Surname		Other Names	
Centre Number			Candidate Number									
Candidate Signature												

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General Certificate of Education
January 2005
Advanced Subsidiary Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

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

Monday 10 January 2005 Morning Session

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

You may use a calculator.

Time allowed: 1 hour

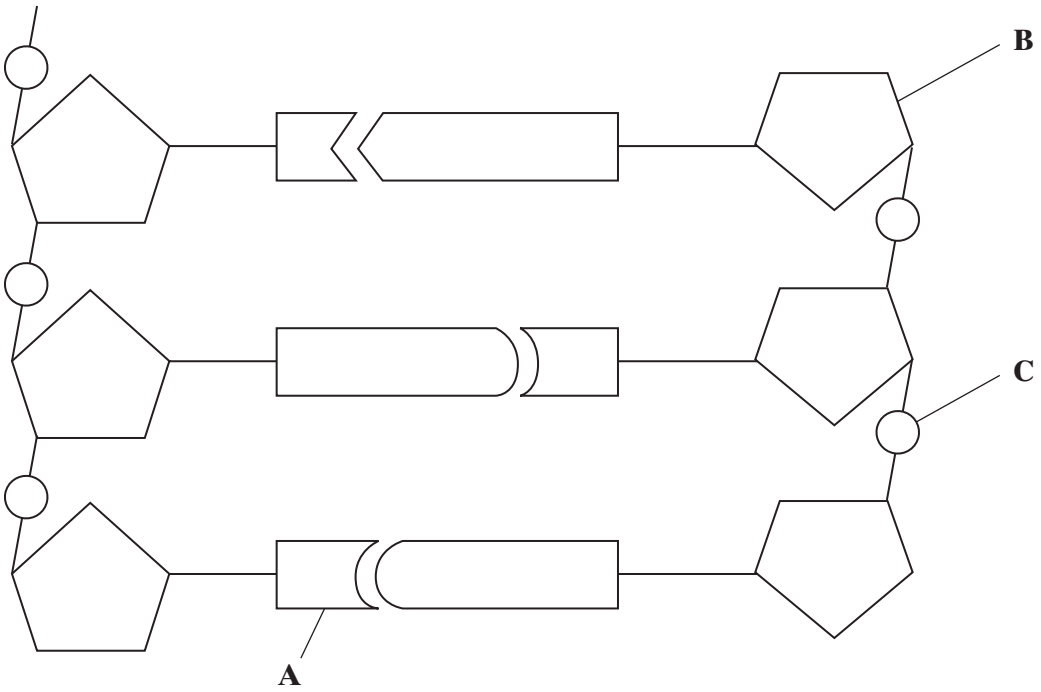
Instructions
- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided. All working must be shown.
- Do all rough work in this book. Cross through any work you do not want marked.

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

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 a short section of a DNA molecule.



(a) On the diagram draw a box round **one** nucleotide.

(1 mark)

(b) Use the letters in the diagram to indicate a part of the molecule which

(i) is **not** a base and is different in an RNA molecule; .....

(ii) contains nitrogen. .....

(2 marks)

(c) (i) The sequence of bases on one strand of DNA is important for protein synthesis. What is its role?

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.....

(1 mark)

(ii) How are the two strands of the DNA molecule held together?

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(1 mark)

(iii) Give **one** advantage of DNA molecules having two strands.

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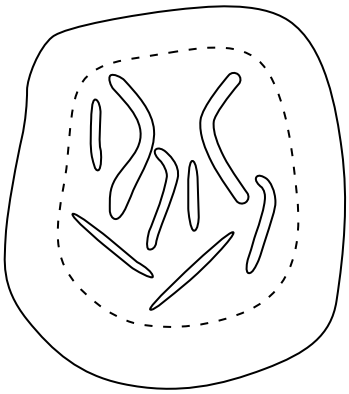
(1 mark)

2 The diagram represents a cell from a fruit fly in which the diploid number is eight.



(a) Draw a diagram to show

(i) this cell during anaphase of mitosis;

(2 marks)

(ii) the chromosomes in a gamete produced from this cell by meiosis.

(2 marks)

(b) Explain why meiosis is important in sexual reproduction, apart from producing gametes that are genetically different.

