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 A) **BYA2**
Unit 2 Making Use of Biology

Wednesday 10 January 2007 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 to be marked.

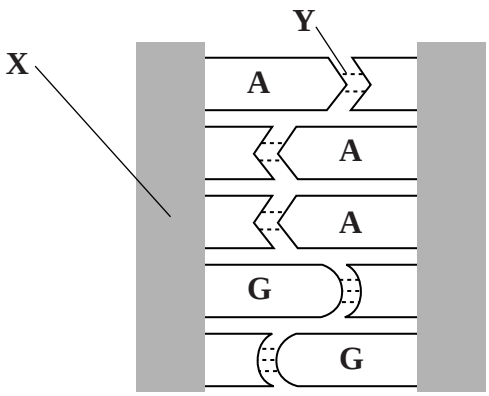
Information

- The maximum mark for this paper is 75.
- The marks for questions are shown in brackets.
- You will be marked on your ability to use good English, to organise information clearly and to use accurate scientific terminology where appropriate.

For Examiner's Use			
Question	Mark	Question	Mark
1			
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) The diagram shows a section of a DNA molecule.



(i) The letters **A** and **G** represent the bases adenine and guanine. Complete the diagram by writing in the first letters of the remaining bases.

(1 mark)

(ii) Name the **two** components of part **X**.

..... and .....

(2 marks)

(iii) Name the type of bond found at **Y**.

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(1 mark)

(b) DNA is an information storage molecule.

(i) The organic bases present in DNA allow DNA to store information about the sequence of amino acids in a protein. Explain how.

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(2 marks)

(ii) DNA molecules are double–stranded. Suggest **one** way in which this allows DNA to store information effectively.

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(1 mark)

2 (a) What is an antigen?

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(2 marks)

(b) Three blood samples were tested by mixing each one with anti-A and anti-B antibodies. Complete the table to show whether agglutination occurred or not. Put a tick when agglutination did occur. Put a cross when agglutination did not occur.

		Blood group of sample		
		A	**AB**	**O**
Antibody added	**Anti-A**			
	Anti-B			

(3 marks)

(c) Paternity cases involve identifying the father of a particular child. Genetic fingerprinting is more useful in determining paternity than using blood groups. Explain why genetic fingerprinting is more useful.

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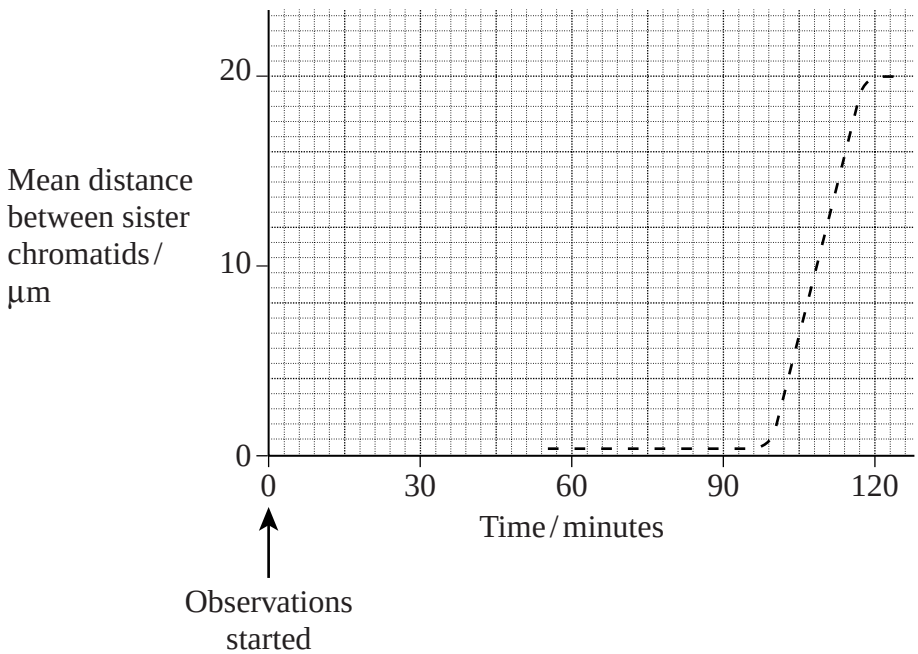
(2 marks)

7

3 An investigator observed a cell during part of one cell cycle. The graph shows the mean distance between sister chromatids.



(a) (i) At what time did anaphase start?

