

Surname						Other Names					
Centre Number						Candidate Number					
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General Certificate of Education
June 2003
Advanced Subsidiary Examination



BIOLOGY (SPECIFICATION A)
Unit 2 Making Use of Biology

BYA2

Monday 2 June 2003 Morning Session

No additional materials are required.
You may use a calculator.

Time allowed: 1 hour 30 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. All working must be shown.
- Do all rough work in this book. Cross through any work you do not want marked.

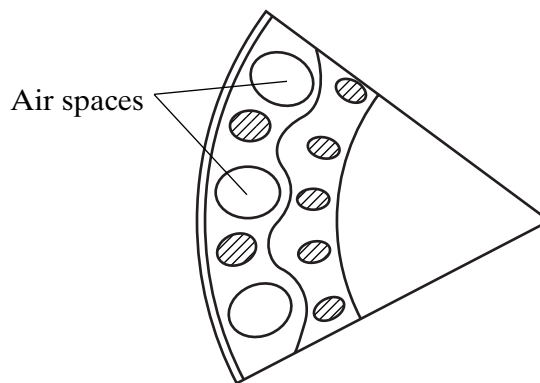
Information

- The maximum mark for this paper is 75.
- Mark allocations are shown in brackets.
- You will be assessed on your ability to use an appropriate form and style of writing, to organise relevant information clearly and coherently, and to use specialist vocabulary, where appropriate.
- The degree of legibility of your handwriting and the level of accuracy of your spelling, punctuation and grammar will also be taken into account.

For Examiner's Use			
Number	Mark	Number	Mark
1			
2			
3			
4			
5			
6			
7			
8			
9			
Total (Column 1)			
Total (Column 2)			
TOTAL			
Examiner's Initials			

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

- 1** The diagram shows a section through the stem of a rice plant.



- (a) Name **two** gases, present in the air spaces shown in the diagram, which can be used in chemical processes in the plant. For **each** of these gases, name **one** process in the plant which uses it.

Gas 1

Process 1

Gas 2

Process 2

(4 marks)

- (b) Describe **one** other function of the air spaces in the stem.

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(1 mark)

- (c) The cells of the rice plant are more tolerant than those of other plants to high concentrations of ethanol. Explain how this tolerance is an adaptation to growth of the plant in swamp conditions.

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(3 marks)

- 2** Blood samples from two different people were each mixed with two different types of antibody, anti-A and anti-B. One person was blood group A and the other was blood group O.

- (a) Complete the table by putting a tick in the box if agglutination occurred and a cross if agglutination did not occur.

Blood group	Antibody	
	anti-A	anti-B
A		
O		

(2 marks)

- (b) (i) What is *agglutination*?

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(2 marks)

- (ii) What causes agglutination?

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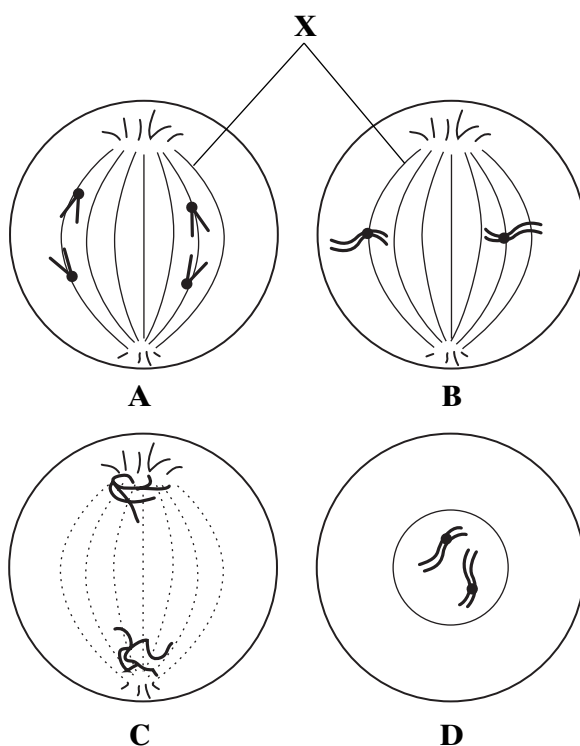
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(2 marks)

6

Turn over ►

- 3 (a) The diagram shows four stages of mitosis in an animal cell. The stages are not in the correct sequence.



