Surname		Other Names	
Centre Number			Candidate Number					
Candidate Signature								

Leave blank

General Certificate of Education
June 2003
Advanced Subsidiary Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

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

Monday 2 June 2003 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 **7** are expected to be short and precise.
- **Question 8** 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			
8			
QWC			
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

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

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

Prophase

.....

.....

Metaphase

.....

.....

Anaphase

.....

.....

Telophase

.....

.....

(4 marks)

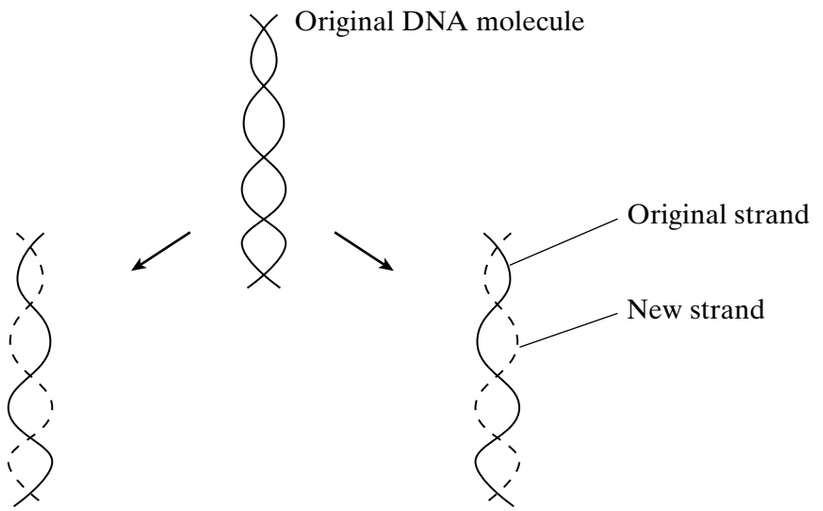
(b) Complete the table to give **two** differences between mitosis and meiosis.

Mitosis	**Meiosis**

(2 marks)

6

2 The diagram shows the replication of a molecule of DNA.



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

.....

.....

(1 mark)

(b) (i) What is meant by *specific base pairing?*

.....

.....

(ii) Explain why specific base pairing is important in DNA replication.

.....

.....

.....

.....

(3 marks)

(c) Describe **two** features of DNA which make it a stable molecule.

1 .....

.....

2 .....

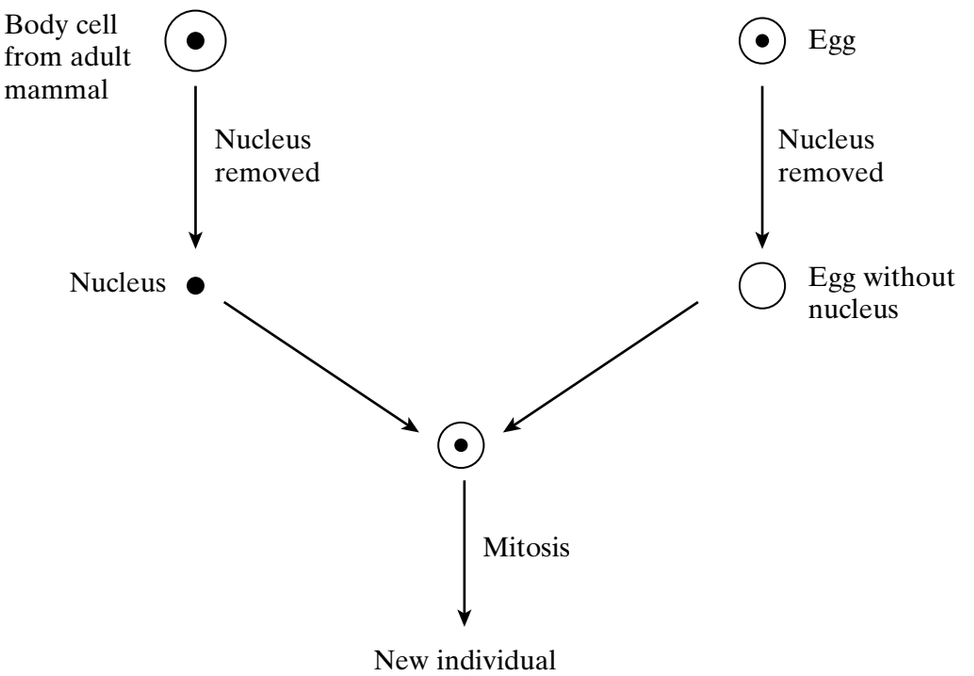
.....

(2 marks)

6

Turn over ▶

3 The diagram shows one method of cloning mammals.



(a) Explain why the new individual will be genetically identical to the adult mammal from which the body cell was taken.

.....

.....

.....

.....

(2 marks)

(b) Suggest why a nucleus from a body cell is used instead of a nucleus from a sperm or an egg.

.....

.....

(1 mark)

(c) Give **one** advantage and **one** disadvantage of producing mammals by cloning rather than by sexual reproduction.

(i) advantage

.....

.....

(1 mark)

(ii) disadvantage

.....

