Surname		Other Names	
Centre Number			Candidate Number									
Candidate Signature												

For Examiner's Use

General Certificate of Education
January 2007
Advanced Subsidiary Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

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

Wednesday 10 January 2007 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 is 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			

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

1 (a) Describe what happens to the chromosomes during each of the following stages of mitosis.

(i) Prophase

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(ii) Metaphase

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(iii) Anaphase

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(3 marks)

(b) Name the stage of mitosis that immediately follows anaphase.

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(1 mark)

(c) The mass of DNA in cells from a tissue in which mitosis was occurring was measured. Some cells were found to have 9.4 units of DNA and others 4.7 units.

Explain why these cells had different amounts of DNA.

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(2 marks)

6

LEAVE MARGIN BLANK

2 (a) Replication of DNA is described as semi-conservative. Explain why.

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(2 marks)

(b) The polymerase chain reaction (PCR) is used to make many copies of a piece of DNA. The steps in each cycle of the reaction take place at different temperatures.

Explain why during each cycle

(i) the DNA is first heated to 95 °C

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(1 mark)

(ii) the temperature is then reduced to 40 °C

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(1 mark)

(iii) the temperature is then increased to 70 °C.

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(1 mark)

5

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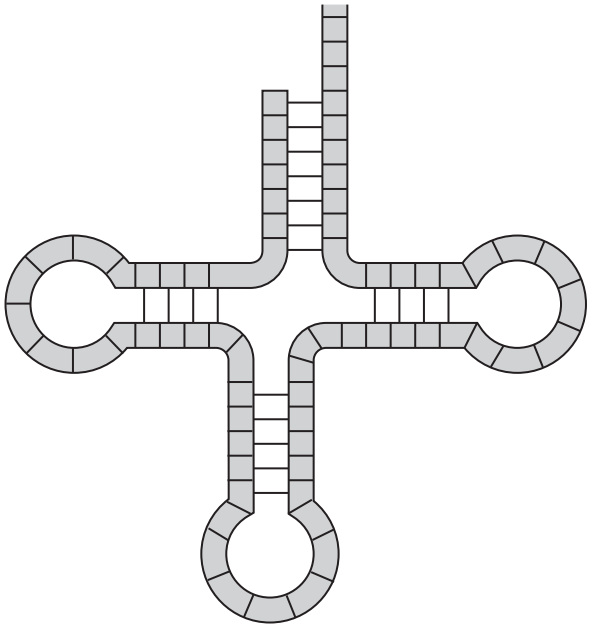
3 (a) The table shows three amino acids and the DNA base sequence that codes for them.

Amino acid	DNA base sequence	mRNA base sequence
Serine	TCG	
Tyrosine	ATA	
Cysteine	ACA	

Complete the table by giving the sequence of mRNA bases that codes for each amino acid. *(1 mark)*

(b) The diagram shows the tRNA molecule that would bring serine to the ribosome.



(i) Write the letter **Y** on the diagram to show where serine would attach. *(1 mark)*

(ii) Write the letter **Z** on the diagram to show where the anticodon would be. *(1 mark)*

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(iii) Explain the role of the anticodon in protein synthesis.

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(2 marks)

(c) The mRNA coding for a protein has 375 bases. The protein is secreted in an inactive form. It is activated when an enzyme removes three amino acids from one end.

Calculate how many amino acids there are in the activated protein. Show your working.

Answer ..... *(2 marks)*

7

Turn over for the next question

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4 (a) Gene mutations occur naturally.

Give **one** factor that increases the rate of gene mutations.

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(1 mark)

(b) The table shows the DNA base sequences that code for three amino acids.

DNA base sequence(s) coding for amino acids	Amino acid
CCA CCG CCT CCC	Glycine
TAC	Methionine
TAA TAG TAT	Isoleucine

Some substitution mutations would affect the sequence of amino acids in a polypeptide, and others would not.

Using only the information in the table, explain why.

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(3 marks)

4

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5 The base sequences on the DNA of homologous chromosomes are almost the same, even though they may have different alleles in many places.

(a) What is an allele?

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(1 mark)

(b) Explain why the DNA base sequences of homologous chromosomes are almost the same.

