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General Certificate of Education  
January 2004  
Advanced Subsidiary Examination



**BIOLOGY (SPECIFICATION A)**  
**Unit 2 Making Use of Biology**

**BYA2**

Thursday 8 January 2004 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.

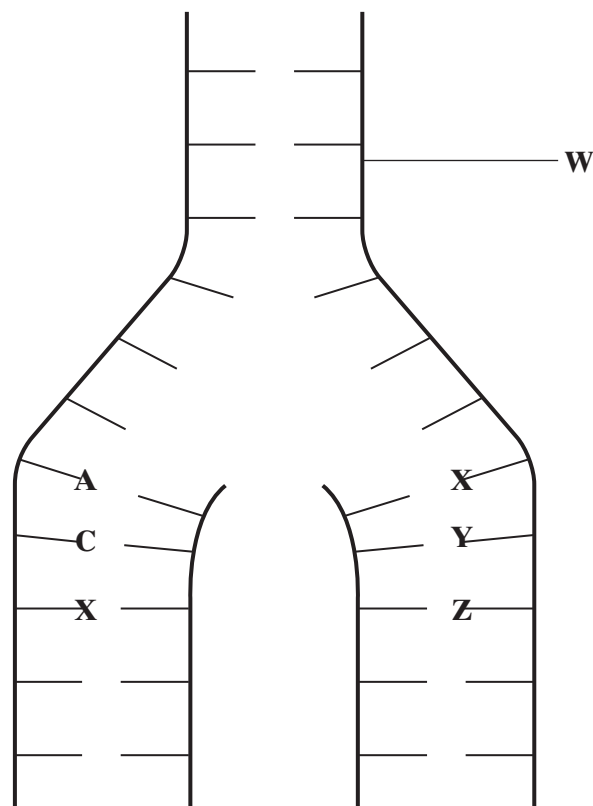
**Information**

- 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			
Total (Column 1)			
Total (Column 2)			
TOTAL			
Examiner's Initials			

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

- 1** The diagram shows the process of DNA replication. The horizontal lines represent the positions of bases.



- (a) (i) What is represented by the part of the DNA molecule labelled **W**?

.....  
(1 mark)

- (ii) In the diagram, **A** represents adenine and **C** represents cytosine.  
Name the base found at

position **X**; .....

position **Y**; .....

position **Z**. .....

(3 marks)

- (b) Describe **one** way in which the process shown in the diagram differs from transcription.

.....

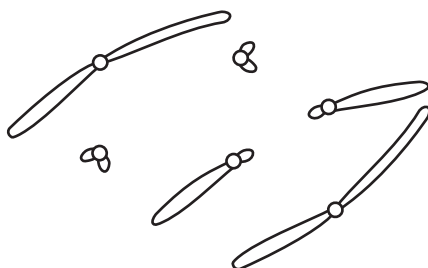
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(1 mark)

- 2 (a) Give **one** process which occurs in the nucleus of a cell during interphase which is necessary before cell division can take place.

.....  
(1 mark)

- (b) The diagram shows the chromosomes from a cell with a diploid chromosome number of six.



Draw a diagram to show the chromosomes from one of the resulting cells if

- (i) the cell divides by **mitosis**;

(2 marks)

- (ii) the cell divides by **meiosis**.

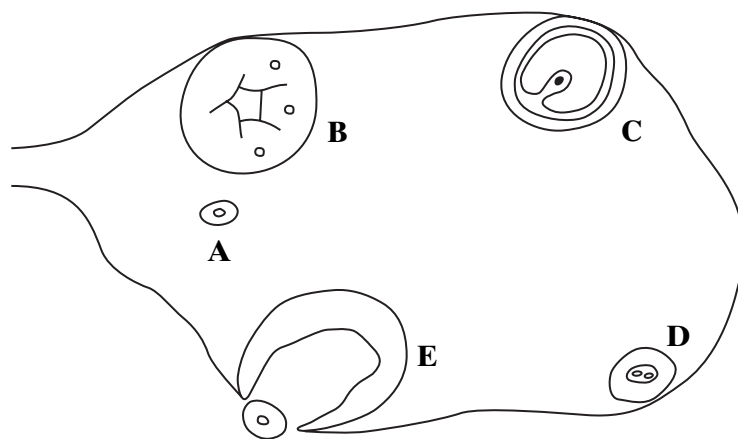
(2 marks)

- (c) Explain **one** advantage of cells lining the human gut dividing very frequently.