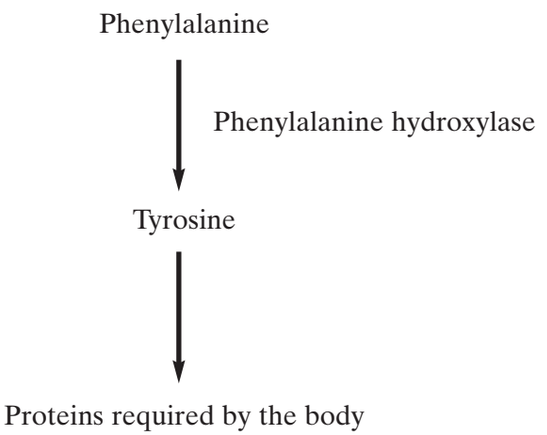
.....

(1 mark)

5

TURN OVER FOR THE NEXT QUESTION

4 Phenylalanine is an amino acid found in many proteins in the diet. In most people it is converted to another amino acid, tyrosine, by the pathway shown.



People with phenylketonuria cannot produce the enzyme phenylalanine hydroxylase. This disorder is the result of a gene mutation. Affected people accumulate phenylalanine and this leads to brain damage.

(a) What is a *gene mutation*?

.....

.....

(1 mark)

(b) Explain how the gene mutation results in failure to produce the enzyme phenylalanine hydroxylase.

.....

.....

.....

.....

.....

.....

(3 marks)

(c) From birth, children with phenylketonuria are given a special diet which is low in phenylalanine.

(i) Explain how such treatment prevents brain damage in the children.

.....

.....

(1 mark)

(ii) Suggest **one** reason why the diet must contain some phenylalanine.

.....

.....

(1 mark)

6

TURN OVER FOR THE NEXT QUESTION

5 In the production of genetically engineered bacteria, a human gene was first combined with a bacterial plasmid containing two antibiotic resistance genes. One gene coded for resistance to tetracycline and one for resistance to ampicillin. The human gene was inserted in the centre of the gene coding for resistance to tetracycline as shown in **Figure 1**.

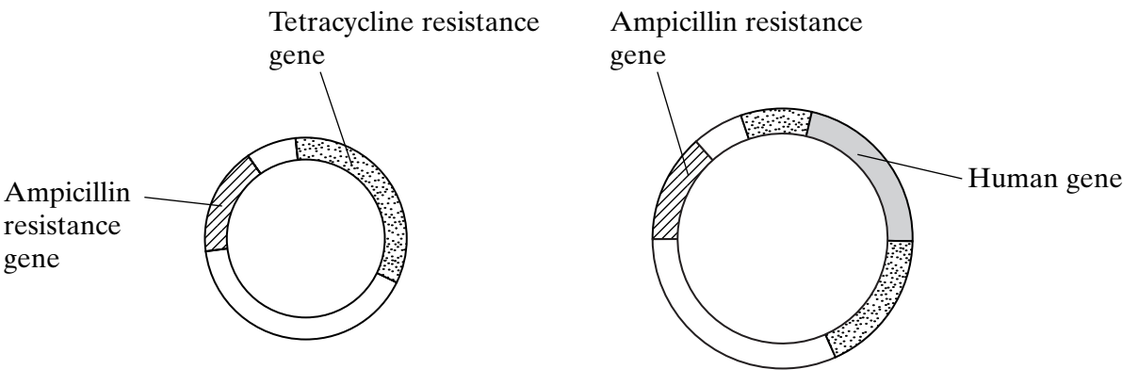


Figure 1

(a) The human gene has split the gene coding for resistance to tetracycline. What effect will this have?

.....

.....

(1 mark)

The plasmids were then added to a bacterial culture. Replica plating was used to find out which bacteria had taken up the plasmid containing the gene. This is shown in **Figure 2**.

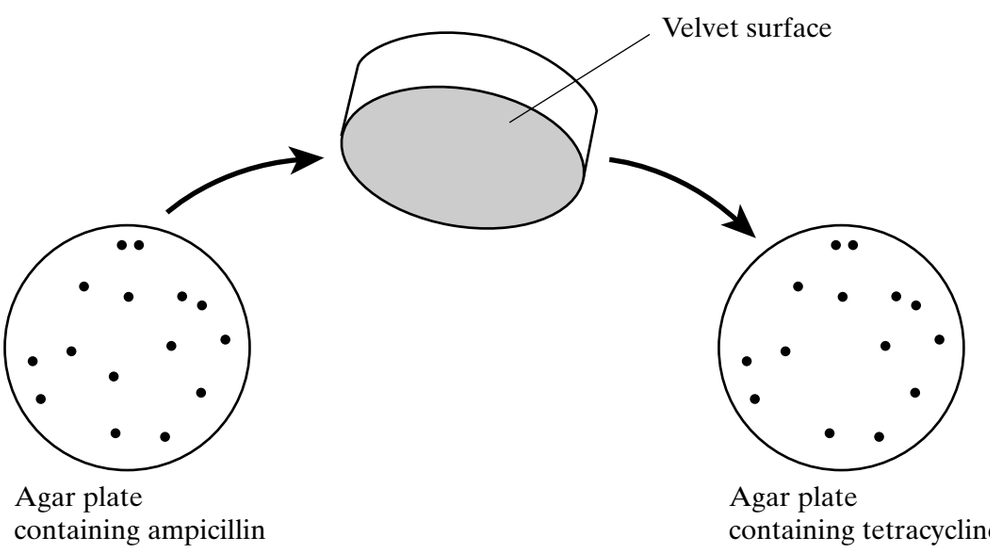


Figure 2

(b) Explain why each of the following was used.