..... minutes *(1 mark)*

(ii) Explain the evidence from the graph that supports your answer.

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(2 marks)

(b) The investigator was not able to obtain measurements between 0 and 60 minutes. Use your knowledge of the cell cycle to explain why.

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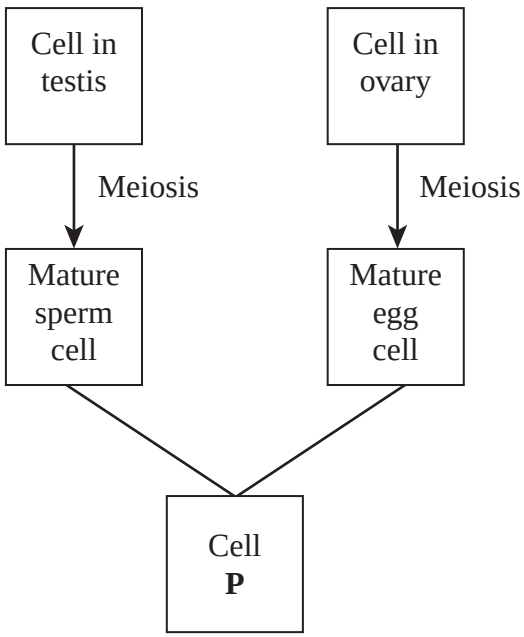
(2 marks)

(c) The diagram summarises gamete formation and fertilisation in humans.



(i) Name cell **P**.

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(1 mark)

(ii) Meiosis halves the chromosome number. Explain why this is important.

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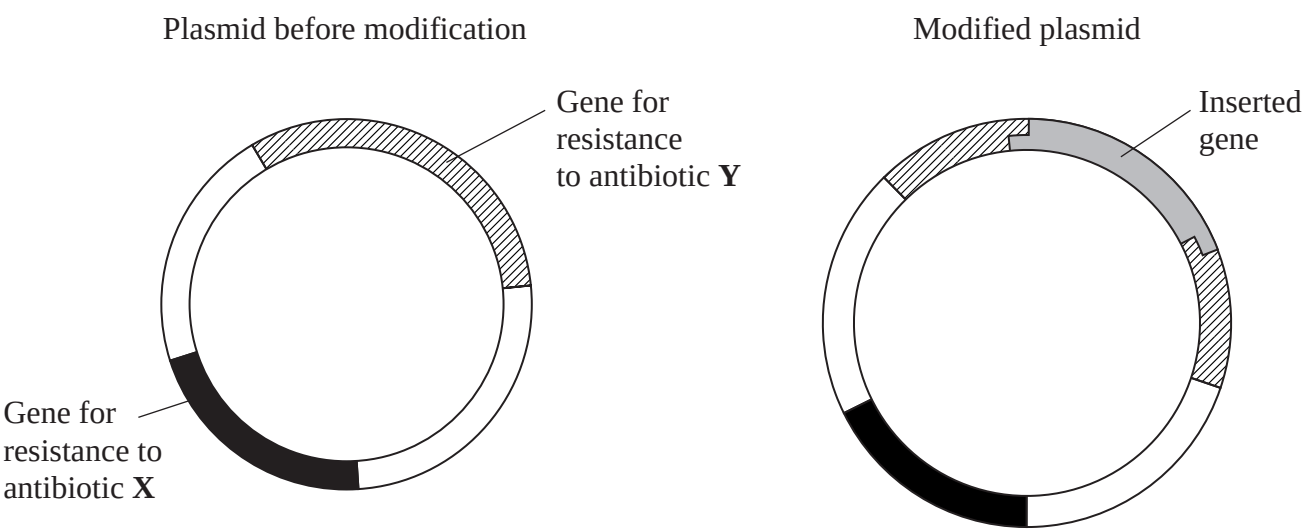
(1 mark)

7

Turn over for the next question

4 The diagram shows

- a plasmid that contains two genes for resistance to antibiotic before modification
- the same plasmid after it has been modified by inserting a gene from another organism.



(a) Two different enzymes are required to produce the modified plasmid. Name these **two** enzymes. Describe the function of each in producing the modified plasmid.

Enzyme 1 .....

Function .....

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Enzyme 2 .....

Function .....

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(2 marks)

(b) Bacteria took up the modified plasmids. Explain why these bacteria were

(i) resistant to antibiotic **X**,

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(1 mark)

(ii) not resistant to antibiotic **Y**.

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(2 marks)

5

Turn over for the next question

5 The table shows the results of an investigation into the effects of fertiliser on grain yield in a tropical area of India.