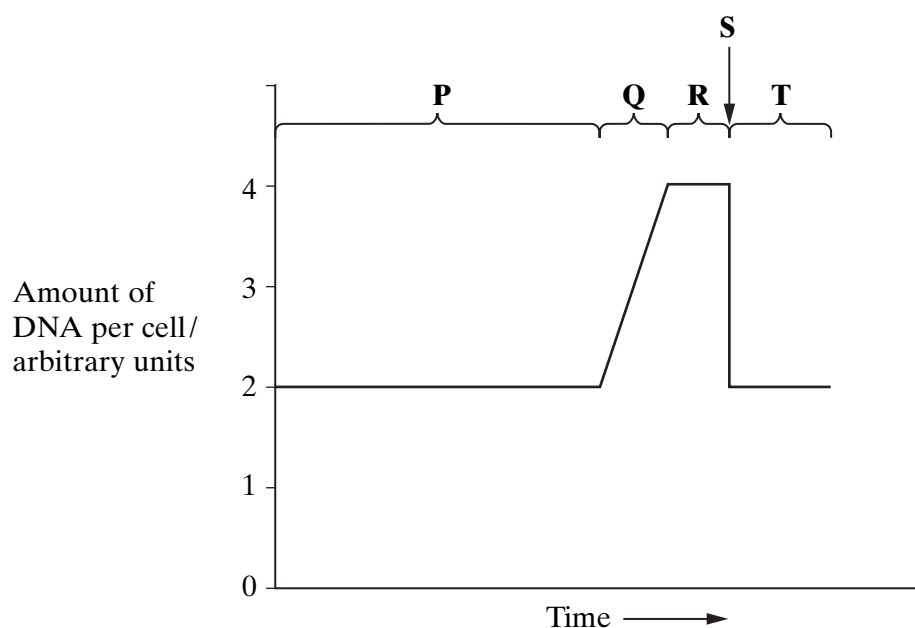
- (i) List the stages **A**, **B**, **C** and **D** in the correct sequence.

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(1 mark)

- (ii) What is the function of structure **X**?

.....
(1 mark)

(b) The graph shows how the amount of DNA in a cell varies during the cell cycle.



Radioactive thymine was supplied to the cells of some growing tissue. The radioactivity of the cells' nuclei increased during period **Q** shown in the graph.

(i) Explain why the radioactivity of the nuclei increased during period **Q**.

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(3 marks)

(ii) Explain why an increase in the amount of DNA is important in the cell cycle.

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(1 mark)

Turn over ►

- 4 **Figure 1** shows the polymerase chain reaction (PCR). This reaction can be used to produce multiple copies of a small amount of DNA, such as might be found in a blood stain at the scene of a crime.