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

Turn over ►

- 3 (a) The diagram shows structures present in an ovary during an oestrous cycle of a mammal.



- (i) Starting with structure **A**, give the structures **A** to **E** in the order in which they appear in an oestrous cycle.

**A** ..... (1 mark)

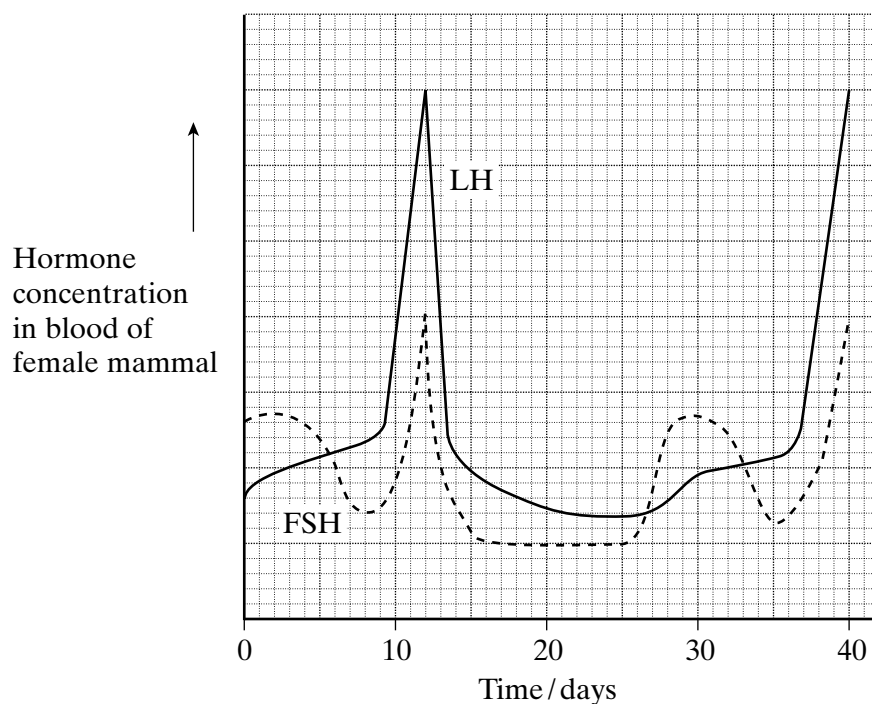
- (ii) Which of these structures produces most of the progesterone during an oestrous cycle?

..... (1 mark)

- (iii) Describe **one** effect of progesterone on the uterus.

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

(b) The graph shows the concentration of the hormones LH and FSH over 40 days.



(i) On which day would you expect this mammal to ovulate?

.....  
(1 mark)

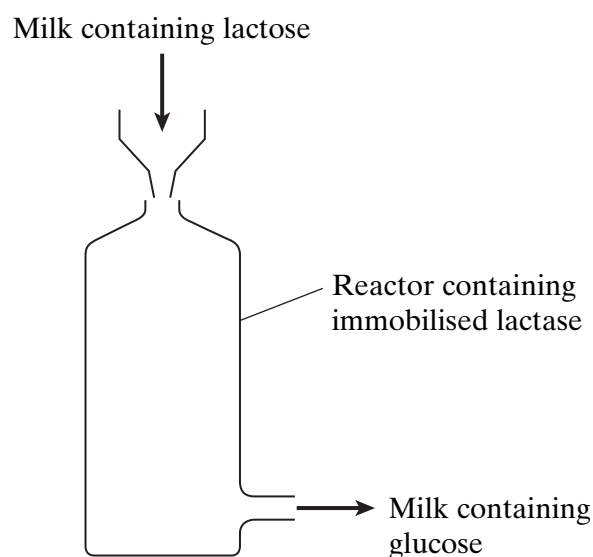
(ii) Give the evidence from the graph which shows that pregnancy did not occur.

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

**TURN OVER FOR THE NEXT QUESTION**

Turn over ►

- 4 Lactose is found in milk. It can be hydrolysed by the enzyme lactase. One of the products of this reaction is glucose. The diagram shows an industrial reactor used to hydrolyse the lactose in milk.



