Surname		Other Names	
Centre Number			Candidate Number									
Candidate Signature												

For Examiner's Use

General Certificate of Education
June 2008
Advanced Subsidiary Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

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

Tuesday 3 June 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 black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. **Answers written in margins or on blank pages will not be marked**.
- If you need extra space use page 16 for your answers.
- 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 **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			
Question	Mark	Question	Mark
1			
2			
3			
4			
5			
6			
7			
Total (Column 1) →			
Quality of Written Communication			
TOTAL			
Examiner's Initials			

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

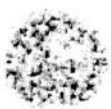
Answer **all** questions in the spaces provided.

1 The photographs show chromosomes during the stages of mitosis.

P

Q

R



S

T

1 (a) (i) Put the stages into the correct sequence. The first stage has been done for you.

R				

(1 mark)

1 (a) (ii) Name stages **Q** and **T**.

Q .....

T .....

(2 marks)

1 (b) Describe **two** events that occur during interphase which prepare a cell for mitosis.

1 .....

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2 .....

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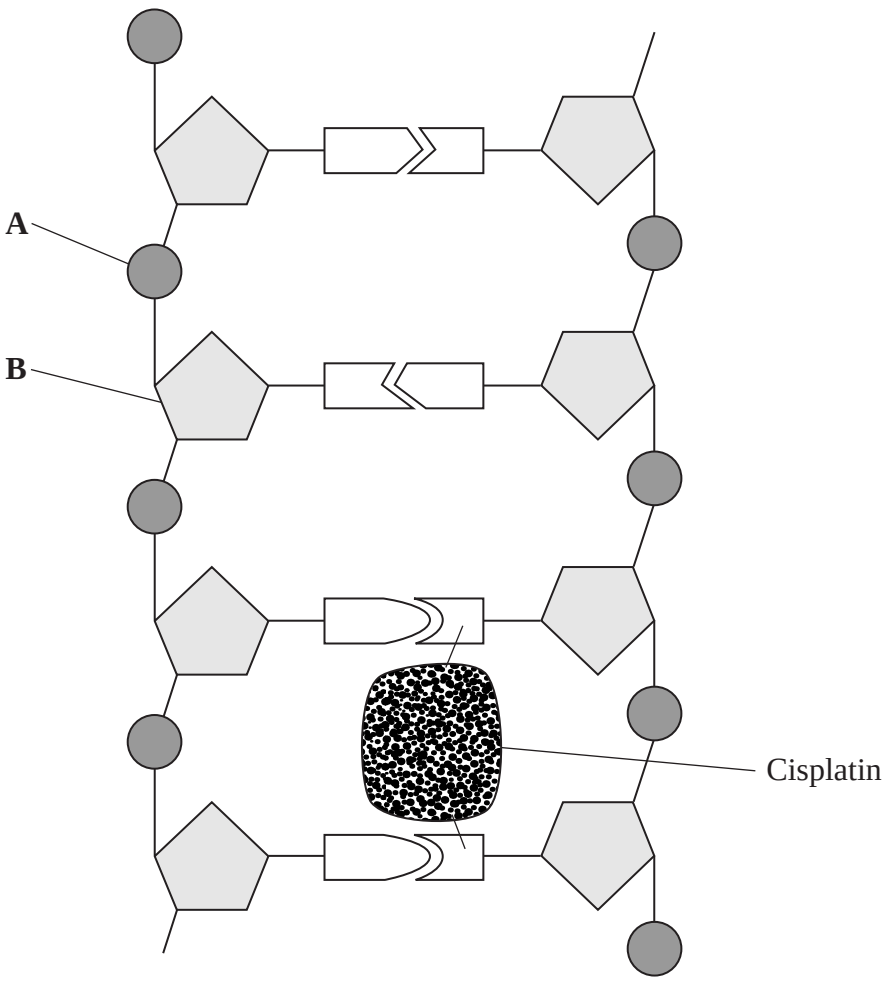
(2 marks)

5

2 Cancer cells divide much more often than normal cells. Cisplatin is a substance used to treat some forms of cancer. Inside cells, each cisplatin molecule forms two chemical bonds with a DNA molecule.

The diagram shows part of a DNA molecule with cisplatin attached.



2 (a) (i) Name **A** and **B**.

A .....

B ..... *(1 mark)*

2 (a) (ii) With which parts of the DNA molecule does cisplatin form chemical bonds?

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(2 marks)

2 (b) Cisplatin inhibits the division of cancer cells. Suggest how.

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(3 marks)

(Extra space) .....