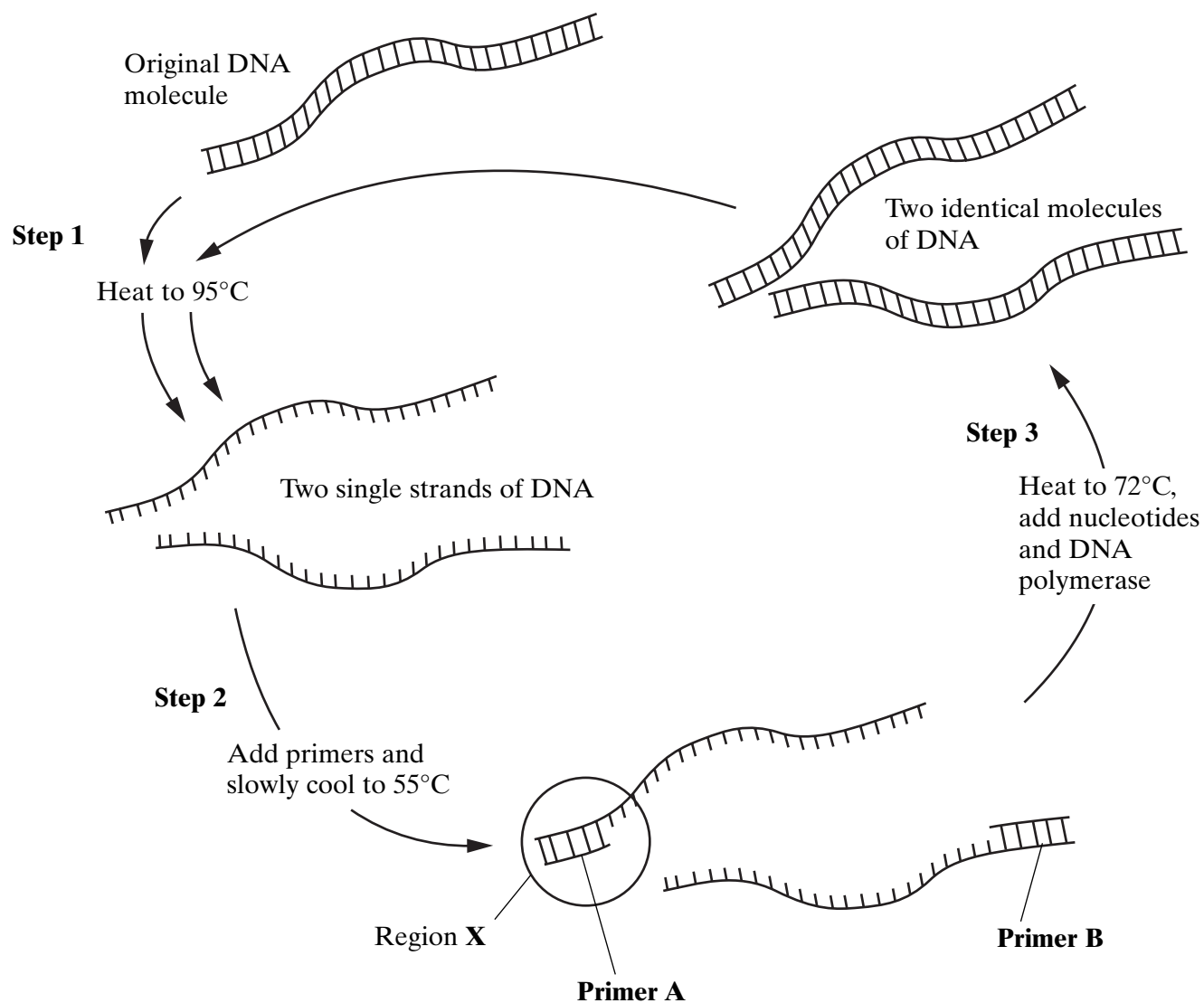


Figure 1

- (a) What type of bond is broken when the DNA is heated to 95°C in **Step 1**?

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(1 mark)

- (b) (i) Why is it necessary to join primer molecules to the single-stranded DNA (**Step 2**) before DNA polymerase is used in **Step 3**?

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 (1 mark)

- (ii) **Figure 2** shows region **X** from **Figure 1**. Complete **Figure 2** to show the sequence of bases on **Primer A**.