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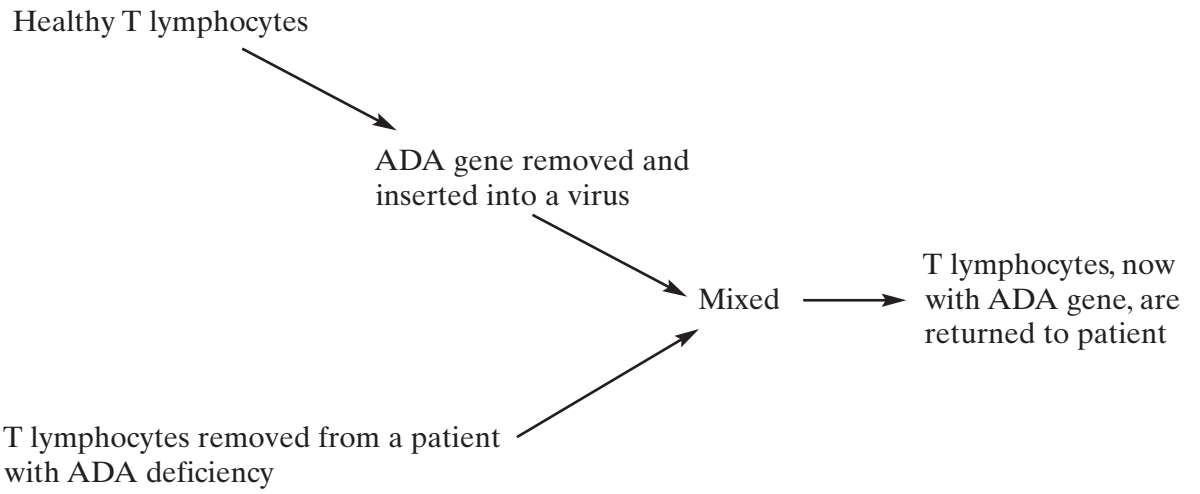
(2 marks)

6

3 Gene therapy is used to treat the genetic disorder, ADA deficiency. Affected individuals are unable to produce the enzyme adenosine deaminase (ADA). Without this enzyme, T lymphocytes, a type of white blood cell, cannot provide immunity to infection. The diagram shows the processes involved in the treatment of ADA deficiency by gene therapy.



(a) What is meant by *gene therapy*?

.....

.....

(1 mark)

(b) The ADA gene is inserted into a virus. Give **two** advantages of using a virus in gene therapy.

1 .....

.....

2 .....

.....

(2 marks)

(c) Individuals who have been treated by this method of gene therapy do not pass on the ADA gene to their children. Explain why.

.....

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(1 mark)

(d) T lymphocytes are produced in bone marrow. A bone marrow transplant from a genetically matched donor can provide a permanent cure for ADA deficiency.

(i) Suggest why bone marrow for a transplant is obtained from a genetically matched donor.

.....

.....

(1 mark)

(ii) Explain why treatment of ADA deficiency by gene therapy must be repeated at regular intervals, whereas a single bone marrow transplant can provide a permanent cure.

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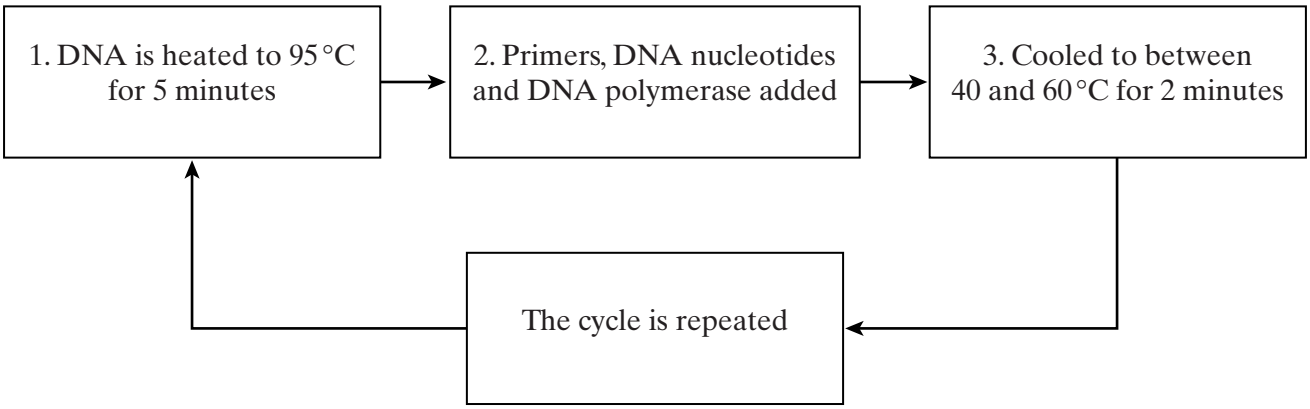
(2 marks)

