Surname		Other Names	
Centre Number			Candidate Number	
Candidate Signature			

For Examiner's Use

General Certificate of Education
January 2008
Advanced Subsidiary Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

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

Wednesday 9 January 2008 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		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) (i) Where in an animal cell does transcription occur?

.....

(1 mark)

(ii) The table contains statements about DNA replication and transcription. Put a tick in the box if the statement is true, or a cross if the statement is not true.

Statement	DNA replication	Transcription
Involves mRNA synthesis		
Requires free nucleotides		
Involves complementary base pairing		

(2 marks)

(b) A DNA molecule contains 2500 guanine bases and 3500 thymine bases. How many deoxyribose molecules does it contain? Explain your answer.

Number of deoxyribose molecules .....

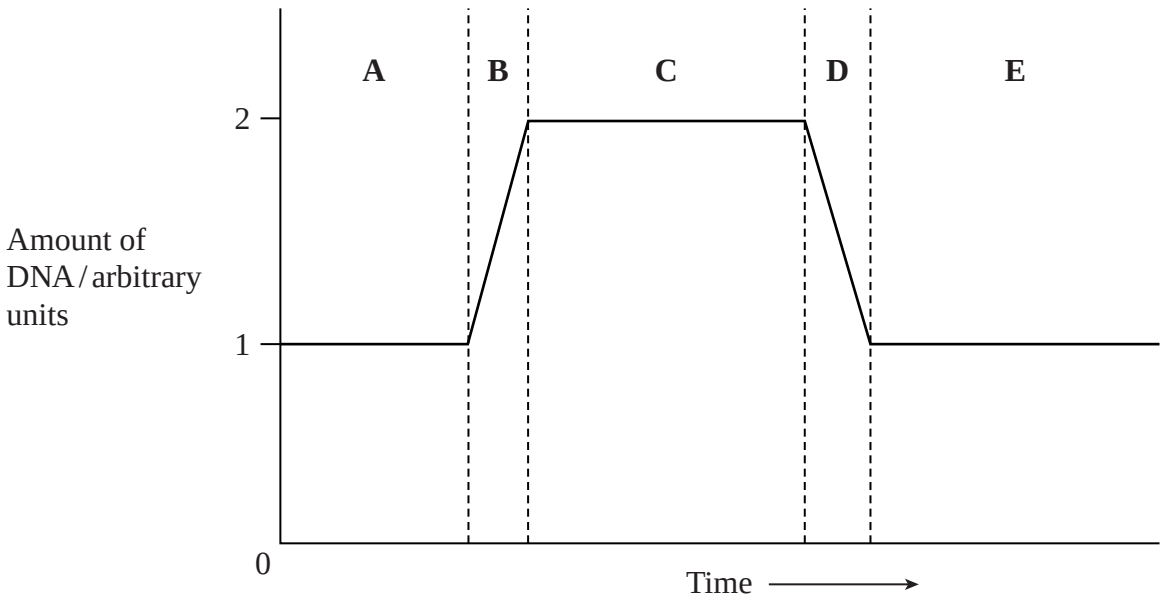
Explanation .....

.....

(2 marks)

5

2 The graph shows changes in the amount of DNA in a cell during one cell cycle.



(a) Name the phase of the cell cycle that occurs during time period **B**.

.....

(1 mark)

(b) Many drugs that are used to treat cancer work at different time periods during the cell cycle.

(i) Cisplatin binds to DNA, and stops free DNA nucleotides joining together. In which time period, **A** to **E**, would you expect cisplatin to have the greatest effect? Explain your answer.

Time period .....

Explanation .....

.....

(2 marks)

(ii) A different drug stops spindle fibres shortening. This drug has its greatest effect during time period **D**. Explain why.

.....

.....

.....

.....

(2 marks)

3 Alzheimer's disease affects the brain and causes serious mental deterioration. In this disease, a small protein called beta-amyloid is produced in large amounts. A new DNA vaccine has been developed. Scientists hope that the vaccine will protect people against Alzheimer's disease by destroying the beta-amyloid protein.

