Surname		Other Names	
Centre Number			Candidate Number									
Candidate Signature												

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General Certificate of Education
June 2004
Advanced Subsidiary Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

BIOLOGY (SPECIFICATION B) BYB2
Unit 2 Genes and Genetic Engineering

Tuesday 8 June 2004 Morning Session

In addition to this paper you will require:
- a ruler with millimetre measurements.

You may use a calculator.

Time allowed: 1 hour

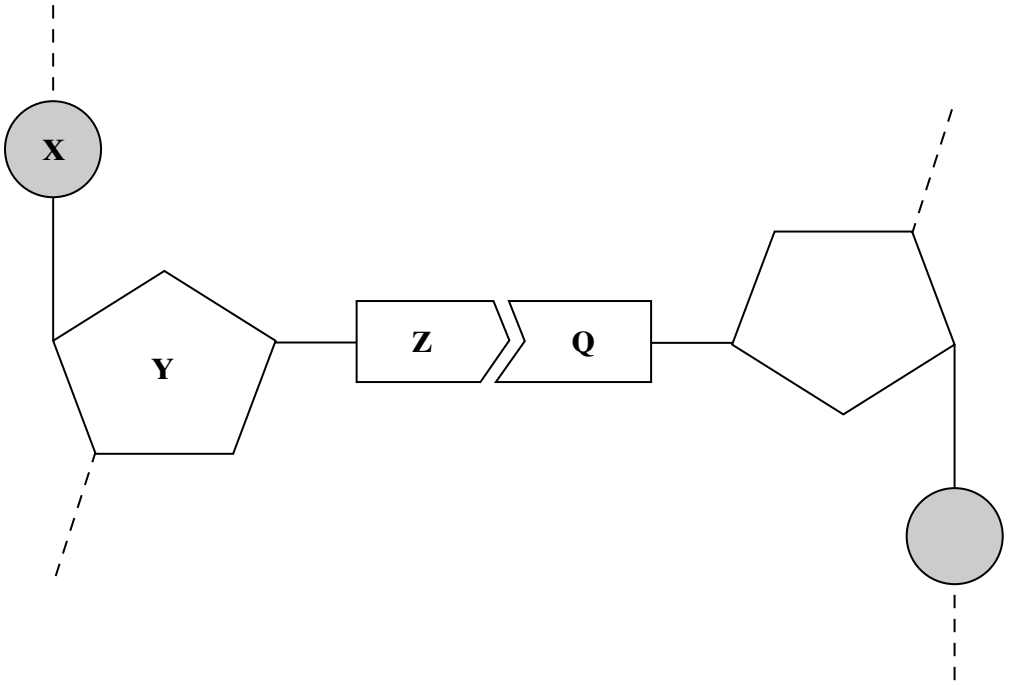
Instructions
- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided. All working must be shown.
- Do all rough work in this book. Cross through any work you do not want marked.

Information
- The maximum mark for this paper is 54.
- Mark allocations are shown in brackets.
- Answers for **Questions 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.

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			

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

1 The diagram shows one nucleotide pair of a DNA molecule.



(a) Name the parts of the nucleotide labelled **X**, **Y** and **Z**.

X .....

Y .....

Z .....

(3 marks)

(b) What type of bond holds **Z** and **Q** together?

.....

(1 mark)

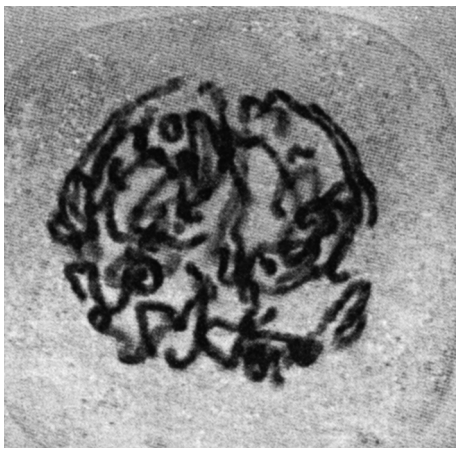
(c) A sample of DNA was analysed. 28 % of the nucleotides contained thymine. Calculate the percentage of nucleotides which contained cytosine. Show your working.