7

TURN OVER FOR THE NEXT QUESTION

4 The polymerase chain reaction is a process which can be carried out in a laboratory to replicate DNA. The diagram shows the main stages involved in the polymerase chain reaction.



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

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(1 mark)

(b) What is the role of

(i) a primer in this process;

.....

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(1 mark)

(ii) DNA polymerase?

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(1 mark)

(c) (i) How many DNA molecules will have been produced from one molecule of DNA after 6 complete cycles?

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(1 mark)

(ii) Suggest **one** use of the polymerase chain reaction.

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(1 mark)

(d) Give **two** ways in which the polymerase chain reaction differs from the process of transcription.

1 .....

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2 .....

.....

(2 marks)

7

TURN OVER FOR THE NEXT QUESTION

5 Lysozyme is an enzyme consisting of a single polypeptide chain of 129 amino acids.

(a) What is the minimum number of nucleotide bases needed to code for this enzyme?

.....

(1 mark)

(b) The diagram shows the sequence of bases in a section of the mRNA strand used to synthesise this enzyme.

G G U C U U U C U U A U G G U A G A U A U

(i) Give the DNA sequence which would be complementary to the first four bases in this section of mRNA.

.....

(1 mark)

(ii) How many different types of tRNA molecule would attach to the section of mRNA shown in the diagram?

.....

(1 mark)

(c) Give **two** factors which might increase the frequency at which a mutation in DNA occurs.

1 .....

2 .....

(2 marks)

(d) Two single base mutations occurred in the DNA coding for this section of mRNA. These mutations caused an alteration in the sequence of amino acids in the enzyme. The diagram shows the original and altered sequences of amino acids.

Original amino acid sequence	Gly	Leu	Ser	Tyr	Gly	Arg	Tyr
Original mRNA base sequence	GGU	CUU	UCU	UAU	GGU	AGA	UAU

Altered amino acid sequence	Gly	Leu	Tyr	Leu	Trp	Arg	Tyr
Altered mRNA base sequence	GGU	CUU				AGA	UAU

(i) Use the mRNA codons provided in the table to complete the altered mRNA base sequence in the diagram.

Amino acid	**mRNA codons which can be used**
Arg	AGA
Gly	GGU
Leu	CUU or UUA
Ser	UCU
Trp	UGG
Tyr	UAU or UAC

(1 mark)

(ii) Use the information provided to determine the precise nature of the **two** single base mutations in the DNA.