Scientists know the amino acid sequence in beta-amyloid. They used this information to produce DNA that codes for beta-amyloid. This DNA is injected into muscle cells, which use the DNA to produce beta-amyloid. This stimulates the production of antibodies against beta-amyloid. 5

(a) Scientists know the amino acid sequence in beta-amyloid. Explain how they can use this information to produce DNA that codes for beta-amyloid (lines 5 and 6).

.....

.....

.....

.....

.....

.....

(3 marks)

(b) (i) What is an antibody?

.....

.....

.....

.....

(2 marks)

(ii) Beta-amyloid produced by muscle cells causes antibodies to be made. Describe how.

.....

.....

.....

.....

.....

.....

.....

.....

(4 marks)

4 A particular species of fish contains an antifreeze protein. When the antifreeze protein is added to ice cream, it improves the texture.

(a) The gene for this antifreeze protein was inserted into microbial cells. Explain the role of each of the following in this process.

(i) DNA ligase .....

.....

(1 mark)

(ii) Plasmids .....

.....

.....

.....

(2 marks)

(iii) A marker gene .....

.....

(1 mark)

(b) The genetically modified microbial cells were grown in large numbers in a fermenter. Describe how.

.....

.....

.....

.....

.....

.....

(3 marks)

7

5 (a) Women who do not ovulate are infertile. They may be treated with daily injections of FSH. Each day the concentration of oestrogen in the woman's blood is measured. When the oestrogen reaches a certain concentration, an injection of LH is given.

(i) The concentration of oestrogen rises in a woman receiving FSH injections. Explain why.

.....

.....

.....

.....

(2 marks)

(ii) Explain why the injection of LH is given.

.....

.....

(1 mark)

(b) FSH is extracted from the urine of menopausal women. The menopause is when a woman's menstrual cycle stops during middle age. By this time, menopausal women have few follicles left in their ovaries. These women have large amounts of FSH in their urine.
Explain why these women have large amounts of FSH in their urine.

.....

.....

.....

.....

(2 marks)

5

6 Scientists have discovered that some fungi produce an extracellular enzyme called laccase. The substrate of this enzyme is lignin, a substance found in wood fibre. Laccase can be used to stick wood fibres together to make fibreboard.

(a) The fungus is grown in a large fermenter.
Describe how a pure sample of laccase could be obtained from the contents of the fermenter.

.....

.....

.....

.....

(2 marks)

(b) Fibreboard is usually made by mixing small pieces of wood fibre with a chemical glue.
Explain **two** advantages of using laccase rather than a chemical glue.

1 .....

.....

2 .....

.....

(2 marks)

(c) In some industrial processes, enzymes are immobilised. Give **three** advantages of using immobilised enzymes rather than enzymes that are not immobilised.

1 .....

.....

2 .....

.....

3 .....

.....

(3 marks)

7

7 Scientists obtained very small amounts of DNA from the fossilised jawbone of a mammoth that died 27 000 years ago. They used this DNA in the polymerase chain reaction (PCR).

(a) Explain why the PCR was necessary.

.....

.....

(1 mark)

(b) Name **two** substances, other than primers, that should be added to the mammoth DNA for the PCR to take place.

1 .....

2 .....

(2 marks)

(c) The mammoth DNA might have been contaminated with other DNA. Explain how the use of primers in the PCR ensured that only mammoth DNA was produced.

.....

.....

.....

.....

(2 marks)

(d) The scientists found that the DNA of the mammoth was very similar to that of modern African elephants. Suggest how they found this out.

.....

.....

.....

.....

(2 marks)

7

8 (a) Describe and explain how sorghum and maize are adapted to growing in hot conditions.

.....

.....

.....

.....

.....

.....

.....

.....

.....

