Surname		Other Names	
Centre Number			Candidate Number									
Candidate Signature												

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General Certificate of Education
January 2006
Advanced Subsidiary Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

BIOLOGY (SPECIFICATION A) **BYA2**
Unit 2 Making Use of Biology

Tuesday 10 January 2006 9.00 am to 10.30 am

For this paper you must have:
- a ruler with millimetre measurements

You may use a calculator.

Time allowed: 1 hour 30 minutes

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 marked.

Information

- The maximum mark for this paper is 75.
- The marks for questions are shown in brackets.
- You are reminded of the need for good English and clear presentation in your answers.
- Use accurate scientific terminology in all your answers.

For Examiner's Use			
Number	Mark	Number	Mark
1		9	
2			
3			
4			
5			
6			
7			
8			
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

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

1 (a) In which phase of the cell cycle does DNA replication take place?

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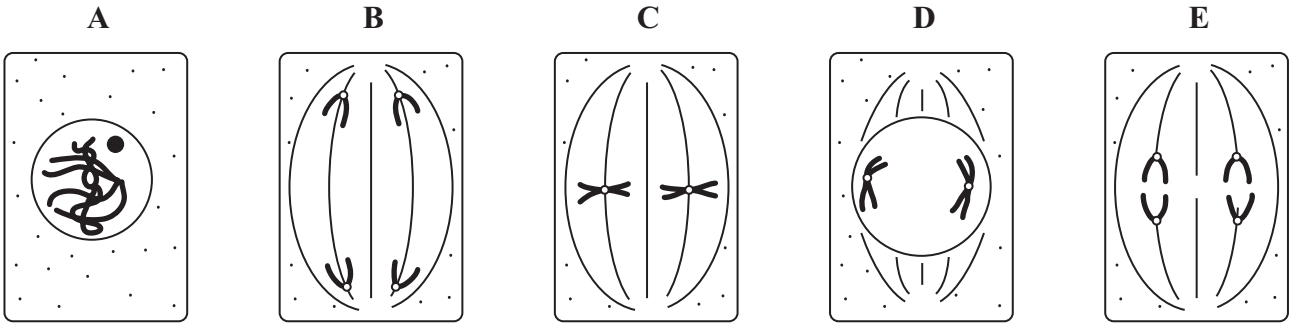
(1 mark)

(b) The diagrams show five stages of mitosis.



List the stages **A** to **E** in the correct sequence, beginning with the earliest stage.

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(1 mark)

(c) Describe the role of the spindle during mitosis.

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(2 marks)

(d) Meiosis also occurs during the life cycle of organisms. What is the importance of meiosis?

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(2 marks)

6

2 Rice is grown in wet conditions. Rice stems contain hollow aerenchyma.

(a) Explain how aerenchyma is an advantage to rice plants.

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(2 marks)

A strain of rice called 'golden rice' has been genetically modified to carry an extra gene. Golden rice produces more vitamin A than ordinary rice.

(b) Describe how this extra gene could be introduced into a cell of a rice plant.

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(1 mark)

(c) (i) When genes are introduced into cells, antibiotic resistance genes are often added as well. Explain the reason for this.

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(2 marks)

(ii) Some scientists are concerned about the use of antibiotic resistance genes in genetic engineering. Suggest why.

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(2 marks)

7

3 Bovine somatotropin (BST) is a hormone used by some farmers in the USA to increase milk yield.

(a) BST has a number of effects. One of these is to increase the rate of mitosis. Explain how an increase in the rate of mitosis increases milk yield in cows.

