

Surname					Other Names				
Centre Number					Candidate Number				
Candidate Signature									

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General Certificate of Education  
 January 2004  
 Advanced Subsidiary Examination



**BIOLOGY (SPECIFICATION B)**  
**Unit 2 Genes and Genetic Engineering**

**BYB2**

Thursday 8 January 2004 Morning Session

**In addition to this paper you will require:**

- a ruler with millimetre measurements.

You may use a calculator.

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

Time allowed: 1 hour

**Instructions**

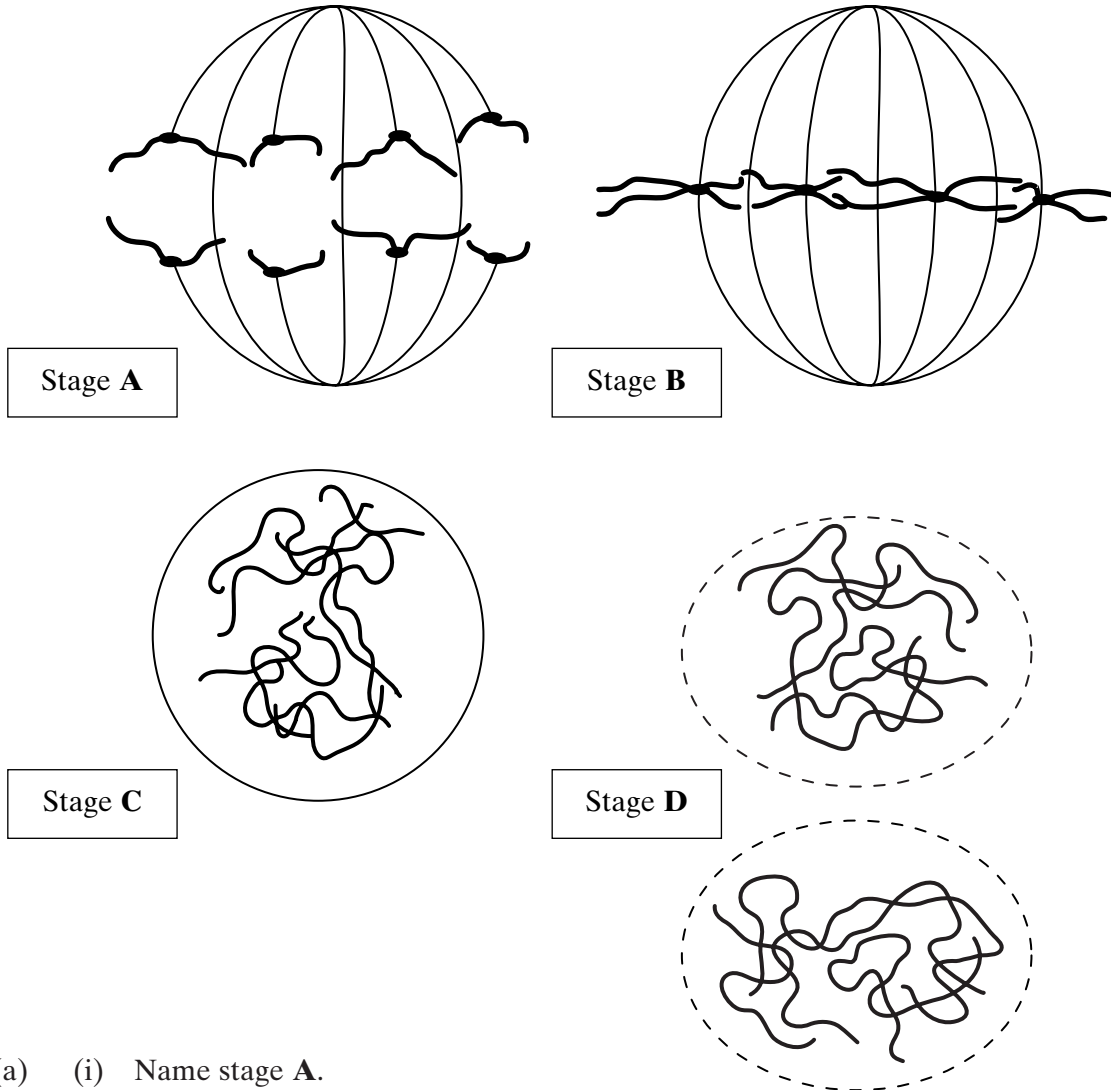
- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided. All working must be shown.
- Do all rough work in this book. Cross through any work you do not want marked.