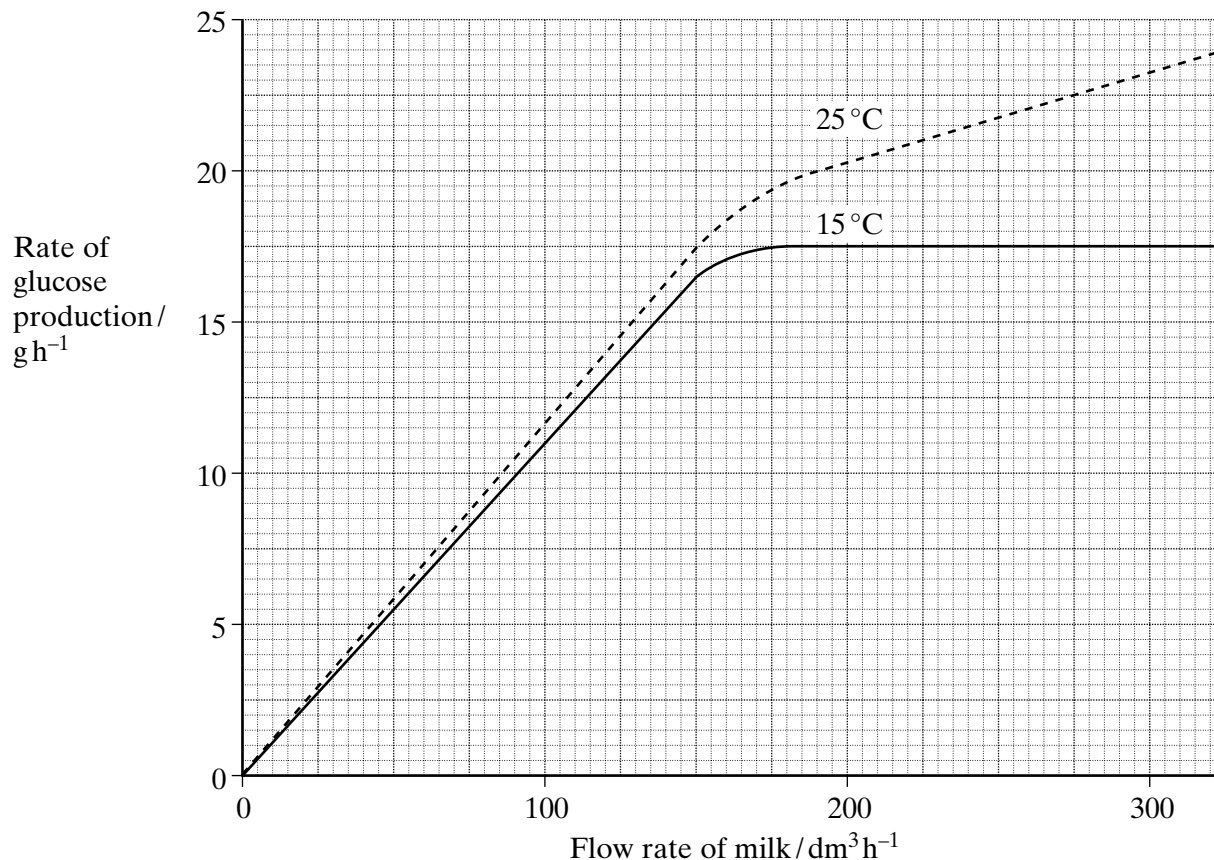
- (a) (i) In this reactor the lactase is immobilised. Explain what is meant by *immobilised*.

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

- (ii) Give **two** reasons why the process is cheaper if the enzymes used are immobilised rather than free in solution.

1 .....  
.....  
2 .....  
.....  
(2 marks)

- (b) The graph shows the effect of flow rate of milk on the rate of glucose production at two different temperatures.



- (i) Use the graph to give **one** way in which a glucose output of 12.5 g h<sup>-1</sup> could be achieved.

.....  
(1 mark)

- (ii) The flow rate of milk is 250 dm<sup>3</sup> h<sup>-1</sup> and the temperature is 15°C. Calculate the percentage increase in the rate of glucose production at this flow rate when the temperature is increased to 25°C. Show your working.