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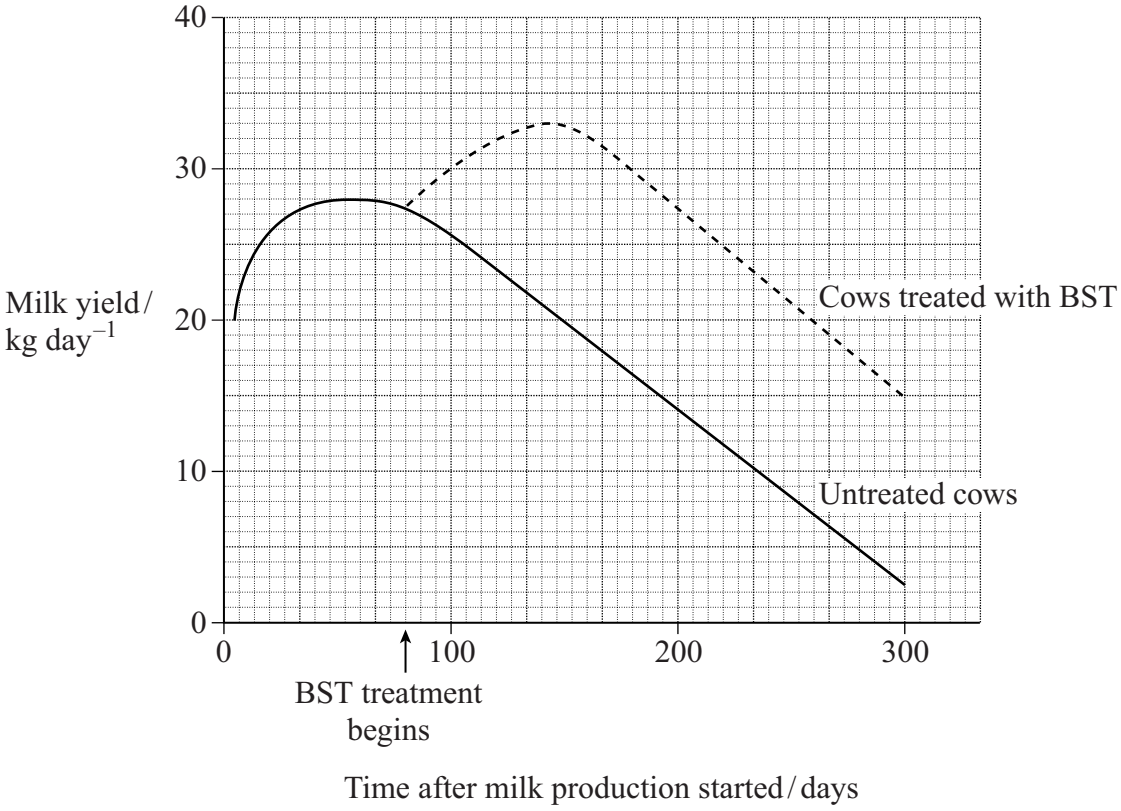
(2 marks)

(b) The graph shows the results of an investigation into the effect of BST on milk yield in cows.



(i) Calculate the percentage increase in yield at 150 days due to the use of BST. Show your working.

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

(ii) Explain why the percentage increase in yield due to BST is greater at 250 days than at 200 days.

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(2 marks)

(c) Although BST increases milk yield in cattle, some dairy farmers in the USA do not use it. Suggest **one** explanation for this.

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(1 mark)

7

Turn over for the next question

4 Phytic acid is found in plant material. The enzyme phytase releases phosphate from phytic acid. Phytase is sometimes added to plant material in animal feed to increase the amount of phosphate available in an animal's diet.

Phytase is an intracellular enzyme. It is produced commercially by microorganisms. The microorganisms are cultured in aseptic conditions.

(a) (i) Explain why the microorganisms are cultured in aseptic conditions.

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(1 mark)

(ii) Describe how enzymes such as phytase are isolated and purified during downstream processing.

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(3 marks)

(b) Chemical treatment may also be used to release phosphate from plant material used in animal feed. Suggest and explain **one** advantage, other than cost, of using an enzyme to release phosphate.

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(2 marks)

(c) Adding phytase to animal feed also results in the animals' faeces containing less phosphate. Suggest how reducing the concentration of phosphate in animal faeces might be considered environmentally friendly.

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(2 marks)

8

Turn over for the next question

5 (a) What is an antigen?