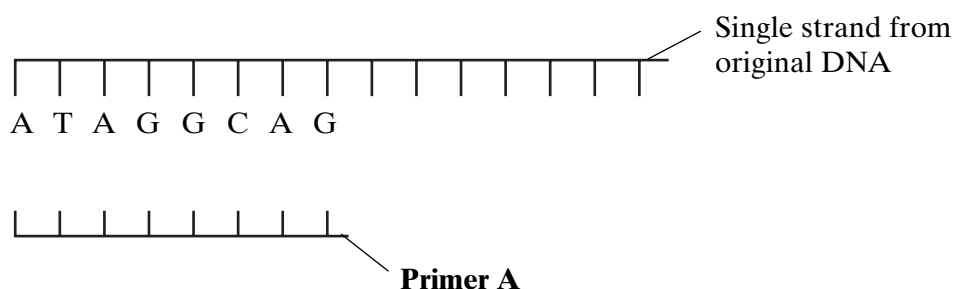


Figure 2

(1 mark)

- (c) Starting with a single molecule of DNA, the polymerase chain reaction was allowed to go through 6 cycles. How many molecules of DNA would be produced?

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 (1 mark)

- (d) The original DNA must not be contaminated with any other biological material, such as bacteria or human skin cells, when carrying out the polymerase chain reaction. Why is this important?

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 (2 marks)

- 5 The adult whitefly and its larva feed on the leaves of crop plants. A parasitic wasp lays its eggs inside the whitefly larva. When the wasp larvae hatch, they feed on the internal organs of the whitefly larva. The wasp can be released into glasshouses to act as a biological control for the whitefly.

- (a) How would the whitefly reduce the yield of a crop plant?

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(2 marks)

- (b) (i) Give **two** reasons why biological control might be better than the use of chemical pesticides for controlling whitefly.

1

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(2 marks)

- (ii) Give **two** reasons why the use of chemical pesticides might be better than biological control of the whitefly.

1

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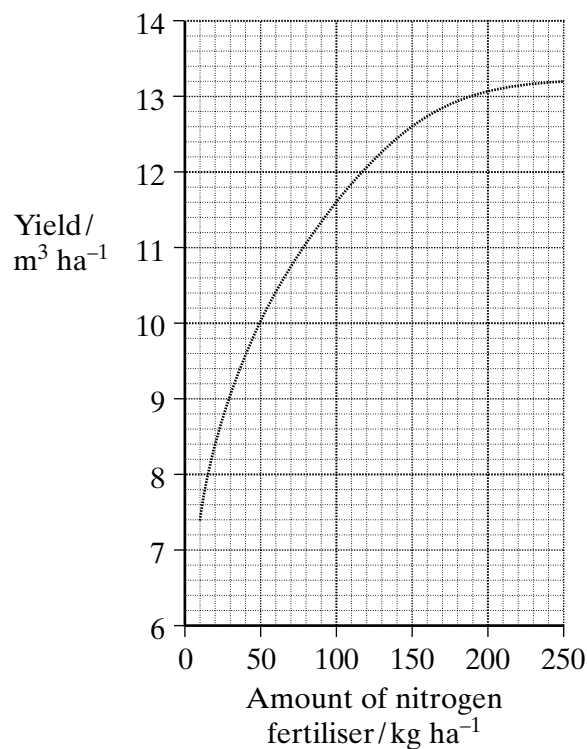
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(2 marks)

6

- 6 The graph shows the effect of nitrogen fertiliser on the yield of maize.



- (a) Calculate the percentage increase in the yield of maize when the fertiliser application was increased from 10 to 60 kg ha⁻¹. Show your working.

Answer %
(2 marks)

- (b) The percentage increase in yield of maize decreases at higher fertiliser applications. Suggest **two** reasons why.

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(2 marks)

4

Turn over ►

- 7 **Figure 1** shows how the gene for human growth hormone (hGH) can be transferred into a bacterium.