Crop	Grain yield / kg ha^{-1}	
	Control	**NPK fertiliser added**
Maize	258	3224
Wheat	396	2609

(a) How should the control crops have been treated?

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(2 marks)

(b) (i) Calculate the percentage increase in grain yield of maize when NPK fertiliser is added compared with the control. Show your working.

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

(ii) When NPK fertiliser was added to maize the increase in grain yield was greater than when it was added to wheat. Suggest **one** explanation for this.

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(2 marks)

(c) When a greater amount of NPK fertiliser was added the yield of maize only increased slightly.
Suggest an explanation for the increase only being slight.

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(1 mark)

(d) The fertiliser added in this investigation was inorganic.
Give **two** advantages, apart from reduction in smell, of using inorganic fertiliser rather than organic fertiliser.

1. .....

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2. .....

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(2 marks)

9

Turn over for the next question

6 Over many years, the water flowing into a lake contained low concentrations of a pesticide. This led to very high concentrations of the pesticide in some species of fish.

(a) The pesticide reached a very high concentration in these species of fish. Explain how.

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(3 marks)

(b) Perch and pike are two species of fish that live in the lake. Perch feed on plants. Pike eat other fish. People can safely eat perch but are advised not to eat pike. Explain why.

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(1 mark)

(c) Although large pike from this lake should not be eaten, it is usually safe to eat small pike.
Suggest why.

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(2 marks)

(d) Crop pests can be controlled by pesticides and by biological control. Integrated pest control combines both these methods. Explain the advantages of integrated pest control.

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(4 marks)

10

Turn over for the next question

7 Read the following passage.

β-galactosidase is an enzyme which catalyses the reaction

$$\text{lactose} + \text{water} \rightarrow \text{glucose} + \text{galactose}$$

This enzyme can be immobilised in a biosensor and used to detect the presence of lactose in milk samples.

β-galactosidase is secreted by some fungi as an extracellular enzyme. β-galactosidase from this source only works at low temperatures.

If a thermostable form of β-galactosidase could be obtained, it could be used, in the dairy industry, to hydrolyse lactose at high temperatures. Some bacteria which live in hot springs produce a thermostable β-galactosidase, which works at high temperatures. These bacteria are expensive to culture for commercial purposes. The gene for thermostable β-galactosidase could be obtained using mRNA from these bacteria. The gene could then be inserted into a microorganism that is cheaper to culture on an industrial scale.

Use information from the passage and your own knowledge to answer the following questions.

(a) Explain why β-galactosidase only catalyses the reaction shown (lines 1–2).

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(2 marks)

(b) Enzymes used in industrial processes are often immobilised. Give **two** advantages of immobilising these enzymes.

1. .....

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2. .....

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(2 marks)

(c) (i) What is meant by an *extracellular* enzyme (line 5)?

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(1 mark)

(ii) Extracellular enzymes are usually cheaper to obtain than other enzymes. Suggest why.

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(1 mark)

(d) Bacteria that produce a thermostable β-galactosidase are expensive to culture (line 10). Suggest why.

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(1 mark)

(e) The gene for thermostable β-galactosidase could be obtained using mRNA from the bacteria which live in hot springs (lines 11–12).
Describe how.

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(2 marks)

Question 7 continues on the next page

(f) A protein such as β-galactosidase is synthesised from the gene that codes for it. Describe how.

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(6 marks)

15

8 (a) Hormones are involved in the development of follicles and ovulation. Describe how.

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(6 marks)

Recombinant FSH (rFSH) and clomiphene are two drugs used to treat women who are infertile because they do not ovulate.

(b) rFSH is a protein. Suggest why rFSH would not be effective if it were taken orally.

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(2 marks)

Question 8 continues on the next page

(c) (i) rFSH injection might help to cause ovulation in a woman who was infertile. Explain how.

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(2 marks)

(ii) Clomiphene blocks the action of oestrogen. Suggest how treatment with clomiphene might cause ovulation.

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(2 marks)

(d) A trial was carried out on the effectiveness of these two drugs. The table shows some of the results of this trial.

	Drug used	
	Recombinant FSH	**Clomiphene**
Number of women treated with drug	200	1 450
Number of pregnancies following treatment	53	56
Total cost of drug used in trial / £	28 000	50 750

Which of the two drugs used in this trial was the more effective? Use suitable calculations based on the data in the table to support your answer.

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(3 marks)

END OF QUESTIONS