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(2 marks)

(b) Samples of blood of each group, A, B, AB and O were tested with anti-A and anti-B antibodies. In some of the samples this resulted in agglutination. The results of the tests with blood group A are shown in the diagram.

Blood group	**A**	**B**	**AB**	**O**
Appearance with anti-A antibodies	✓			
Appearance with anti-B antibodies	×			

Key ✓ Agglutination

× No agglutination

Complete the diagram with a tick or a cross to show the results you would expect for blood groups B, AB and O.

(3 marks)

5

6 The table shows the sequence of bases on part of the coding strand of DNA.

Base sequence on coding strand of DNA	**C**	**G**	**T**	**T**	**A**	**C**
Base sequence of mRNA						

(a) Complete the table to show the base sequence of the mRNA transcribed from this DNA strand.

(2 marks)

(b) A piece of mRNA is 660 nucleotides long but the DNA coding strand from which it was transcribed is 870 nucleotides long.

(i) Explain this difference in the number of nucleotides.

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(1 mark)

(ii) What is the maximum number of amino acids in the protein translated from this piece of mRNA? Explain your answer.

Number of amino acids .....

Explanation .....

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(2 marks)

(c) Complete the table to give **two** differences between the structure of mRNA and the structure of tRNA.

mRNA	**tRNA**

(2 marks)

7

7 An investigation was carried out into the effect of carbon dioxide concentration and light intensity on the rate of photosynthesis in a species of plant.

(a) The temperature was kept constant during this investigation. Explain why.

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(2 marks)

(b) The table shows the effect of increasing carbon dioxide concentration on the rate of photosynthesis in maize.

Carbon dioxide concentration / arbitrary units	**Rate of photosynthesis / arbitrary units**
30	10
60	20
100	30
150	40
230	50
300	60
400	60

Describe and explain the effect of increasing carbon dioxide concentration on the rate of photosynthesis.

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(3 marks)

5

8 Purple loosestrife is a plant which grows in Europe. It was introduced into the USA where it became a pest.

(a) Suggest why purple loosestrife became a pest when it was introduced into the USA, but is not a pest in Europe.

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(2 marks)

(b) A European beetle was tested to see whether it could be used for the biological control of purple loosestrife in the USA. In an investigation, beetles were released in an area where purple loosestrife was a pest. The table shows some of the results.

Time after releasing beetles / years	Mean number of purple loosestrife stems per square metre	Mean number of beetles per square metre
1	22	5
2	8	40
3	6	68
4	7	62

Are the beetles effective in controlling purple loosestrife? Give evidence from the table to support your answer.