Answer ..... %  
(2 marks)

- (iii) Explain why the curve for 15°C levels out at a flow rate of 180 dm<sup>3</sup> h<sup>-1</sup>.

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

QUESTION 4 CONTINUES ON THE NEXT PAGE

Turn over ►

- (c) In practice, the reactor is used at 10°C and the milk is passed through the reactor several times before the product is collected.

- (i) Suggest why the reactor is used at 10°C rather than at a higher temperature.

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

- (ii) Suggest why the milk is passed through the reactor several times.

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

9

- 5 Two fields, **A** and **B**, were used to grow the same crop. The fields were divided into plots. Different masses of fertiliser containing sodium nitrate were applied to these plots. After six weeks, samples of crop plants from each plot were collected and their mass determined. The results are shown in the table.

Mass of fertiliser added/kg ha <sup>-1</sup>	Mass of crop/kg m <sup>-2</sup>	
	Field <b>A</b> - used for grazing cattle in previous year	Field <b>B</b> - used for same crop in previous year
0	14.5	6.4
10	16.7	9.8
20	17.4	12.9
30	17.5	16.2
40	17.5	17.1
50	17.5	17.1
60	17.5	17.1

- (a) (i) Describe the pattern shown by the data for field **B**.

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



- (ii) Explain the change in the mass of crop produced from field **B** when the mass of fertiliser added increases from 0 to  $20 \text{ kg ha}^{-1}$ .

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(2 marks)

- (iii) Explain why the mass of crop produced stays the same in both fields when more than  $40 \text{ kg}$  of fertiliser is added.

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(2 marks)

- (b) In the previous year, field **A** had been used for grazing cattle. Field **B** had been used to grow the same crop as this year. When no fertiliser was added, the mass of crop from field **A** was higher than from field **B**. Explain this difference.

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(2 marks)

- (c) Explain **two** advantages and **one** disadvantage of an inorganic fertiliser such as sodium nitrate compared with an organic fertiliser such as manure.

Advantage 1 .....

.....

Advantage 2 .....

.....

Disadvantage .....

.....

(3 marks)

Turn over ►

10

- 6 (a) Insecticides are pesticides which kill insects. A low concentration of insecticide was sprayed on the leaves of rose plants to kill greenfly which were feeding on the plants. Ladybirds eat greenfly. One month after spraying, the concentration of insecticide in the tissues of ladybirds was found to be higher than the concentration sprayed on the rose plants. Explain why.

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(3 marks)

- (b) Spotted knapweed is a common weed in the USA. Two methods, chemical control and biological control, have been used to reduce the numbers of spotted knapweed plants. The table shows the results of an investigation comparing the effectiveness of these two methods.

Month	Mean number of spotted knapweed plants per m <sup>2</sup>	
	Chemical control	Biological control
February	2	2
March	15	3
April	3	3
May	20	5
June	3	4
July	16	3
August	2	2

- (i) Describe the pattern of plant numbers resulting from the use of

chemical control; .....

.....  
(1 mark)

biological control. ....

.....  
(1 mark)

- (ii) Explain how chemical control leads to the changes in the number of spotted knapweed plants from March to June.

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

- (c) Explain why the spotted knapweed plants were never completely eliminated when using

- (i) chemical control;

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.....  
(2 marks)

- (ii) biological control.

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.....  
(2 marks)