(i) The velvet surface.

.....

.....

(1 mark)

(ii) The agar plate containing ampicillin.

.....

.....

.....

.....

(2 marks)

(iii) The agar plate containing tetracycline.

.....

.....

.....

.....

(2 marks)

(c) Draw a circle around the colony containing the human gene. *(1 mark)*

7

TURN OVER FOR THE NEXT QUESTION

6 Alpha-l-antitrypsin (αAT) is a protein needed to prevent the breakdown of the elastic tissue in the lungs. Some people have a different form of the gene for αAT. These people cannot produce the αAT protein.

(a) What term is used to refer to different forms of a gene?

.....

(1 mark)

(b) People who are unable to produce αAT can be treated with αAT extracted from the milk of genetically engineered sheep. These sheep are produced by inserting the human αAT gene into the fertilised eggs of sheep. These eggs are allowed to develop into embryos which are then implanted into surrogate sheep.

Suggest **one** reason why

(i) only a few live births result from the large number of embryos implanted;

.....

.....

(1 mark)

(ii) only 1 in 20 of the female sheep born produce αAT in their milk.

.....

.....

(1 mark)

(c) When sheep capable of producing αAT in their milk are allowed to breed, some of their female offspring are also able to produce milk containing αAT.

(i) Explain how the ability to produce milk containing αAT is passed from mother to offspring.

.....

.....

.....

.....

(2 marks)

(ii) Suggest why only some of the female offspring produce milk containing αAT.

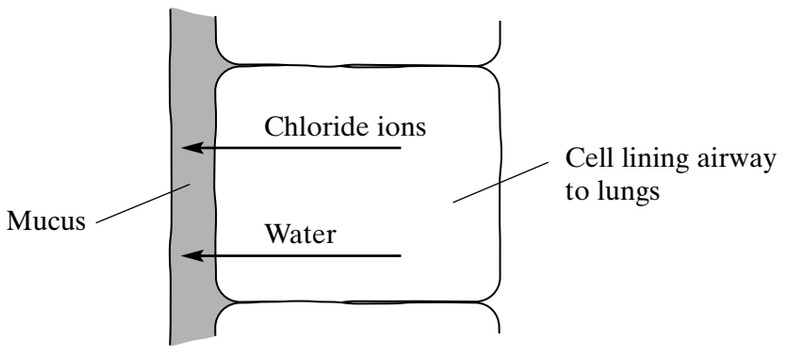
.....

.....

(1 mark)

6

7 The diagram shows the movement of chloride ions and water in the cells of the lung of a healthy human.



(a) In people with cystic fibrosis the gene controlling the movement of chloride ions is defective. Explain why the movement of chloride ions and water is reduced in a person with cystic fibrosis.

.....

.....

.....

.....

.....

.....

(3 marks)

(b) People with cystic fibrosis produce mucus which is stickier and thicker than healthy people. Suggest why people with cystic fibrosis are more likely to develop bacterial infections, such as pneumonia.

.....

.....

.....

.....

(2 marks)

LEAVE MARGIN BLANK

(c) Describe **one** way in which normal genes might be introduced into the cells lining the airways of the lungs.

.....

.....

.....

.....

.....

.....

.....

.....

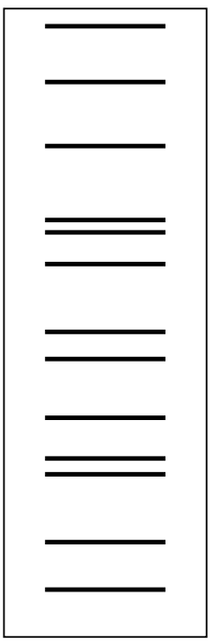
(4 marks)

9

TURN OVER FOR THE NEXT QUESTION

Question 8 should be answered in continuous prose.
Quality of Written Communication will be assessed in these answers.

8 DNA fingerprinting can be used to identify an individual from a small spot of blood. The diagram shows a DNA fingerprint.



(a) After the DNA has been extracted from the blood, it is copied by the polymerase chain reaction (PCR). The DNA is then cut into fragments, which are separated by electrophoresis. Describe the main stages in the copying, cutting and separation of the DNA.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(6 marks)

(b) The position of the fragments is determined by the use of radioactive probes. These probes consist of short lengths of DNA with specific base sequences, which bind onto the fragments. Suggest why several different probes have to be used to produce a DNA fingerprint with a large number of bands.

.....

.....

.....

.....

(2 marks)

8

END OF QUESTIONS

QWC

1