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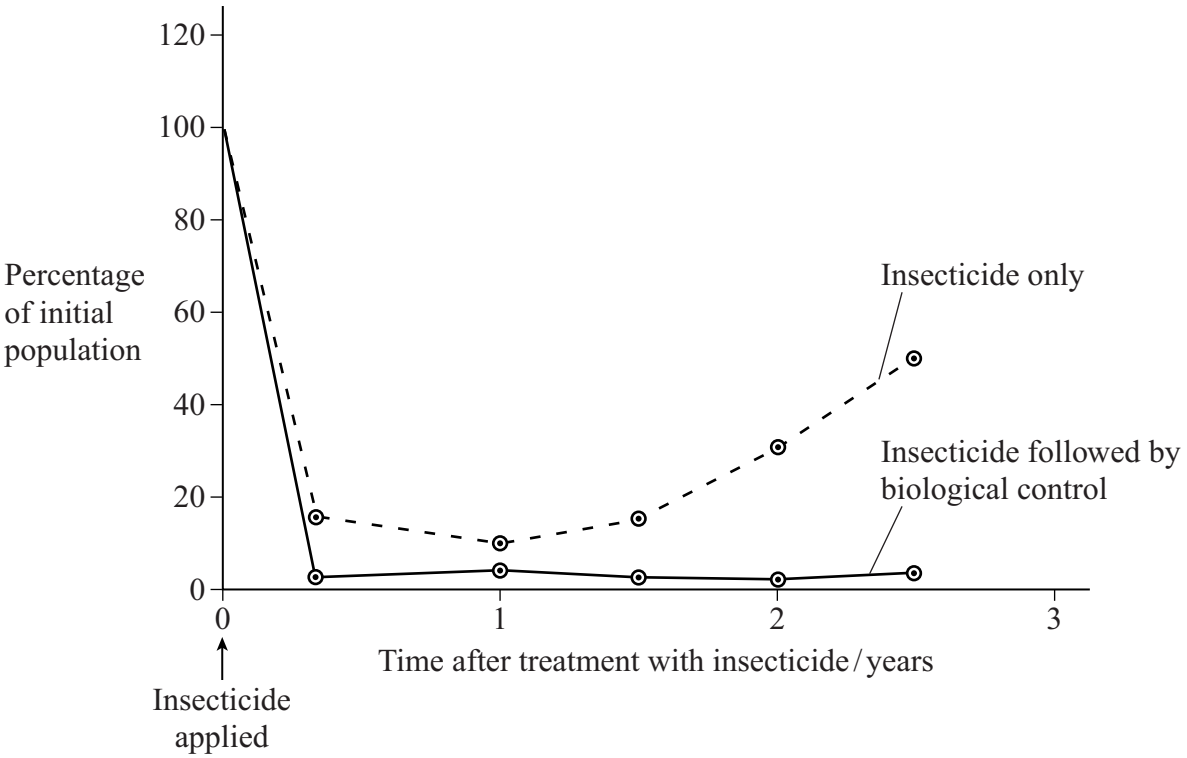
(2 marks)

Question 8 continues on the next page

(c) Fire-ants are a serious pest in parts of the USA. An investigation was carried out to find the best way to control the fire-ant population. The graph shows the results of this investigation.



(i) Describe the effect of using insecticide followed by biological control.

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(2 marks)

(ii) Explain the change in fire-ant population over the period when they were treated with an insecticide alone.

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(3 marks)

(d) Give the advantages and disadvantages of using biological control.

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(6 marks)

15

Turn over for the next question

9 Read the following passage.

The giant panda is one of the rarest animals in the world and is considered to be on the brink of extinction in the wild. Giant pandas have been kept and bred in zoos with the hope that they could be released into the wild. One worry is that small populations, like those in zoos, reduce the genetic variation needed to allow the species to adapt to changing conditions.

Unfortunately, pandas find it difficult to reproduce in captivity. Fertilisation of the females is guaranteed only by insemination with semen from several males. With so many potential fathers, the true paternity of the cubs is not clear. It is important to identify the fathers to maintain genetic variation.

Panda faeces can be collected in the wild. The faeces contain DNA from the panda, from the bamboo on which they feed and from bacteria. The DNA is subjected to the polymerase chain reaction (PCR). The primers used attach only to the panda DNA. The resulting DNA is subjected to genetic fingerprinting. This can help us to count the number of individuals in the wild because it allows us to identify individual pandas.

Use information in the passage and your own biological knowledge to answer the questions.

(a) Describe how genetic fingerprinting may be carried out on a sample of panda DNA.

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(6 marks)

(b) (i) Explain how genetic fingerprinting allows scientists to identify the father of a particular panda cub.

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(2 marks)

(ii) When pandas are bred in zoos, it is important to ensure only unrelated pandas breed. Suggest how genetic fingerprints might be used to do this.

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(1 mark)

(c) (i) Suggest why panda DNA is found in faeces. (line 10)

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(1 mark)

(ii) Explain why the PCR is carried out on the DNA from the faeces. (line 12)

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(1 mark)

(iii) Explain why the primers used in the PCR will bind to panda DNA, but not to DNA from bacteria or bamboo. (line 12)

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(2 marks)

Question 9 continues on the next page

(d) DNA from wild pandas could also be obtained from blood samples. Suggest **two** advantages of using faeces, rather than blood samples, to obtain DNA from pandas.

1 .....

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2 .....

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(2 marks)

15

END OF QUESTIONS