**Information**

- The maximum mark for this paper is 54.
- Mark allocations are shown in brackets.
- Answers for **Question 1** to **6** are expected to be short and precise.
- **Question 7** should be answered in continuous prose. Quality of Written Communication will be assessed in the answer. You will be awarded up to 1 mark for 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 legibility of your handwriting and the accuracy of your spelling, punctuation and grammar will also be taken into account.

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

**1** The diagrams show four stages of mitosis.

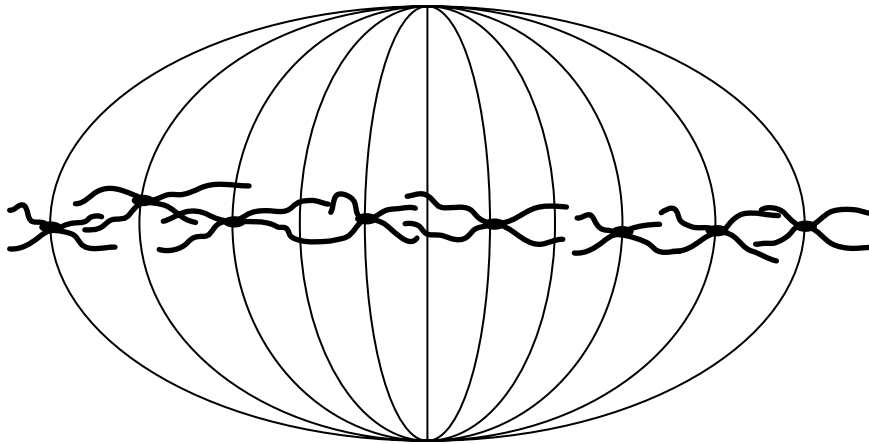


(a) (i) Name stage **A**.  
 .....  
 (1 mark)

(ii) Starting with stage **C**, give the stages **A** to **D** in the correct order.  
**C** .....  
 (1 mark)

(iii) Describe and explain the appearance of one of the chromosomes in stage **B**.  
 .....  
 .....  
 .....  
 .....  
 (2 marks)

- (b) Colchicine is a substance that prevents the formation of the spindle in mitosis. Dividing cells were treated with colchicine. This stopped them dividing. After a few hours, the colchicine was removed and the cells began to divide again. The diagram shows the chromosomes from one of the treated cells at stage **B** after the cell began dividing again.



- (i) What has happened to the chromosome number?

.....  
(1 mark)

- (ii) Suggest an explanation for the change in the chromosome number.

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(1 mark)

6

**TURN OVER FOR THE NEXT QUESTION**

Turn over

2 (a) Explain the importance of meiosis in the life cycles of organisms which reproduce sexually.

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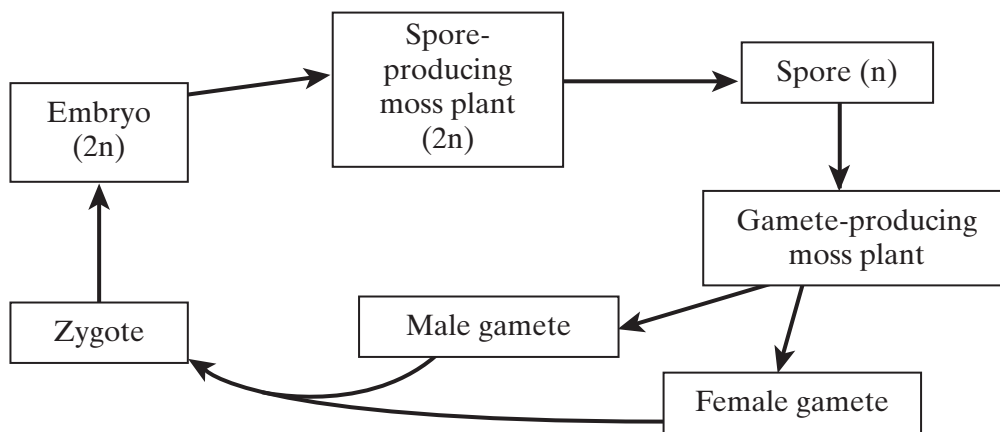
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(3 marks)