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(2 marks)

(c) The diameter of a mammalian egg cell is 0.2 mm. The diameter of the head of the sperm cell is 1.6 µm.

(i) Calculate how many times the egg cell is larger than the head of the sperm cell.

Answer ..... *(1 mark)*

(ii) What is the advantage of producing large egg cells?

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(1 mark)

5

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6 (a) Explain the importance of meiosis in the life cycle of organisms that reproduce sexually.

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(2 marks)

(b) The sea-fir is a marine animal. It has two body forms in its life cycle, the polyp and the medusa. The polyp lives its whole life attached to a rock. The polyp reproduces asexually. All its offspring have the medusa body form. These offspring can swim. A mature medusa reproduces sexually. Its offspring have the polyp body form.

(i) Draw a simple diagram of the life cycle of the sea-fir. Show on your diagram where mitosis, meiosis and fertilisation occur.

(3 marks)

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(ii) Suggest **one** advantage to the polyp of reproducing asexually. Give a reason for your answer.

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(2 marks)

7

Turn over for the next question

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7 (a) Gene therapy is being developed to treat people with cystic fibrosis. It involves transferring healthy CFTR genes into cells with defective genes.

Healthy CFTR genes could be isolated and then introduced into the lung cells of someone with cystic fibrosis using a harmless virus. Describe how.

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(6 marks)

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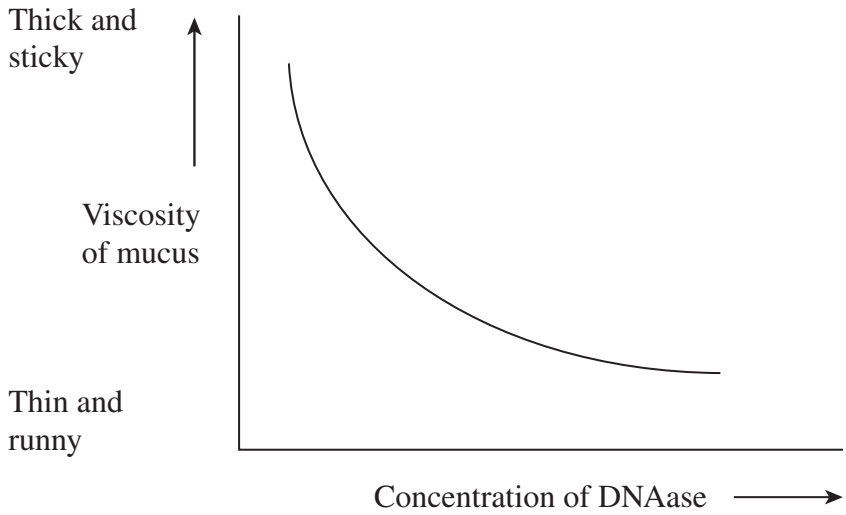
(b) The mucus produced in the lungs of someone with cystic fibrosis contains a lot of DNA from dead cells. DNAase is an enzyme which cuts DNA into short pieces. In an investigation, different concentrations of DNAase were added to mucus collected from people with cystic fibrosis. The graph shows the results.



DNAase has recently been approved for the treatment of cystic fibrosis. Use the information given to explain why inhaling DNAase helps someone with cystic fibrosis to breathe more easily.

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(3 marks)

9

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

8 (a) Bacterial cells which had been exposed to plasmids were grown in a Petri dish. Each plasmid carried the human gene for insulin. The plasmids also carried a gene for resistance to an antiobiotic.

Describe and explain how bacteria carrying the insulin gene could be identified and then grown on a commercial scale.

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(6 marks)

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(b) A genetically modified goat was produced which secreted a useful protein in its milk. Two methods were considered for producing more goats with this characteristic.

Method 1
Take eggs from the modified goat and fertilise them with sperm from an unmodified male goat. Split apart the embryos formed.

Method 2
Take body cells from the modified goat and remove their nuclei. Insert these nuclei into fertilised egg cells from an unmodified goat, which had previously had their own nuclei removed. The cytoplasm of these fertilised egg cells is not removed.

Suggest why the **Method 2** was chosen, rather than **Method 1**.

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(4 marks)

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END OF QUESTIONS

QWC

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