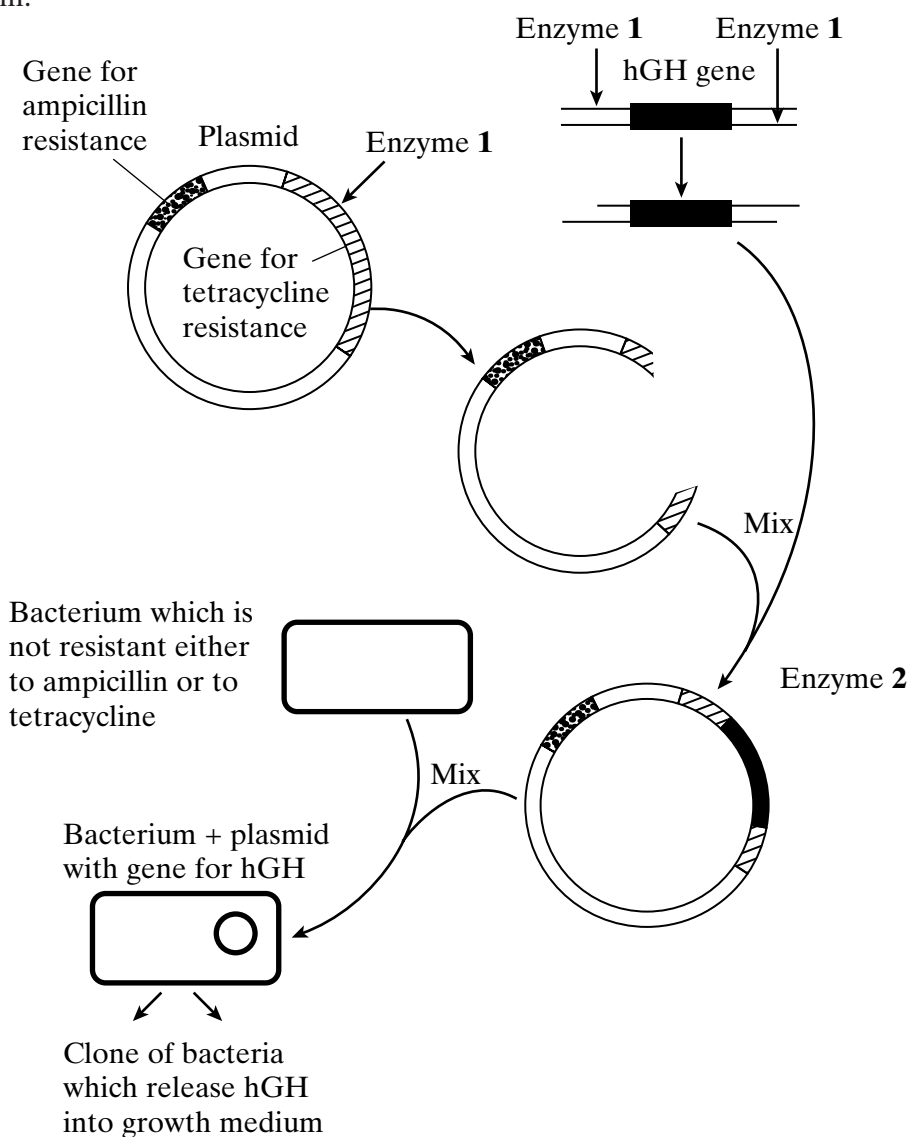


Figure 1

- (a) Name

Enzyme 1;

Enzyme 2.

(2 marks)

- (b) After mixing with the plasmid, the bacteria are first grown in Petri dishes of agar containing ampicillin. What is the reason for this?

