Surname		Other Names	
Centre Number			Candidate Number									
Candidate Signature												

For Examiner's Use

General Certificate of Education
January 2008
Advanced Subsidiary Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

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

Wednesday 9 January 2008 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 to be marked.

Information

- The maximum mark for this paper is 54.
- The marks for questions are shown in brackets. One mark will be awarded for Quality of Written Communication.
- You are reminded of the need for good English and clear presentation in your answers.
- Use accurate scientific terminology in your answers.
- Answers for **Questions 1** to **7** are expected to be short and precise.
- Answer **Question 8** in continuous prose. Quality of Written Communication will be assessed in the answer.

For Examiner's Use			
Question	Mark	Question	Mark
1			
2			
3			
4			
5			
6			
7			
8			
Total (Column 1) →			
Total (Column 2) →			
Quality of Written Communication			
TOTAL			
Examiner's Initials			

There are no questions printed on this page

LEAVE MARGIN BLANK

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

1 (a) Genetically engineered microorganisms can be used to produce substances that are used in medicine. Name **two** of these substances.

1 .....

2 .....

(2 marks)

(b) A plasmid can be used to transfer an isolated human gene into a bacterium. Describe how.

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(3 marks)

5

Turn over for the next question

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2 (a) Base pairing is important in DNA replication. Explain how.

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(2 marks)

(b) DNA polymerase is involved in DNA replication. Explain how.

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(2 marks)

(c) DNA replication is described as semi-conservative. Explain why.

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(1 mark)

5

3 (a) (i) Describe **one** way in which the structure of a male gamete is different from the structure of a female gamete.

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(1 mark)

(ii) Explain the importance of this difference in structure.

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(1 mark)

(b) (i) The chromosome number is halved during meiosis. Describe how.

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(2 marks)

(ii) It is important that gametes contain the haploid number of chromosomes. Explain why.

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(2 marks)

6

4 (a) Name **two** mutagenic agents.

1 .....

2 .....

(2 marks)

(b) Gaucher disease is a human metabolic disorder. It is caused by a mutation that leads to the production of a non-functional form of an enzyme.

Figure 1 shows the three-dimensional structure of the active site region of the functional enzyme.

Figure 2 shows the same region of the non-functional enzyme.

Figure 1

Active site region of the functional enzyme

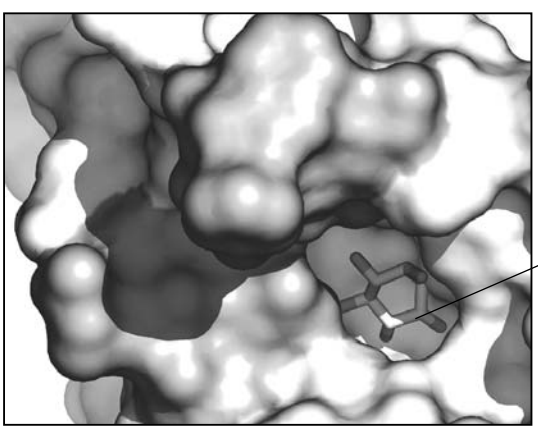
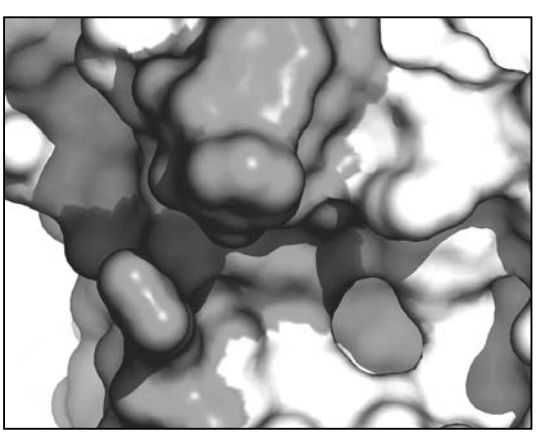


Figure 2

Active site region of the non-functional enzyme



(i) The enzyme shown in **Figure 2** is non-functional. Use the diagrams to explain why.

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(1 mark)

(ii) Explain how the mutation leads to the production of the non-functional enzyme.

