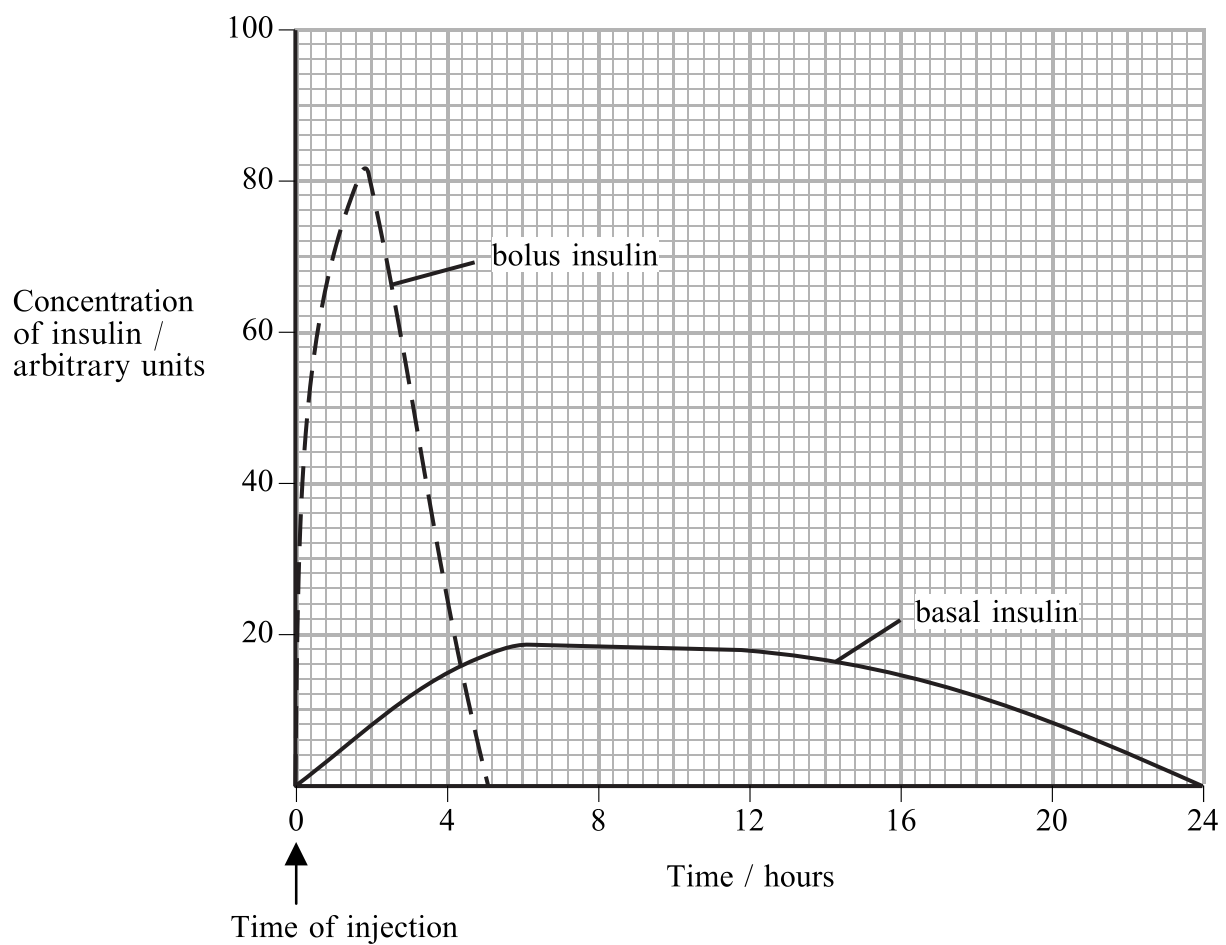
(i) Compare the changes in concentration of each type of insulin during the 24 hour period.

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(3)

(ii) Explain why a diabetic person might inject basal insulin as well as bolus insulin.

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(3)

(iii) Explain why diabetics should not inject bolus insulin more than 15 minutes before they eat.

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(2)

(b) Ray Swinner is an athlete who has insulin-dependent diabetes. Each unit of insulin that he injects lowers his blood glucose level by 1.5 mmol dm^{-3}. He has been advised to carry out carbohydrate counting. This involves estimating the number of grams of carbohydrate that is present in his meals. This enables him to calculate how much insulin to take to lower his blood glucose concentration.

Every 10 grams of carbohydrate is referred to as one carbohydrate portion (CP). He needs to inject 1.5 units of insulin for each CP that he eats. Ray eats the following meal for breakfast.

Food	**Carbohydrate / g**
Two fried eggs	0
Two slices of bacon	0
400 g of baked beans	65
Two slices of brown toast	40
150 cm^3 of fruit juice	15

Calculate the number of units of insulin that he should inject to control the rise in blood glucose level as a result of eating this meal. Show your working

Answer...........................

(2)

(c) State **two** ways in which insulin reduces blood glucose concentration.

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2 ....

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(2)

Q4

(Total 12 marks)

5. Give an account of anaerobic respiration of glucose in a mammalian muscle cell.

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(Total 10 marks)

Q5

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Option A: Microbiology and Biotechnology.