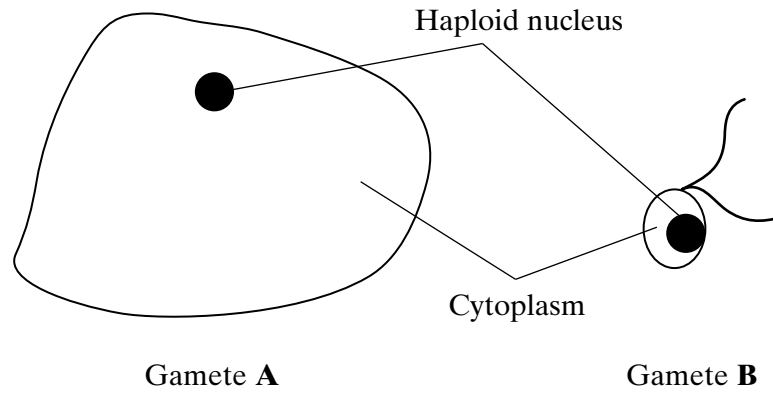
(b) The diagram shows the life cycle of a moss plant.



On the diagram mark with an **M** where meiosis takes place.

(1 mark)

(c) The diagrams show the male and female gametes of the moss, drawn to the same scale.



Which gamete is the male? Give **two** reasons for your answer.

Male gamete.....

- 1 .....
- .....
- 2 .....
- .....

(2 marks)

6

**TURN OVER FOR THE NEXT QUESTION**

Turn over

3 (a) Name and describe **one** type of gene mutation.

Name .....

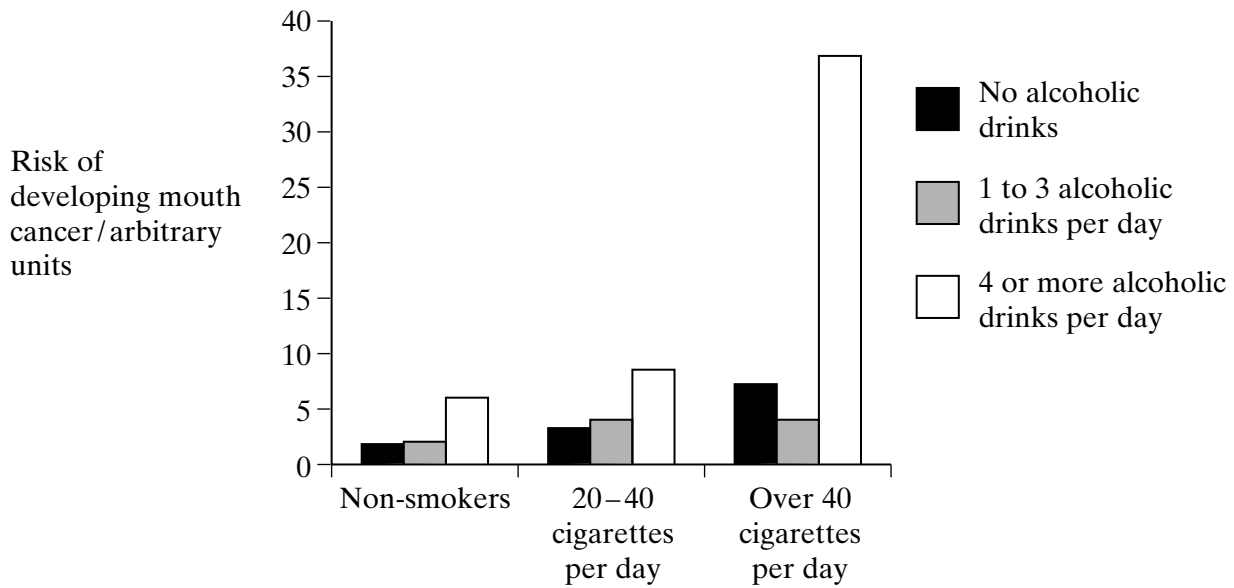
Description .....

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(2 marks)

(b) The bar chart shows the effects of smoking and alcoholic drinks on the risk of developing mouth cancer.



(i) Describe the effects of smoking and drinking on the risk of developing mouth cancer.

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(3 marks)

(ii) Suggest **one** reason why people who neither drink nor smoke sometimes develop mouth cancer.

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(1 mark)

Turn over

4 (a) Describe how a gene can be isolated from human DNA.

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(2 marks)

(b) Describe how an isolated gene can be replicated by the polymerase chain reaction (PCR).

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(4 marks)

- (c) (i) Describe how a harmless virus, genetically engineered to contain a CFTR gene, can be used to insert the gene into a cystic fibrosis sufferer.