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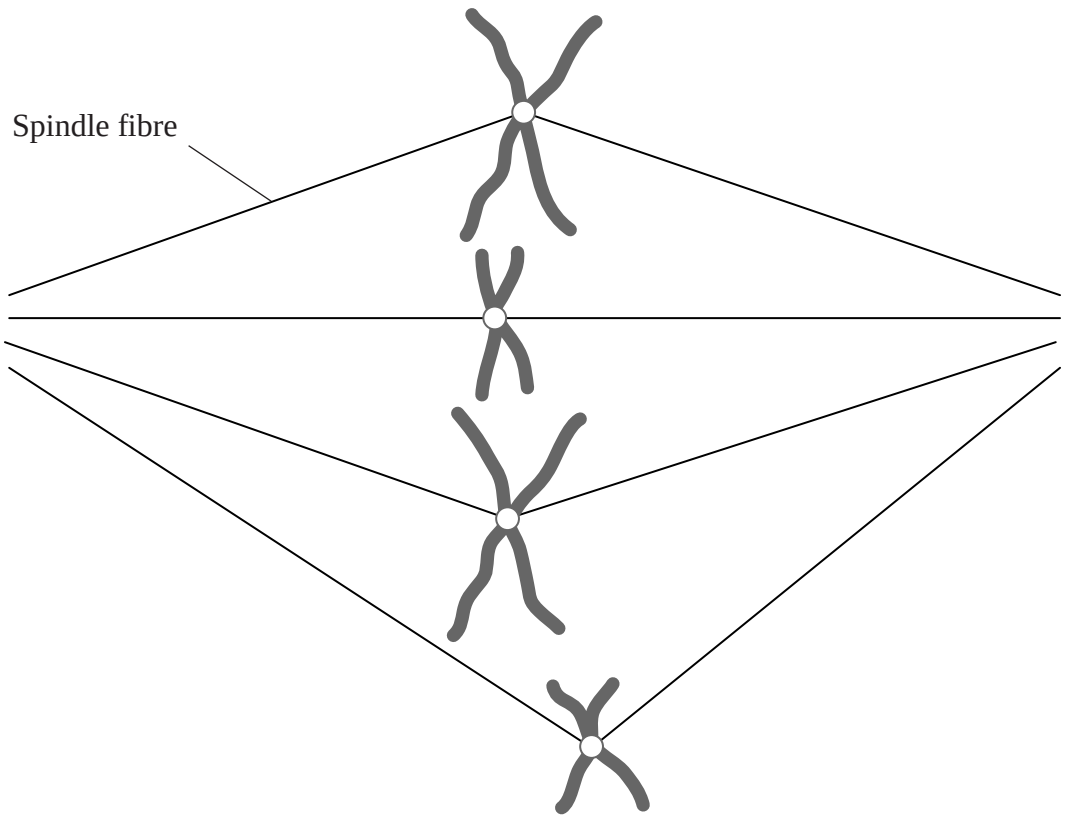
(3 marks)

6

Turn over for the next question

5 (a) The diagram shows a stage of mitosis.



Describe what happens in the next stage of mitosis.

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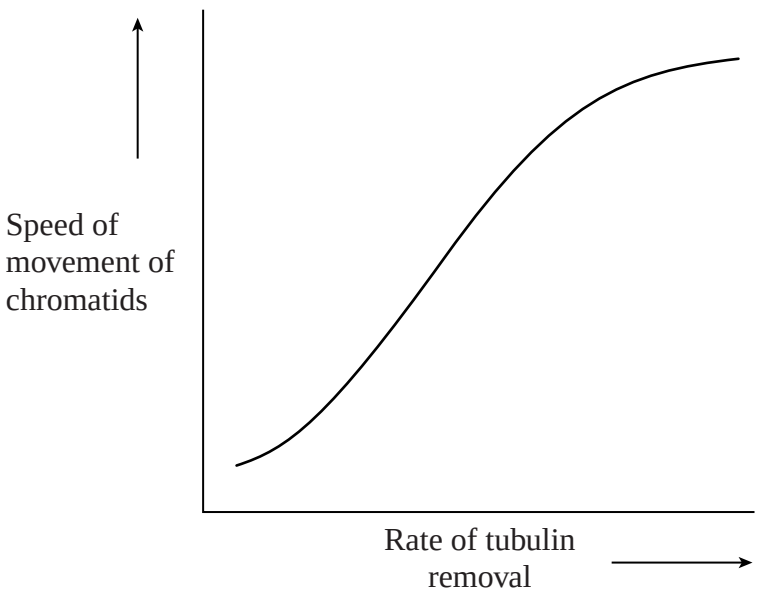
(2 marks)