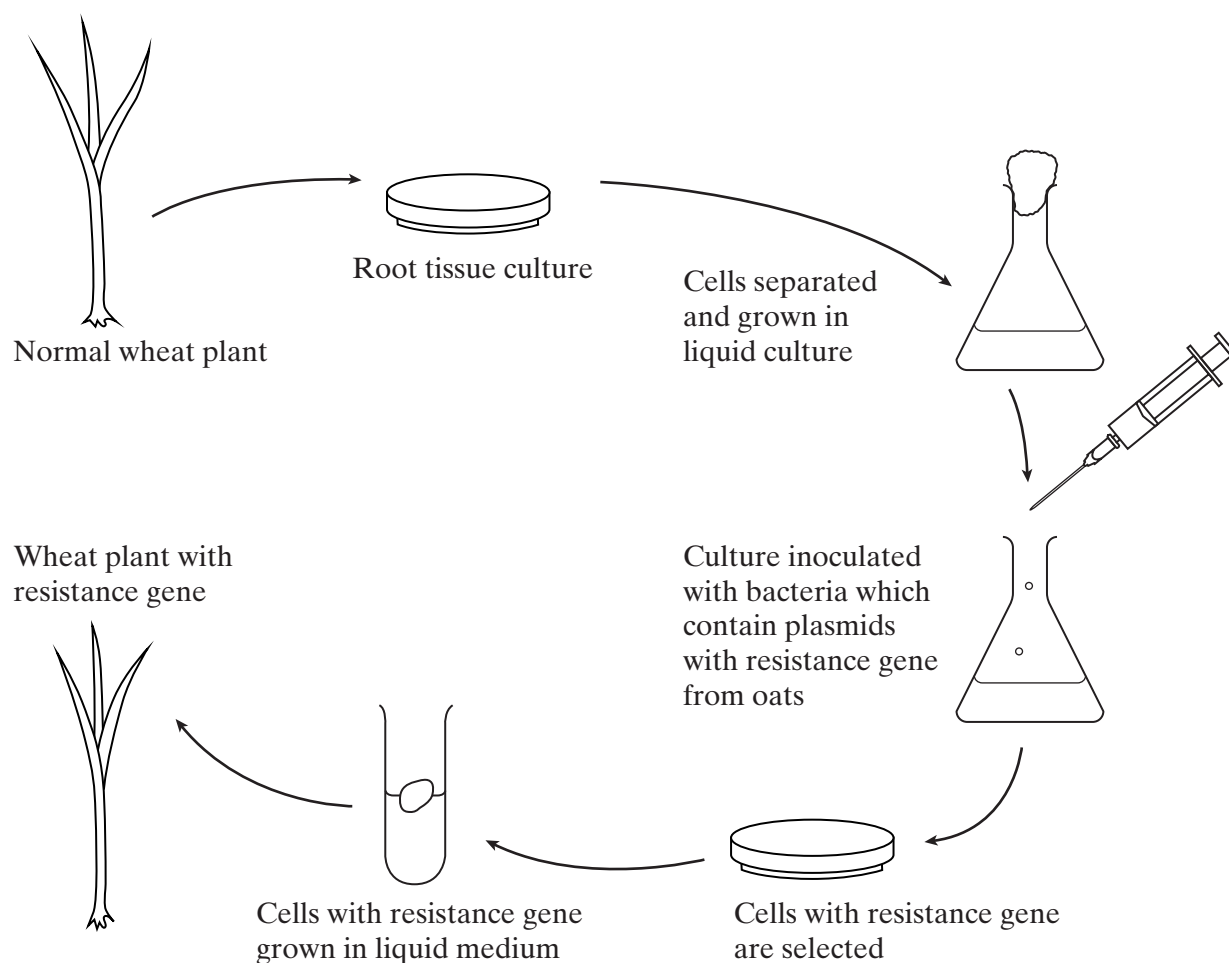
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**TURN OVER FOR THE NEXT QUESTION**

Turn over ►

- 7 'Take-all' is a disease of wheat caused by a fungus. It can cause serious damage to the crop. There is no gene for resistance to this fungus in wheat. There is, however, a gene for resistance to this fungus present in oats.

The diagram shows how this gene might be transferred to wheat.



- (a) (i) The wheat plant with the resistance gene contains recombinant DNA. What is *recombinant DNA*?

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

- (ii) The plasmids act as vectors for the resistance gene. What is a *vector*?

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

(iii) Suggest how cells with the resistance gene might be selected.

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(2 marks)

(b) A laboratory has oat plants containing the resistance gene and a supply of plasmids. Describe how bacteria may be produced which have the resistance gene in their plasmids.