6. Describe the use of each of the following in the culturing of microorganisms.

(a) Selective media

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(2)

(b) Stirrers

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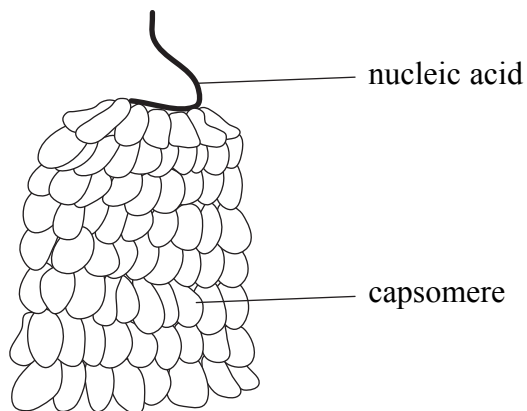**(2)**

(c) Nitrogen sources

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(2)   **Q6**

(Total 6 marks)

7. The diagram below shows the structure of a Tobacco Mosaic Virus (TMV).

nucleic acid

capsomere

(a) (i) Name the type of nucleic acid found in Tobacco Mosaic Virus.

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(1)

(ii) Name the type of molecule that a capsomere is made from.

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(1)

(b) Tobacco Mosaic Virus causes destruction of plant cells by the cell infection cycle.

Describe the cell infection cycle.

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(2) **Q7**

(Total 4 marks)

8. Yeast is used by the dairy industry and by the brewing industry.

(a) Describe the metabolic processes involved in fermentation by yeast in brewing.

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(3)

(b) An investigation was carried out to compare the fermentation of lactose and glucose by a strain of yeast used in the dairy industry (Type D) and a strain of yeast used in the brewing industry (Type B).

Two cultures of yeast Type D were made by adding one gram of yeast to 20 cm^3 of a sugar solution. The first culture was made using a solution of glucose and the second using a solution of lactose of the same concentration.

The degree of fermentation that had occurred was assessed using a bubble monitor to count the total number of bubbles produced during a 24 hour time period.

This experiment was then repeated using the yeast Type B.

The results of this investigation are shown in the table below.

| Yeast | Total number of bubbles produced in 24 hours | |
	Glucose fermentation	Lactose fermentation
Type D	21 530	21 630
Type B	22 010	195

N 2 4 7 3 2 A 0 1 8 2 4

(i) State what the results of this experiment show about the fermentation of glucose and lactose by the two types of yeast.

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(3)

(ii) Suggest why only a few bubbles were produced by yeast Type B cultured in lactose solution.

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(1)

(c) Another investigation was carried out to compare the fermentation of glucose and lactose by the two types of yeast.

Instead of counting bubbles, the extent of fermentation was assessed by determining the total number of yeast cells present in each culture after 24 hours, using an optical method.

Describe how you would use an optical method to count the total number of yeast cells present in the culture after 24 hours.
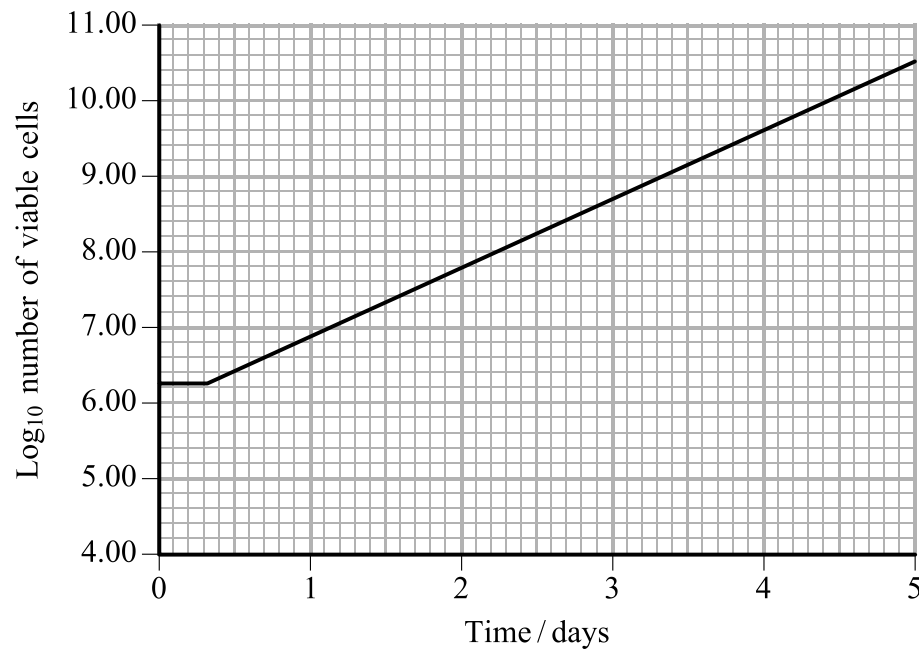
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(4)

Q8

(Total 11 marks)

9. The graph below shows the growth of a yeast population in continuous fermentation over a period of 5 days.

(a) (i) Give **two** environmental conditions that must be maintained at a constant level throughout the 5 days to ensure exponential growth.

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2 ....

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(1)

(ii) Calculate the growth constant (k) for this culture. Show your working.

$$k = \frac{\log_{10} N_t - \log_{10} N_0}{\log_{10} 2 \times t}$$

$\log_{10} N_t = \log_{10}$ number of viable cells at 5 days
$\log_{10} N_0 = \log_{10}$ number of viable cells at start of exponential phase
t = time period of exponential growth
$\log_{10} 2 = 0.301$

=.................................. number of doublings per day

(3)

(iii) Suggest how the shape of the graph might differ if the yeast had been grown using a batch fermentation for the same length of time. Give reasons for your answer.

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(3)

(b) (i) *Fusarium graminearum* is the mould fungus used in the production of mycoprotein. Mycoprotein can provide a healthy alternative to meat as it has a high fibre content.

Suggest why a mould fungus rather than yeast is used to produce mycoprotein.

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(1)

(ii) From your knowledge of the structure of a mould fungus suggest the source of the fibre.

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(1)

Q9

(Total 9 marks)

TOTAL FOR PAPER: 70 MARKS

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