(b) Spindle fibres are polymers made from tubulin monomers. The removal of tubulin monomers causes spindle fibres to shorten.
Scientists investigated the effect of the rate of tubulin removal on the speed of movement of chromatids during mitosis. The results are shown on the graph.



What do these results suggest about the role of spindle fibres in the movement of chromatids during mitosis?

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(2 marks)

4

6 (a) (i) Name the process used in the laboratory to make many copies of DNA.

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(1 mark)

(ii) In this process, describe and explain how DNA is separated into single strands.

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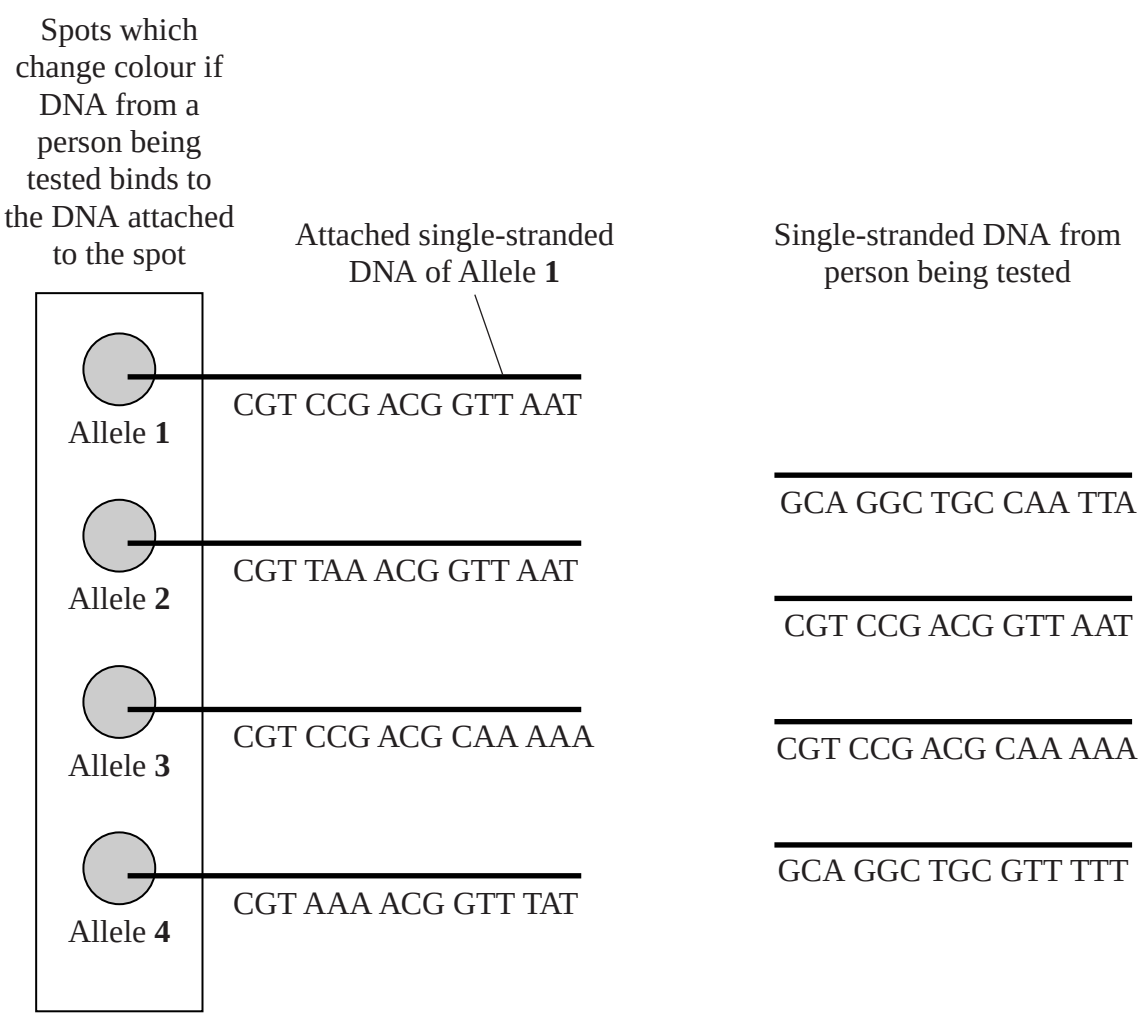
(2 marks)