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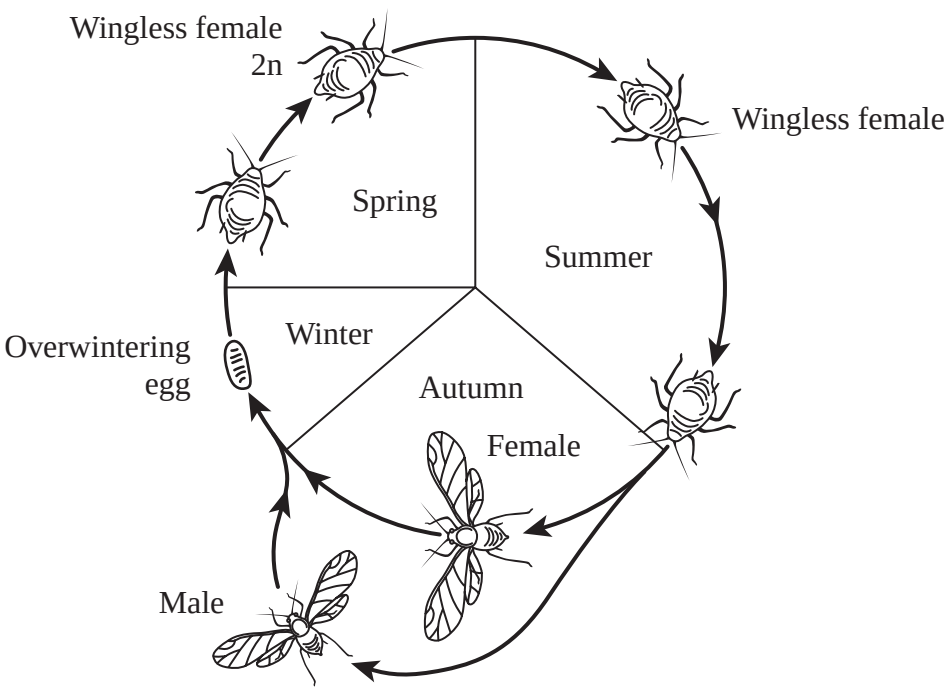
6

Turn over for the next question

3 Aphids are small insects that feed on plants. They have an unusual life cycle because, at different times of year, females either lay eggs or give birth to live young.

In autumn, adult male and female aphids mate and the females lay eggs on suitable food plants. In temperate climates, the low temperatures of winter kill the adults but the eggs survive. In spring, these eggs hatch into wingless female aphids. Without any mating or fertilisation of their eggs, these females give birth to live young, all of which are wingless females. Many generations of wingless females are produced in this way throughout the spring and summer. In autumn, a change in daylength causes the females to give birth to young males as well as to more young females. Unlike their mothers, these males and females have wings. It is these winged males and females which mate.

The diagram shows the life cycle of an aphid.



3 (a) Put an **M** on the diagram to indicate where meiosis occurs. *(1 mark)*

3 (b) (i) Suggest **one** advantage to the aphid of producing wingless females.

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(2 marks)

3 (b) (ii) Suggest **one** advantage to the aphid of producing males and females with wings in the autumn.

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(2 marks)

3 (c) Name **two** features of asexual reproduction. For each feature, suggest how it is an advantage to the aphid.

Feature .....

Advantage .....

.....

Feature .....

Advantage .....

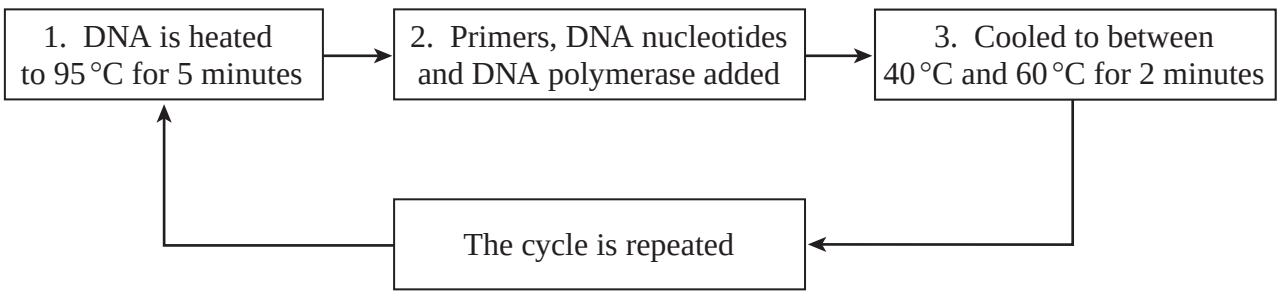
.....

(2 marks)

7

Turn over for the next question

4 (a) The polymerase chain reaction (PCR) can be used to make many copies of a gene. The diagram shows the main stages in the process.