Answer ..... %

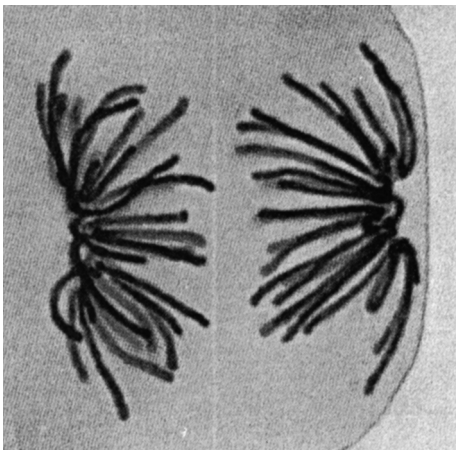
(2 marks)

6

2 (a) The photographs show two stages in mitosis of a plant cell.



A



B

Name stages **A** and **B**. In each case describe what is happening to the chromosomes.

(i) Stage **A** .....

.....

.....

.....

(2 marks)

(ii) Stage **B** .....

.....

.....

.....

(2 marks)

(b) Describe **two** events during interphase which prepare a cell for mitosis.

1 .....

.....

2 .....

.....

(2 marks)

6

Turn over ▶

3 (a) Explain the reason for each of the following in the polymerase chain reaction (PCR).

(i) DNA is heated to 95 °C.

.....

.....

(1 mark)

(ii) DNA polymerase used is heat-stable.

.....

.....

(1 mark)

(iii) The reaction mixture is cooled to 40 °C.

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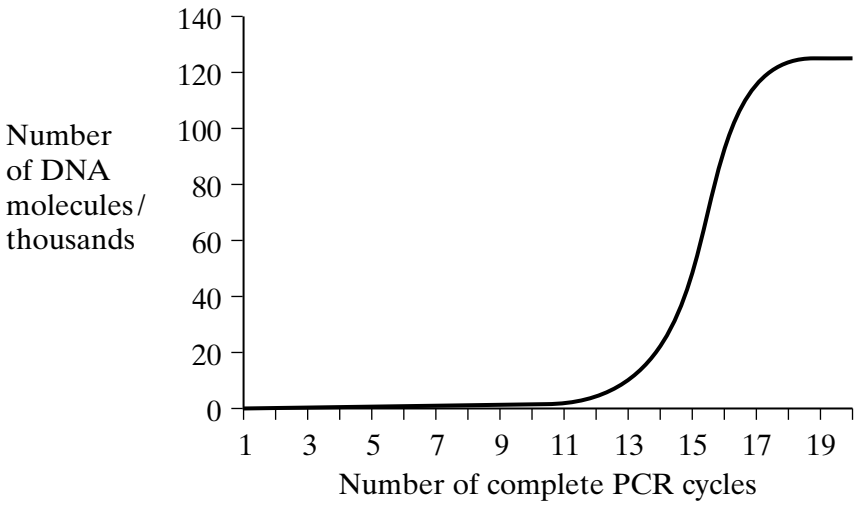
.....

(1 mark)

(b) The graph shows the number of DNA molecules made using PCR, starting with one molecule.



(i) Explain the shape of the curve from cycles 1 to 16.

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(2 marks)

(ii) Suggest **one** explanation for the levelling out of the curve from cycles 17 to 20.

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(2 marks)

7

Turn over ▶

4 (a) During meiosis, one chromosome from each homologous pair goes to each of the cells produced. Explain why this is important.

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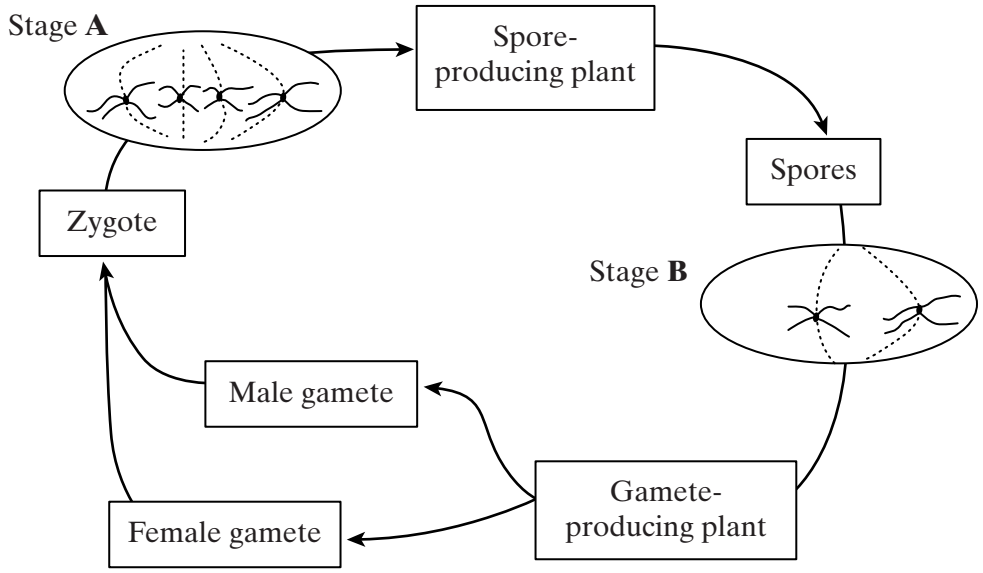
(2 marks)

(b) The diagram shows the life cycle of a fern plant. Drawings of the chromosomes during cell division are shown for the stages that give the spore-producing plant and the gamete-producing plant.



