

Surname						Other Names					
Centre Number						Candidate Number					
Candidate Signature											

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General Certificate of Education
 January 2006
 Advanced Subsidiary Examination



BIOLOGY (SPECIFICATION B)
Unit 2 Genes and Genetic Engineering

BYB2

Tuesday 10 January 2006 9.00 am to 10.00 am

For this paper you must have:

- 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.
- Answer the questions in the spaces provided.
- 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.
- The marks for questions are shown in brackets.
- You are reminded of the need for good English and clear presentation in your answers.
- Use accurate scientific terminology in all answers.
- Answers for **Questions 1 to 6** are expected to be short and precise.
- Answer **Question 7** in continuous prose. Quality of Written Communication will be assessed in the answer.

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

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

1 (a) What name is given to the different forms of a gene?

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(1 mark)

(b) Cystic fibrosis develops when someone inherits two defective forms of the gene for a protein controlling the movement of chloride ions through cell membranes. Explain how this

(i) affects the movement of chloride ions in a person with cystic fibrosis;

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(2 marks)

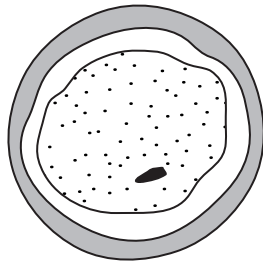
(ii) results in the production of thick, sticky mucus on the surfaces of the cells lining the lungs.

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(2 marks)

(c) Describe and explain how gene therapy may be used to treat a person with cystic fibrosis.

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(3 marks)

- 2 (a) The diagrams show a female and a male gamete. The diameter of the head of the male gamete on the diagram measures 3 mm.



×40
Female gamete



3 mm
×800
Male gamete

- (i) Calculate how many times the diameter of the female gamete is greater than the diameter of the head of the male gamete. Show your working.

Answer
(2 marks)

- (ii) Give **one** advantage of producing a large female gamete.

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(1 mark)

- (b) A thick layer forms rapidly around a female gamete immediately after a male gamete has entered. Suggest and explain why this layer is important.

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(2 marks)

3 A protein produced by a species of bacterium is toxic to caterpillars. The gene coding for this protein was removed and transferred into a crop plant.

(a) (i) Describe how the gene could have been removed from the bacterial DNA.

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(2 marks)

(ii) Many copies of the isolated gene were required. Name the process used in a laboratory to produce many copies of DNA from a small amount.

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(1 mark)

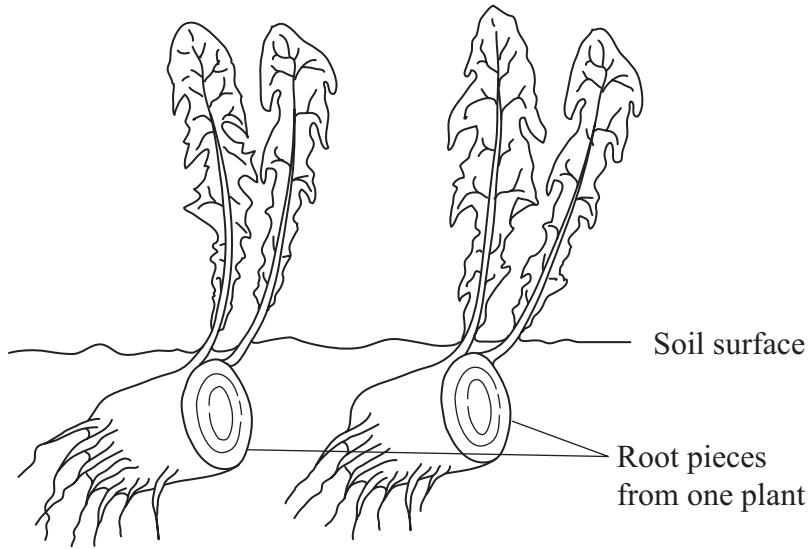
(b) The gene was injected into isolated cells from the crop plant. These cells were then cloned and new plants grown from the cloned cells. Explain the advantage of inserting the gene into isolated plant cells rather than directly into cells within a whole plant.

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(3 marks)

6

4 It is difficult to get rid of dandelions from a garden because small pieces of the root are able to grow into new plants if left behind in the soil. This is shown in the drawing.



(a) Explain why the plants produced form a clone.

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(2 marks)

(b) Suggest **one** reason why the plants in a clone may not be identical in appearance.

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(1 mark)

(c) Most plants produce seeds after fertilisation in sexual reproduction. However, dandelions produce small, windblown seeds without fertilisation taking place. Suggest **two** advantages to the dandelion of being able to reproduce from these seeds, as well as from pieces of root.

Advantage 1

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Advantage 2

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(2 marks)

- 5 (a) **Figure 1** shows the exposed bases (anticodons) of two tRNA molecules involved in the synthesis of a protein.

Figure 1



Complete the boxes to show the sequence of bases found along the corresponding section of the coding DNA strand.

(2 marks)

- (b) Describe the role of tRNA in the process of translation.

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(3 marks)

- (c) **Figure 2** shows the sequence of bases in a section of DNA coding for a polypeptide of seven amino acids.

Figure 2

TACAAGGTCGTCCTTTGTCAAG

The polypeptide was hydrolysed. It contained four different amino acids. The number of each type obtained is shown in the table.

Amino acid	Number present
Phe	2
Met	1
Lys	1
Gln	3

Use the base sequence shown in **Figure 2** to work out the order of amino acids in the polypeptide. Write your answer in the table below.

Met						
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(2 marks)

7

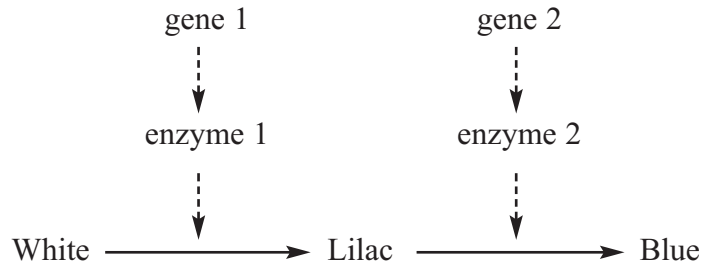
Turn over for the next question

Turn over 

6 (a) Name **one** mutagenic agent.

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(1 mark)

(b) In flax plants the flowers are white, lilac or blue. The diagram shows the pathway by which the flower cells produce coloured pigments.







(i) A deletion mutation occurs in gene 1. Describe how a deletion mutation alters the structure of a gene.

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(2 marks)

(ii) Describe and explain how the altered gene could result in flax plants with white-coloured flowers.

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(4 marks)

- (iii) Electrophoresis was used to separate the enzymes involved in this pathway. When extracts of the differently coloured flax petals were analysed, four different patterns of bands were produced. In the table, only bands that contain functional enzymes are shown.

Result of electrophoresis	Colour of petal
	White
	
	
	

Complete the table to give the colour of the petal from which each extract was taken.

(2 marks)

9

Turn over for the next question

Turn over 

Answer **Question 7** in continuous prose.
Quality of Written Communication will be assessed in these answers.

7 (a) Describe and explain how the structure of DNA results in accurate replication.

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(4 marks)

(b) Describe the behaviour of chromosomes during mitosis and explain how this results in the production of two genetically identical cells.

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(7 marks)

- (c) A cancerous tumour is formed by uncontrolled mitotic division. This results in a mass of cells with an inadequate blood supply. Drugs are being developed which only kill cells in a low oxygen environment. Suggest how these drugs could be useful in the treatment of cancer.

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(2 marks)

13

END OF QUESTIONS

QWC

1

There are no questions printed on this page