4 (a) (i) Explain why primers are added.

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(1 mark)

4 (a) (ii) The DNA is cooled to between 40 °C and 60 °C. Explain why.

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(1 mark)

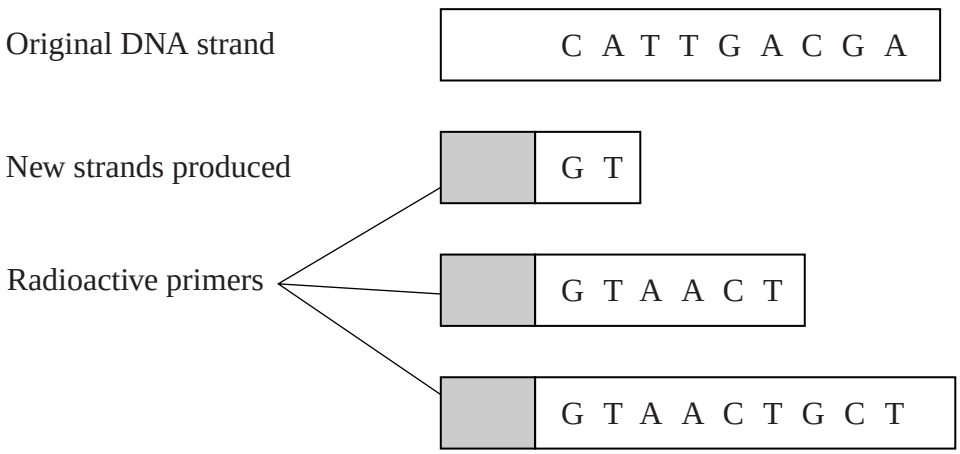
4 (b) How many cycles of the PCR would be needed to produce 128 molecules of DNA from a single DNA molecule?

Answer .....

(1 mark)

4 (c) The sequence of nucleotides in a sample of DNA can be found using a method involving the PCR followed by electrophoresis. In this method, the primers used in the PCR are radioactively labelled and some of the nucleotides are chemically altered.

The diagram shows a single strand of DNA and the copies produced by the PCR using a mixture of DNA nucleotides where some of the thymine-containing nucleotides were chemically altered.



4 (c) In this method, explain the use of

4 (c) (i) radioactive primers

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(1 mark)

4 (c) (ii) electrophoresis.

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(1 mark)

4 (d) Explain why three different lengths of new strand were produced.

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(2 marks)

7

5 **Table 1** shows the first 12 bases on the coding strand of a DNA molecule.

Table 1

DNA	G	C	C	T	A	C	A	A	C	G	C	T
RNA												

Table 2 shows the DNA triplets for four amino acids.

Table 2

DNA triplets	**Amino acid coded for**
GCG, GCC, GCA, GCT	arg
AAT, AAC	leu
TAA, TAG, TAT	iso
TAC	met

5 (a) Complete **Table 1** to show the **first five** bases on the messenger RNA produced by transcription of this DNA. *(1 mark)*

5 (b) Give the amino acid sequence which is coded for in the **DNA** sequence given in **Table 1**.

(1 mark)

5 (c) Substitution is a type of gene mutation. Use the information in **Table 2** to explain the effect on the amino acid sequence of

5 (c) (i) substitution of the **third** DNA base in **Table 1**

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(2 marks)

(Extra space) .....

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5 (c) (ii) substitution of the **sixth** DNA base in **Table 1**.

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(2 marks)

(Extra space) .....

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5 (d) Explain why a mutation involving the deletion of a base might have a greater effect than a mutation involving the substitution of one base for another.

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(2 marks)

(Extra space) .....

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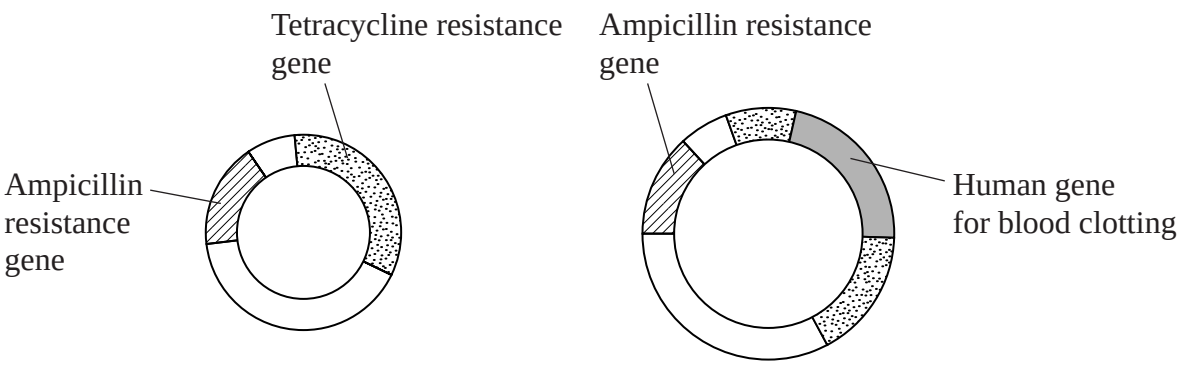
8