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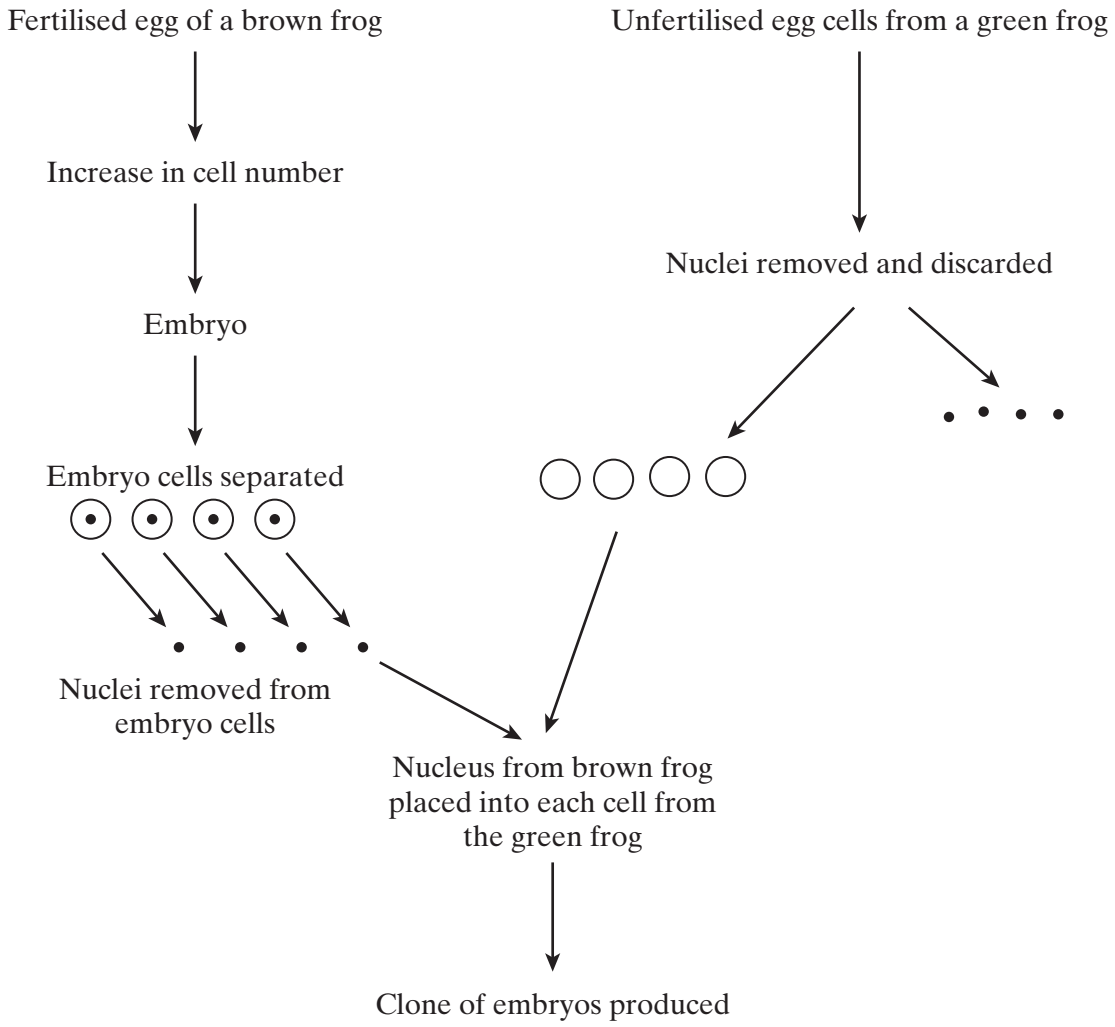
(3 marks)

9

Turn over ▶

6 A clone of frogs was produced by nuclear transfer. This procedure is summarised in the diagram.



(a) What is a clone?

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(1 mark)

(b) Name the type of cell division occurring in a developing embryo.

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(1 mark)

(c) The embryo cells used are from an early stage of development. Explain why.

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.....

(1 mark)

(d) What would be the colour of the cloned offspring? Explain your answer.

.....

.....

(1 mark)

(e) Give **two** differences between the nuclei removed from the embryo cells and the nuclei discarded from the unfertilised egg cells.

1 .....

2 .....

(2 marks)

(f) Only 30% of the cloned cells successfully developed into embryos. Suggest a reason for this low success rate.

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(1 mark)

7

TURN OVER FOR THE NEXT QUESTION

Answers to **Question 7** should be written in continuous prose, where appropriate. Quality of Written Communication will be assessed in the answer.

7 Research scientists can increase the nutritional value of potatoes by genetically engineering potato plants. A gene which results in increased protein production has been removed from cells of an amaranth plant and inserted into cells of a potato plant.

(a) Describe how a gene could be removed from cells of an amaranth plant and inserted into cells of a potato plant.

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(6 marks)

(b) Describe the advantages of using vegetative propagation rather than sexual reproduction to reproduce genetically engineered potato plants.

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(3 marks)

(c) Whole potato plants can be produced from genetically identical potato cells grown in a tissue culture. Use your knowledge of genes to suggest how different cells, such as leaf and root cells, can develop from genetically identical cells.

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(2 marks)

11

END OF QUESTIONS

QWC

1

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