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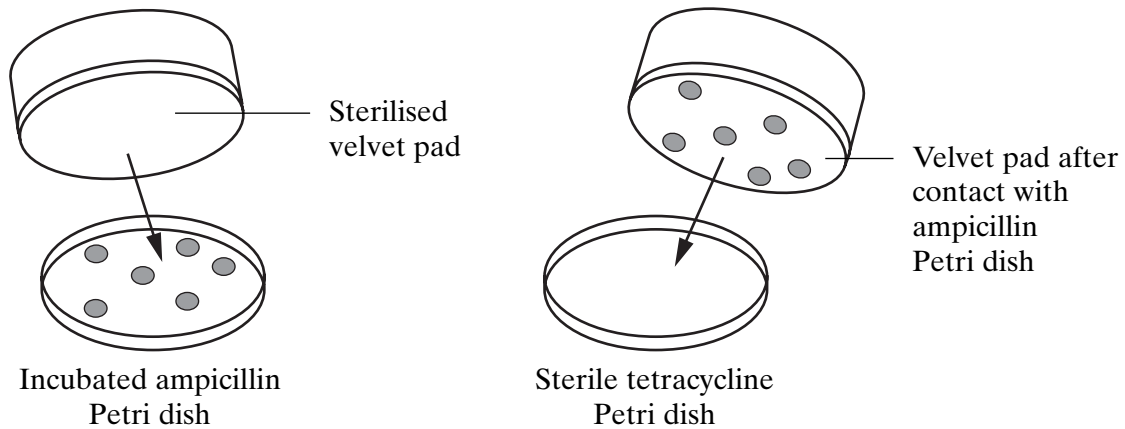
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(2 marks)

- (c) **Figure 2** shows how colonies of bacteria can be transferred from a Petri dish of agar containing ampicillin to identical positions on a Petri dish of agar containing tetracycline.

Method



Results

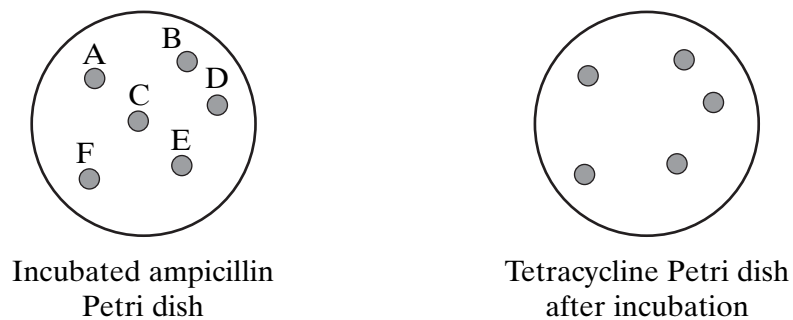


Figure 2

- (i) Give the **letter** of **one** bacterial colony which contained a modified plasmid with the gene for hGH.

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(1 mark)

- (ii) Explain your answer to part (i).

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(2 marks)

QUESTION 7 CONTINUES ON THE NEXT PAGE

Turn over ►

- (d) Describe **one** possible danger of using plasmids which contain genes for antibiotic resistance.