(i) What is the diploid number of chromosomes in this fern plant?

.....

(1 mark)

(ii) Explain the difference in the number of chromosomes at stages **A** and **B**.

.....

.....

(1 mark)

(iii) Are the male and female gametes produced by mitosis or meiosis? Explain your answer.

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(2 marks)

6

TURN OVER FOR THE NEXT QUESTION

5 (a) CFTR is a transmembrane regulator protein. Its molecules have 1480 amino acids. People with cystic fibrosis produce defective CFTR protein which is missing one amino acid from its structure.

(i) What is the minimum number of bases on DNA which would code for the normal CFTR protein? Explain your answer.

Number of bases .....

.....

.....

.....

.....

(2 marks)

(ii) Which type of gene mutation produced the cystic fibrosis allele? Explain your answer.

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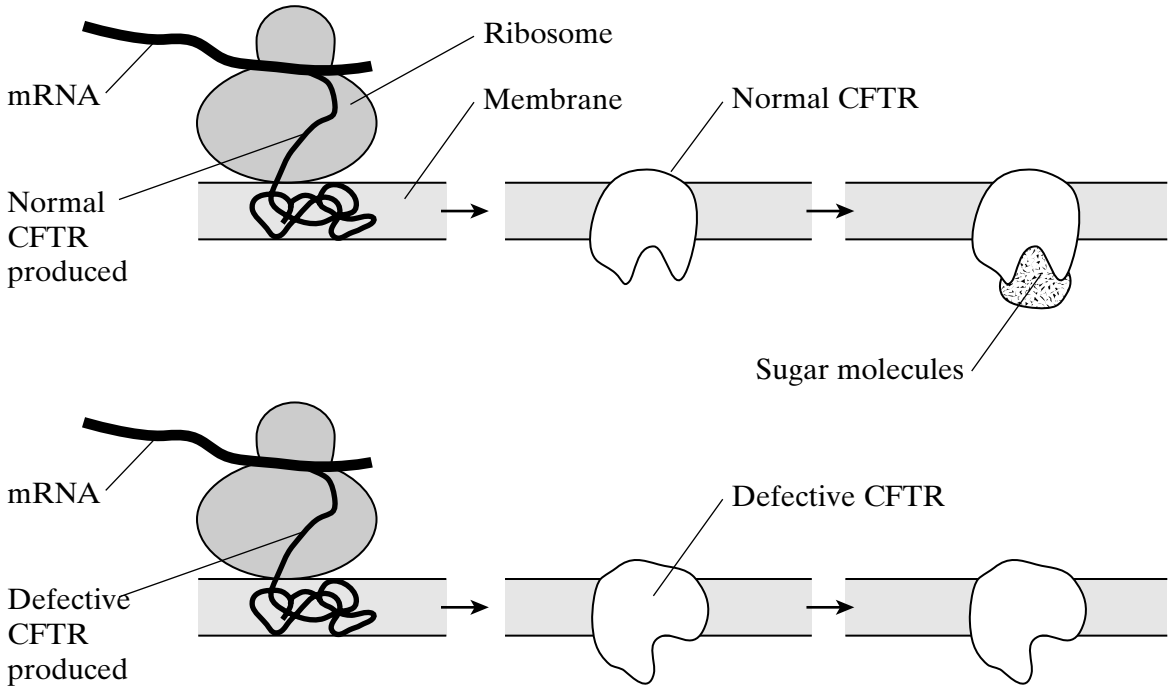
(2 marks)

(b) The diagram shows part of the process of making normal and defective CFTR in a cell. A normal CFTR protein molecule has sugar molecules attached to it which make it functional.



(i) Describe how the information on mRNA is translated into CFTR at the ribosome.

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(4 marks)

(ii) Using information in the diagram and your own knowledge, suggest why defective CFTR, missing one amino acid, is not functional.

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(2 marks)

10

TURN OVER FOR THE NEXT QUESTION

6 (a) Give **three** ways in which vegetative propagation is different from sexual reproduction.

1 .....