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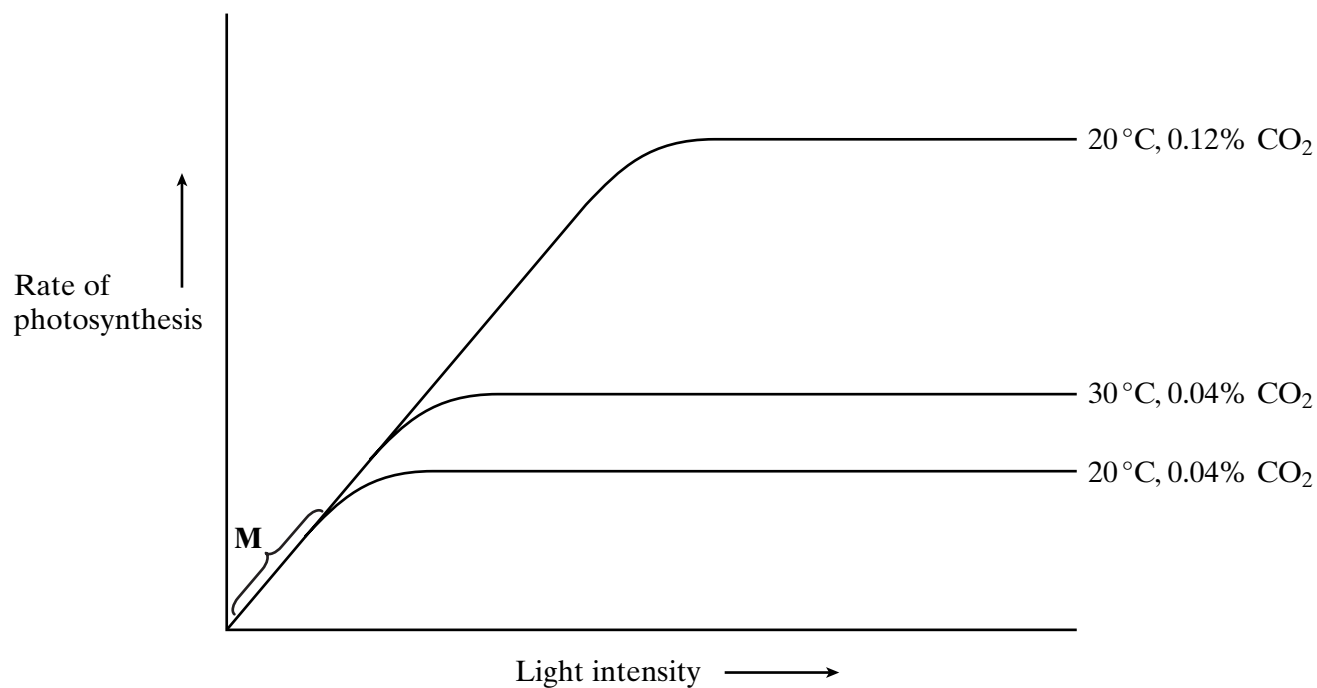
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(6 marks)

**QUESTION 7 CONTINUES ON THE NEXT PAGE**

**Turn over** ►

- (c) The graph shows the effect of different conditions on the rate of photosynthesis in wheat.



- (i) Name the factor which is limiting photosynthesis at **M**.

.....  
(1 mark)

- (ii) Give a reason for your answer.

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.....  
(1 mark)

- (iii) Mark with an **X** a point on the graph where carbon dioxide concentration is limiting the rate of photosynthesis.

(1 mark)

- (iv) Explain why you have chosen this point.

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.....  
(1 mark)

- (d) Suggest how carbon dioxide concentration could be increased in a glasshouse.

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.....  
(1 mark)

The chart shows some of the results obtained from the genetic fingerprinting of seven of the skeletons, three children and four adults.

<u>Child 1</u>	<u>Child 2</u>	<u>Child 3</u>	<u>Adult 1</u>	<u>Adult 2</u>	<u>Adult 3</u>	<u>Adult 4</u>
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(a) Explain why the polymerase chain reaction was used in this investigation.

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(b) In the polymerase chain reaction, DNA is heated to 95 °C and nucleotides, enzymes and DNA primers are added to the mixture.

(i) Explain why the DNA is heated to 95 °C.

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

(ii) What are DNA *primers*?

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

(iii) Why are DNA primers added during the polymerase chain reaction?

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.....  
(1 mark)

(iv) What is the advantage of the enzyme used in the polymerase chain reaction being thermostable?

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(2 marks)

QUESTION 8 CONTINUES ON THE NEXT PAGE

Turn over ►



- (c) Describe how genetic fingerprinting is carried out.

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(6 marks)

- (d) All three children on the chart had the same parents. One of the parents was **Adult 1**. Which of the other three adults on the chart was the other parent? Give the reason for your answer.

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(2 marks)

**END OF QUESTIONS**