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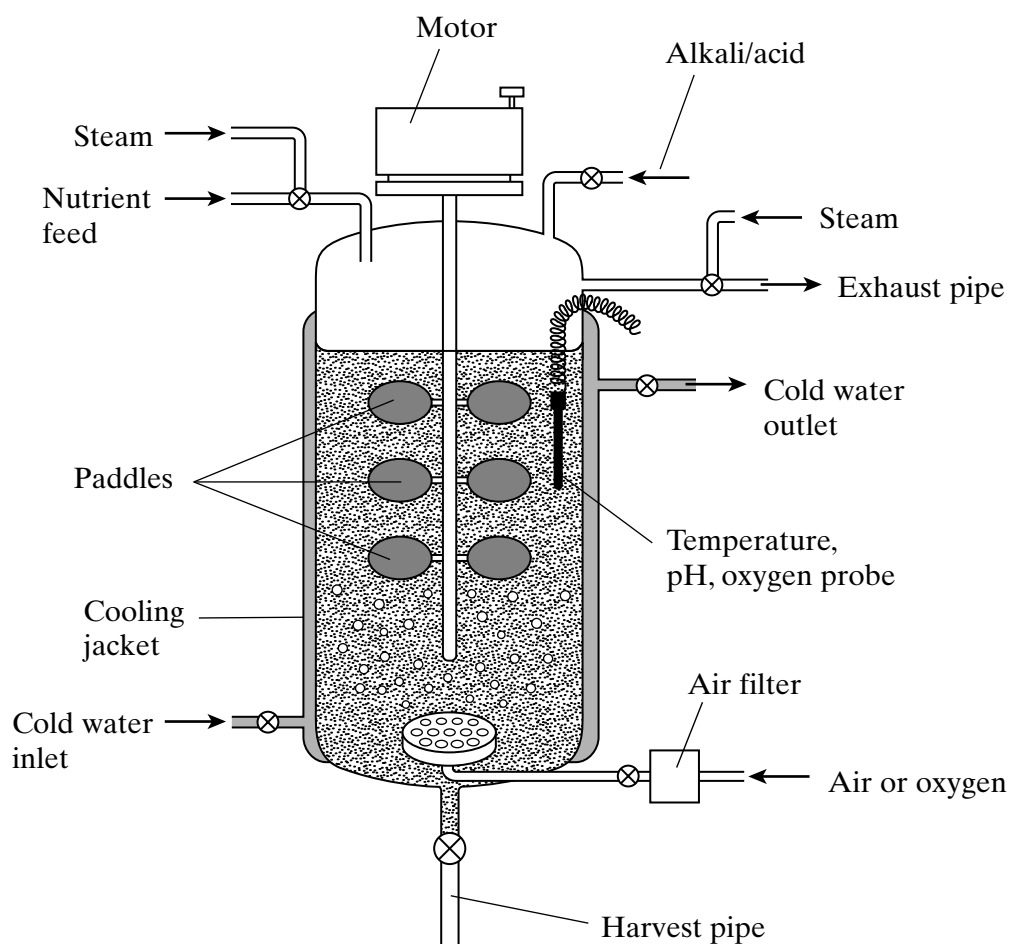
(2 marks)

9

8 Read the following passage.

Bacterial α -amylase is an extracellular, starch-digesting enzyme which is made by the bacterium, *Bacillus licheniformis*. The enzyme can be produced in large quantities from a culture of the bacteria growing in a fermenter – a large container in which the optimum conditions for bacterial metabolism and reproduction are maintained.

The diagram shows a fermenter.



Use information from the passage, the diagram and your own knowledge to answer the questions.

- (a) (i) Before adding the culture medium and bacteria, the inside of the fermenter is treated with high-pressure steam. Explain the purpose of this.

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(2 marks)

- (ii) When the fermenter is being used to grow bacteria, cold water is circulated through the cooling jacket. Why is this necessary?

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(2 marks)

- (iii) The culture medium used for the bacteria during their growth is rich in starch. Why is starch used in the production of α -amylase, rather than sugars like maltose or sucrose?

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(2 marks)

QUESTION 8 CONTINUES ON THE NEXT PAGE

Turn over ►

- (iv) Explain why the purification of an *intracellular* enzyme made by the bacteria would have been more complicated than the purification of α -amylase.

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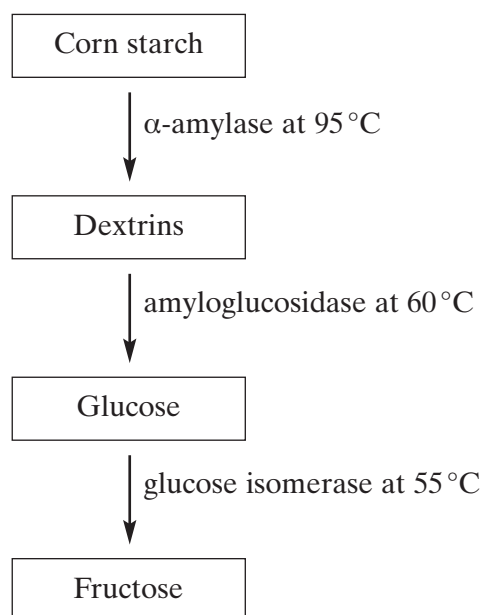
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(3 marks)

- (b) The flow-chart shows how α -amylase and other enzymes can be used to produce fructose from corn starch.