A DNA test can be used to identify the person from which a sample of DNA may have come. One test can identify four alleles of the human HLA gene. The test strip has four spots on it, one for each allele. Each spot has attached to it a single-stranded piece of DNA from a different one of these alleles.



(b) What is an allele?

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(1 mark)

(c) On the diagram, label with **X** the spot, or spots, which will change colour when the DNA being tested is added.

(1 mark)

Explain your answer.

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(1 mark)

(d) Only one or two spots ever change colour when one person's DNA is added.
Explain why.

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(2 marks)

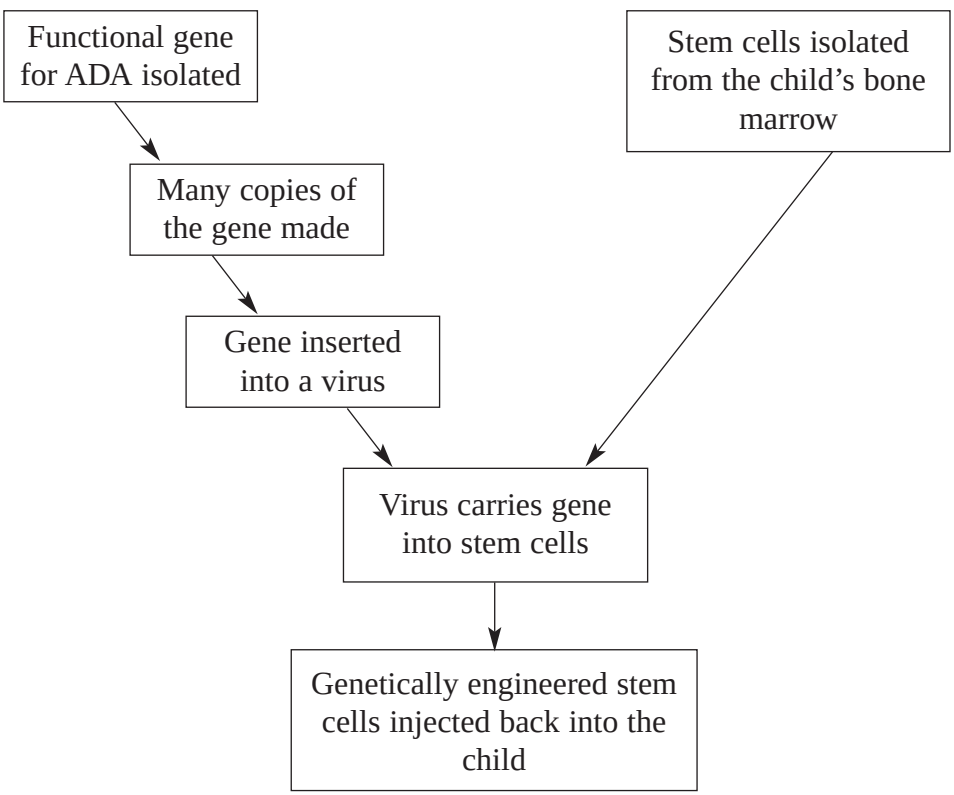
8

Turn over for the next question

7 Children with severe combined immunodeficiency disorder (SCID) cannot produce the many types of white blood cells that fight infections. This is because they do not have the functional gene to make the enzyme ADA.

Some children with SCID have been treated with stem cells. Stem cells can divide and develop into any type of blood cell, including white blood cells.

The treatment used with the children is described in the diagram.