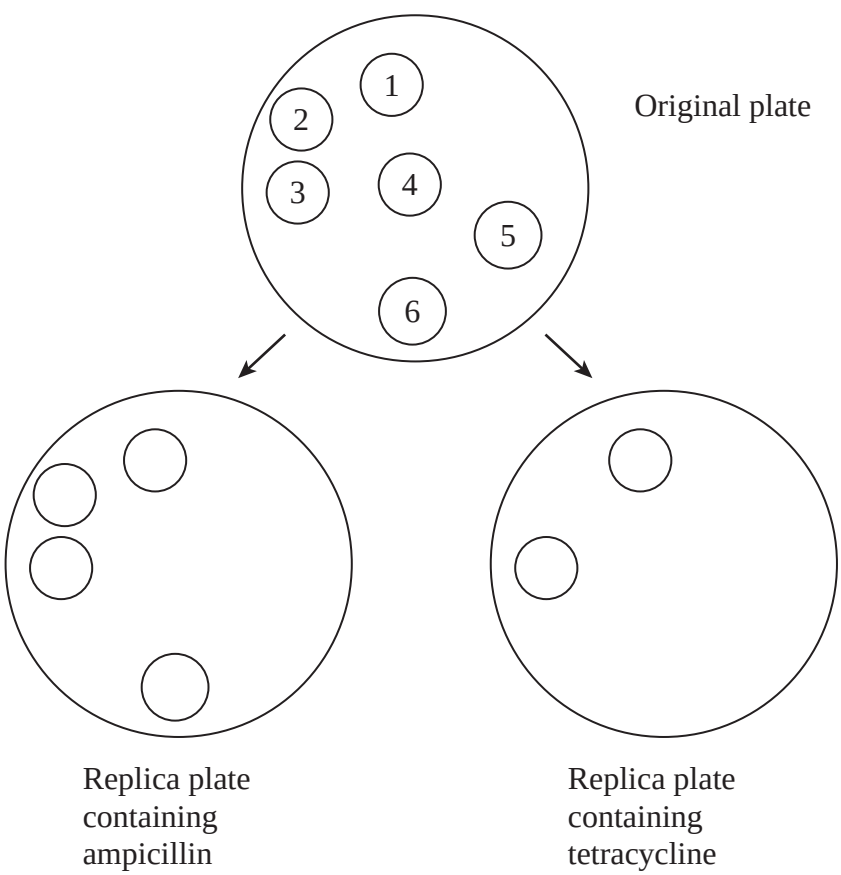
6 In genetic engineering, genes for antibiotic resistance in bacterial plasmids can be used as genetic markers. Scientists used a plasmid containing genes for resistance to two antibiotics, ampicillin and tetracycline. They inserted the human gene for blood clotting in the plasmid in the position shown in **Figure 1**.

Figure 1



Plasmids were then inserted into bacteria. Some of the plasmids did not take up the human gene. Replica plating was used to identify the bacteria with the human gene. **Figure 2** shows the bacterial colonies that grew on two replica plates.

Figure 2



6 (a) (i) Name the type of enzyme which is used to cut the plasmid.

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(1 mark)

6 (a) (ii) Name the type of enzyme which is used to join the plasmid to the human gene for blood clotting.

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(1 mark)

6 (b) (i) Complete **Figure 2** by writing the correct numbers for the bacterial colonies on the replica plates.

(1 mark)

6 (b) (ii) Explain the results of the replica plate containing ampicillin.

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(2 marks)

(Extra space) .....

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6 (b) (iii) Explain the results of the replica plate containing tetracycline.

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(3 marks)

(Extra space) .....

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8

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

1 .....

2 .....

(2 marks)

7 (b) Cystic fibrosis is caused by a mutation of the gene producing the protein CFTR. Explain how the presence of this altered protein results in the production of thick, sticky mucus and how this accounts for the symptoms of the disease.

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(6 marks)

(Extra space) .....

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7 (c) Describe **two** techniques that could be used to introduce functional CFTR genes into someone with cystic fibrosis.

1 .....

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2 .....

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(4 marks)

12

END OF QUESTIONS

QWC

1

If you need extra space use this page for your answers.