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2 .....

.....

3 .....

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(3 marks)

(b) Maize seeds bought from seed companies grow into plants that give a high yield of grain. Unfortunately, seeds produced by these plants by sexual reproduction do not grow into high-yielding plants. This means that farmers have to buy new seeds each year, instead of using seeds saved from their own crop.
Some weed plants can produce seeds without sexual reproduction. They use a type of vegetative propagation called apomixis to do this. Research is under way to isolate the genes for apomixis and insert them into high-yielding maize plants.

(i) Suggest and explain **two** advantages to farmers of using high-yielding maize plants with apomixis genes.

1 .....

.....

.....

2 .....

.....

.....

(2 marks)

(ii) Suggest **two** reasons why some people are against the introduction of apomixis genes into crop plants.

1 .....

.....

2 .....

.....

(2 marks)

7

Answers to **Question 7** should be written in continuous prose.
Quality of Written Communication will be assessed in these answers.

7 (a) Plasmids can be modified by genetic engineering and inserted into bacteria. These bacteria can then make useful substances normally made by another organism. Explain how modified plasmids are made by genetic engineering and how the use of markers enable bacteria containing these plasmids to be detected.

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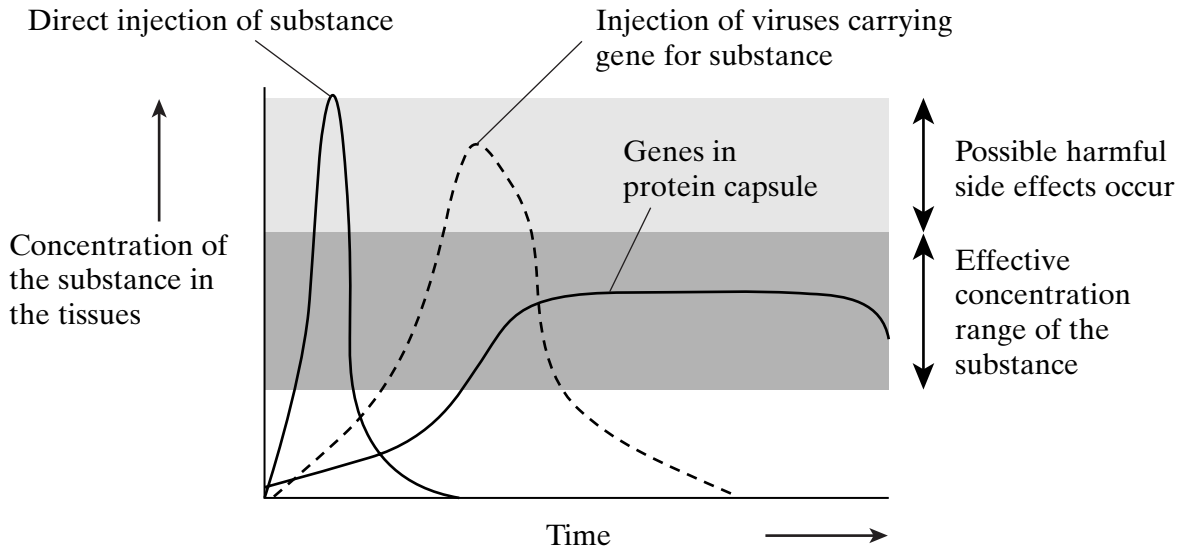
(6 marks)

QUESTION 7 CONTINUES ON THE NEXT PAGE

(b) In gene therapy, genes are introduced into a person who has defective genes which do not produce an important substance. Three experiments were done to compare techniques for introducing an important substance into a person with defective genes.

1. The substance was injected directly.
2. Harmless viruses carrying genes coding for the substance were injected.
3. The genes were put into a protein capsule which was inserted into the tissues.

The graph shows results of the experiments.



(i) Describe the results of the three experiments.

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(3 marks)

(ii) Using the information in the graph, suggest **one** advantage and **one** disadvantage of the capsule method compared to the others.

Advantage .....

.....

Disadvantage .....

.....

(2 marks)

11

END OF QUESTIONS

QWC

1

THERE ARE NO QUESTIONS PRINTED ON THIS PAGE

ACKNOWLEDGEMENT OF COPYRIGHT-HOLDERS AND PUBLISHERS

Question 2 McLeish and Snoad, *Looking at Chromosomes,* (MacMillan and Co. Ltd.) 1958

Question 7 Takahiro Ochiya et al, *Biomaterials for Gene Delivery: Studies on Metastasis,* (National Cancer Centre, Research Institute, Tokyo, Japan) 1999

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