Explain why several different enzymes are needed in this process and why immobilising them on a solid support would be useful in the industrial production of fructose.

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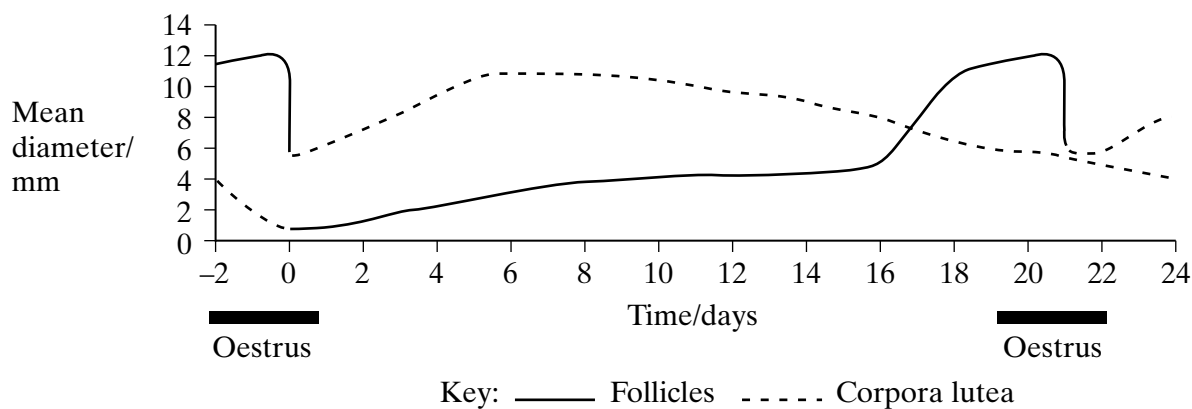
(6 marks)

15

TURN OVER FOR THE NEXT QUESTION

Turn over ►

- 9 The graph shows how the diameters of the follicles and corpora lutea vary during the oestrous cycle of a pig.



- (a) In this cycle, ovulation occurred on day 21. Explain how the graph gives evidence for this.

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(2 marks)

The table shows how the concentrations of the hormones progesterone and oestrogen vary during the oestrous cycle of the pig.

Time / days	Concentration of hormone in the blood / arbitrary units	
	Progesterone	Oestrogen
0	1.8	1.0
2	4.7	0.9
4	9.0	0.9
6	12.1	0.9
8	12.0	0.9
10	8.7	0.9
12	3.5	0.9
14	0.9	1.7
16	0.6	2.1
18	0.6	6.0
20	1.1	3.2
22	3.7	0.9
24	7.5	0.9

- (b) Use the table and the graph to explain why the presence of oestrogen in the female pig's urine can be used to predict the start of oestrus.

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(2 marks)

- (c) Describe and explain the relationship between the diameter of the corpora lutea and the concentration of progesterone in the pig's blood between days 0 and 14.

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(2 marks)

- (d) Use the data and your own knowledge to explain how changing concentrations of oestrogen and progesterone regulate the oestrous cycle.

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(6 marks)

QUESTION 9 CONTINUES ON THE NEXT PAGE

Turn over ►

- (e) A herd of female pigs can be given synthetic progesterone in their diet for about 14 days. They then all come into oestrus 5 days later.

- (i) Why is it useful for a farmer to be able to determine when oestrus will occur?

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(1 mark)

- (ii) In Sweden and Norway, public opinion is against feeding reproductive hormones to pigs. Give a biological explanation upon which this opinion could be based.

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(2 marks)

15

END OF QUESTIONS