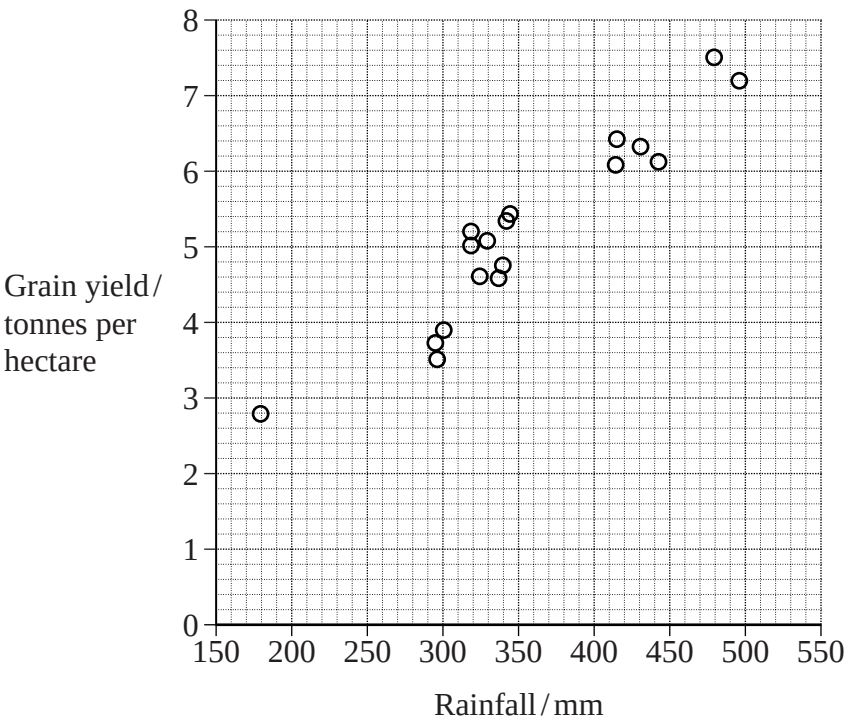
.....

.....

(6 marks)

Question 8 continues on the next page

A group of students collected data about the effect of rainfall on the yield of sorghum grain. The data are for 2001 and came from different plots of land in one state in the USA.



(b) (i) Use the graph to predict the yield of sorghum grain when the rainfall was 380 mm. Explain how you arrived at your answer.

.....

.....

.....

.....

(2 marks)

(ii) The students used these data to conclude that higher rainfall causes a greater yield of sorghum grain. Is this a valid conclusion? Explain your answer.

.....

.....

.....

.....

.....

.....

(3 marks)

(c) The table shows the effect of adding nitrogen fertiliser on the yields of three different cereal crops in the USA.

Crop	Mean yield of grain / tonnes ha^{-1}	
	Without nitrogen fertiliser	**With nitrogen fertiliser**
Maize	4.4	8.2
Sorghum	3.8	4.6
Wheat	1.8	2.2

(i) Calculate the percentage increase in yield of maize when nitrogen fertiliser was added. Show your working.

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

(ii) Nitrogen fertiliser has a different effect on each crop. Suggest an explanation for this different effect.

.....

.....

.....

.....

(2 marks)

15

9 The carp is a freshwater fish. It was introduced to Australia, where it became a pest.

Scientists are trying to control the carp by using gene technology. They have inserted a gene into carp embryos that prevents the production of an enzyme, aromatase. The inserted gene causes female embryos to develop as males.

The inserted gene produces mRNA with a base sequence that is complementary to the base sequence of the mRNA produced by the aromatase gene.

(a) Suggest why the carp became a pest when it was introduced into Australia.

.....

.....

(1 mark)

(b) Describe how the enzyme aromatase is normally produced from the aromatase gene.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(6 marks)

(c) The table shows part of the base sequence of the aromatase gene. It also shows part of the base sequence of the mRNA produced by the inserted gene.

	Sequence of bases					
Coding strand of aromatase gene	T	G	G	C	A	T
mRNA transcribed from coding strand of aromatase gene						
Coding strand of inserted gene						
mRNA transcribed from coding strand of inserted gene	U	G	G	C	A	U

(i) Complete the table to show the sequence of bases in the mRNA transcribed from the aromatase gene and the sequence of bases on the coding strand of the inserted gene.

(3 marks)

(ii) The inserted gene prevents the production of aromatase. Use information from the table to suggest how.

.....

.....

.....

.....

.....

.....

(3 marks)

(d) Release of genetically modified carp with the inserted gene could reduce the population of carp. Suggest how.

.....

.....

.....

.....

(2 marks)

END OF QUESTIONS

There are no questions printed on this page

There are no questions printed on this page

There are no questions printed on this page