(a) Using the information given, suggest and explain **two** reasons why stem cells were used in this treatment.

1 .....

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2 .....

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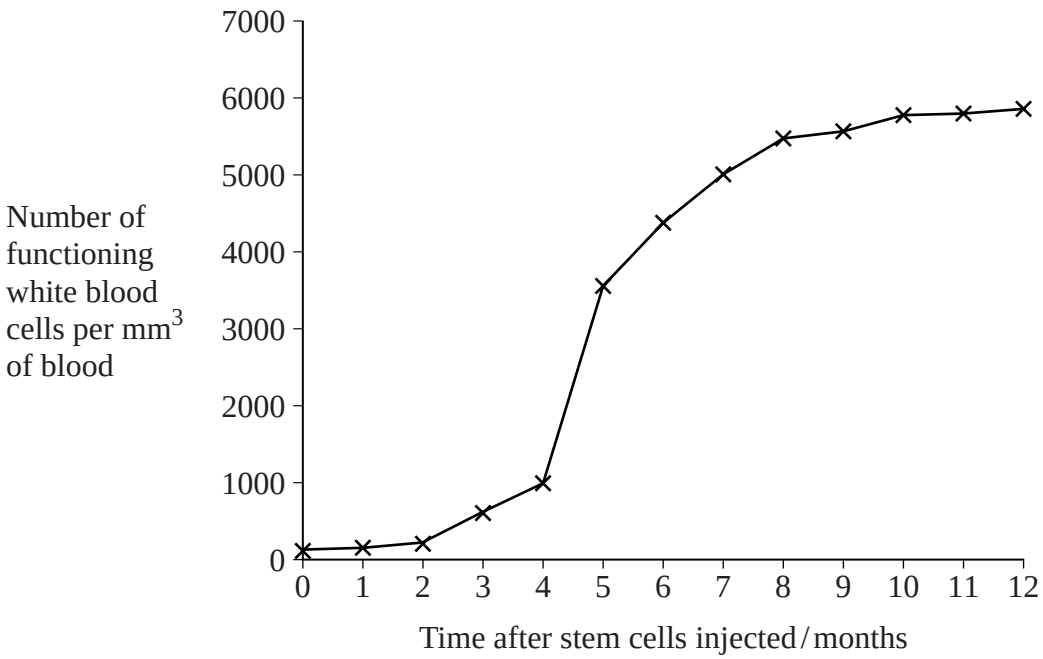
(4 marks)

(b) A child was treated with genetically engineered stem cells. The graph shows the number of functioning white blood cells in the child during the year following treatment. Children who do not suffer from SCID have between 5000 and 8000 white blood cells per mm^3 of blood.



Describe and explain these results.

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(3 marks)

7

Answer **Question 8** in continuous prose.
Quality of Written Communication will be assessed in the answer.

8 (a) Transcription and translation are stages in protein synthesis. Describe what happens during transcription and translation.

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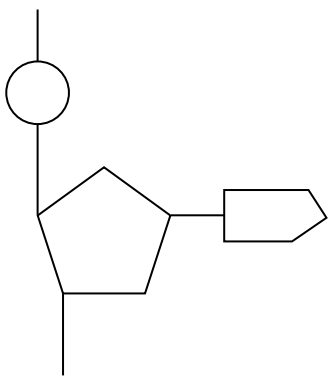
(7 marks)

(b) Ricin is a protein produced by some plants. In animal cells, ricin acts as an enzyme. This enzyme removes the adenine molecule from one of the nucleotides in the RNA of ribosomes. As a result, the ribosome changes shape. The diagram shows the nucleotide from which adenine is removed by ricin.



(i) Use a labelling line and the letter **B** to show the bond or bonds broken by ricin.

(1 mark)

(ii) Ricin causes the death of cells and is very poisonous to many animals.
Suggest how the action of ricin on ribosomes could cause the death of cells.

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(2 marks)

(iii) Ricin is found in high concentrations in the seeds of some species of plant.
Suggest and explain **one** advantage of this to the plant.

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(2 marks)

END OF QUESTIONS

12

QWC

1

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Question 4 Source: Premkumar, L. et al. J. Biol. Chem. 2005; 280:23815-23819