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(2 marks)

- (ii) A virus used in gene therapy has RNA as its genetic material and has an enzyme called reverse transcriptase. Inside a human cell, reverse transcriptase uses viral RNA to make viral DNA.

Explain why the enzyme is called *reverse transcriptase*.

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(1 mark)

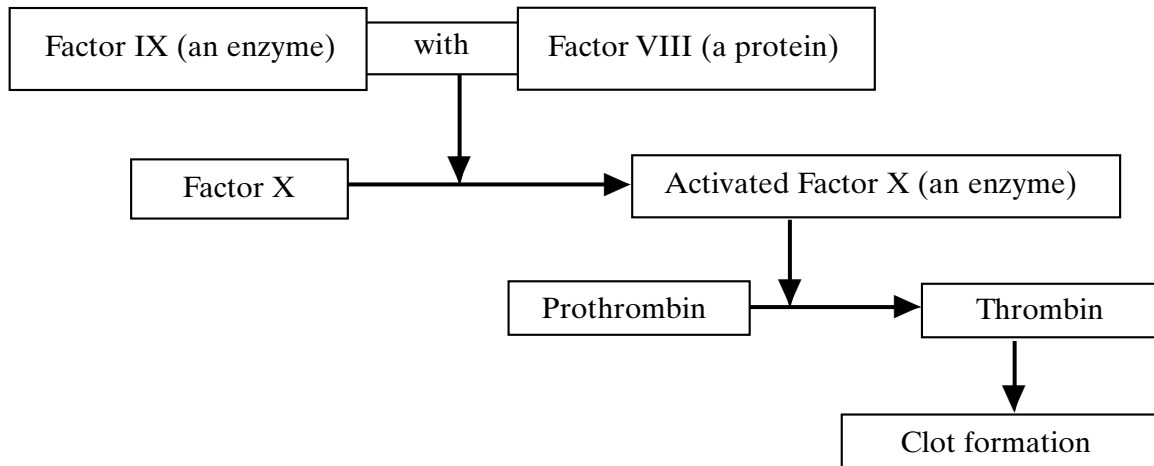
9

**TURN OVER FOR THE NEXT QUESTION**

Turn over 



5 The diagram shows part of the metabolic pathway involved in the clotting of blood in response to an injury.



Haemophilia is a condition in which blood fails to clot. This is usually because of a mutant allele of the gene for Factor VIII.

(a) Explain how mutation could lead to faulty Factor VIII.

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(2 marks)

(b) Use information in the diagram to explain how faulty Factor VIII causes haemophilia.

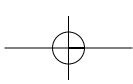
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(2 marks)



- (c) A boy had haemophilia caused by faulty Factor IX. When his blood was mixed with blood from a haemophiliac with faulty Factor VIII, the mixture clotted. Suggest an explanation for clotting of the mixture.

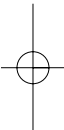
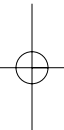
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(2 marks)

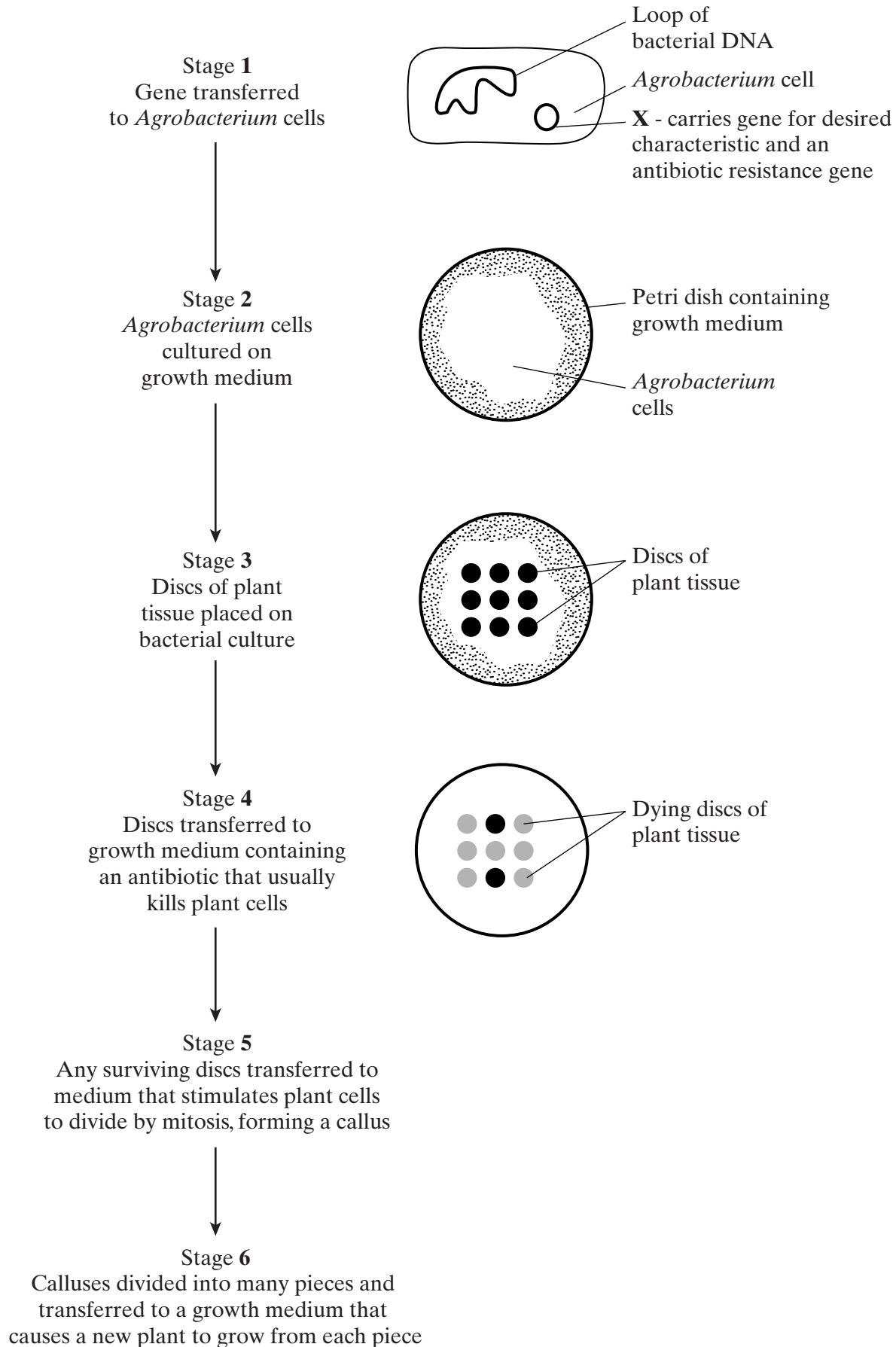
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**TURN OVER FOR THE NEXT QUESTION**

Turn over 



- 6 (a) *Agrobacterium* is a bacterium used in genetic engineering of plants. The diagram shows stages in the transfer of a gene into a plant.



(i) Name structure **X** in stage **1**.

.....  
(1 mark)

(ii) In stage **2**, explain why the bacteria are cultured before the plant tissue is added.

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(1 mark)

(iii) In stage **4**, explain why the growth medium contains antibiotic.

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(2 marks)

(iv) Suggest why stages **5** and **6** are necessary for the commercial production of genetically engineered plants.

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(2 marks)

(b) (i) A toxin that kills insects can be sprayed directly onto the leaves of crop plants. A gene has now been transferred into crop plants that makes their leaves produce this toxin.

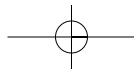
Explain **one** advantage to farmers of growing the genetically engineered crop plants, rather than spraying leaves with the toxin.

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

(ii) Suggest **one** reason why some people are concerned that the toxin gene might get transferred to wild plants that are related to the crop plants.

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

Turn over ▶



**Question 7** should be answered in continuous prose.  
Quality of Written Communication will be assessed in the answer.

7 (a) Describe how DNA is replicated.

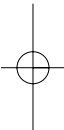
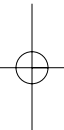
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(6 marks)

(b) (i) Starting with mRNA, describe how the process of translation leads to the production of a polypeptide.

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(4 marks)



- (ii) Normal tomato plants have an enzyme that softens tomatoes as they ripen. Genetically engineered tomatoes ripen and soften more slowly. A gene was inserted which reduces the amount of softening enzyme produced.

The diagram shows matching parts of the base sequences for the mRNA produced by the gene for the softening enzyme and that produced by the inserted gene.

Softening gene mRNA ...AAUCGGAAU...

Inserted gene mRNA ...UUAGCCUUA...

Suggest how the inserted gene reduces the production of the softening enzyme.

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(2 marks)

$\frac{12}{1}$

**END OF QUESTIONS**

**QWC**

$\frac{1}{1}$