Surname		Other Names	
Centre Number			Candidate Number									
Candidate Signature												

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General Certificate of Education
June 2006
Advanced Subsidiary Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

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

Monday 5 June 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 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			

LEAVE MARGIN BLANK

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

1 When fertilisers are applied to fields next to a lake, nitrogen-containing substances from the fertilisers get into the lake.

(a) (i) Describe how the nitrogen-containing substances get into the lake.

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(1 mark)

(ii) It takes longer for the nitrogen-containing substances to get into the lake when an organic fertiliser is used than when an inorganic fertiliser is used. Explain why it takes longer when an organic fertiliser is used.

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(2 marks)

(b) Describe how the presence of nitrates in a lake may eventually lead to the death of fish.

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(4 marks)

7

2 (a) Describe how B-lymphocytes respond when they are stimulated by antigens.

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(4 marks)

(b) The table gives information about some components of a red blood cell.

Component	Glycoprotein	Phospholipid	Haemoglobin
Location in cell	on outer surface of plasma membrane	within plasma membrane	in cytoplasm

Suggest which component of an intact red blood cell is most likely to act as an antigen during a blood transfusion. Explain your answer.

Component .....

Explanation .....

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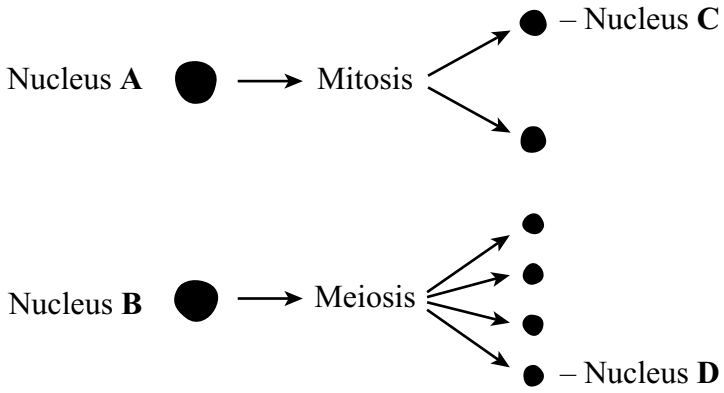
(2 marks)

6

3 (a) Nucleus **A** and nucleus **B** come from the same organism. The diagram shows these nuclei immediately before division and the nuclei formed immediately after their division. The table gives information about some of the nuclei shown in the diagram.



Nucleus	Number of chromosomes	Mass of DNA / arbitrary units
A	8	600
B	8	600
C		
D		

Complete the table for nuclei **C** and **D**. *(2 marks)*

(b) A student investigated the process of meiosis by observing cells on a microscope slide. The cells on the slide had been stained.

(i) Name an organ from which the cells may have been obtained.

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(1 mark)

(ii) Explain why a stain was used.

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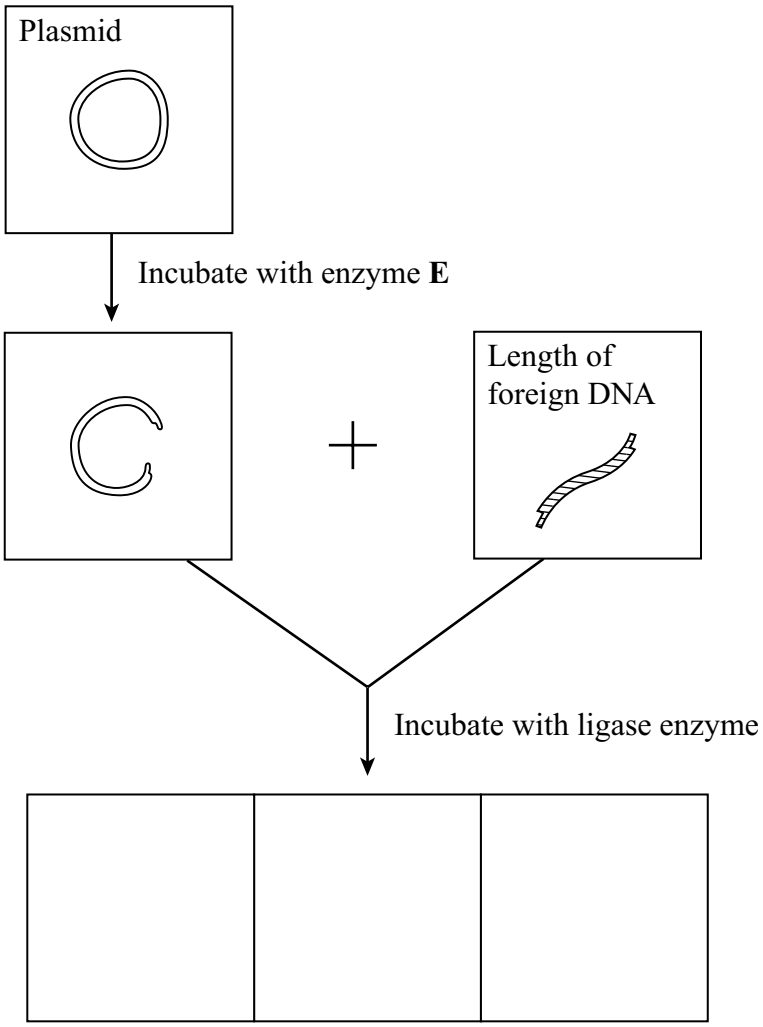
(1 mark)

4

4 Plasmids can be used as vectors to insert lengths of foreign DNA into bacteria. The diagram shows how this is achieved.



(a) Name enzyme **E**.

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(1 mark)

(b) Cut plasmids and lengths of foreign DNA can join. What features of their ends allows them to join?

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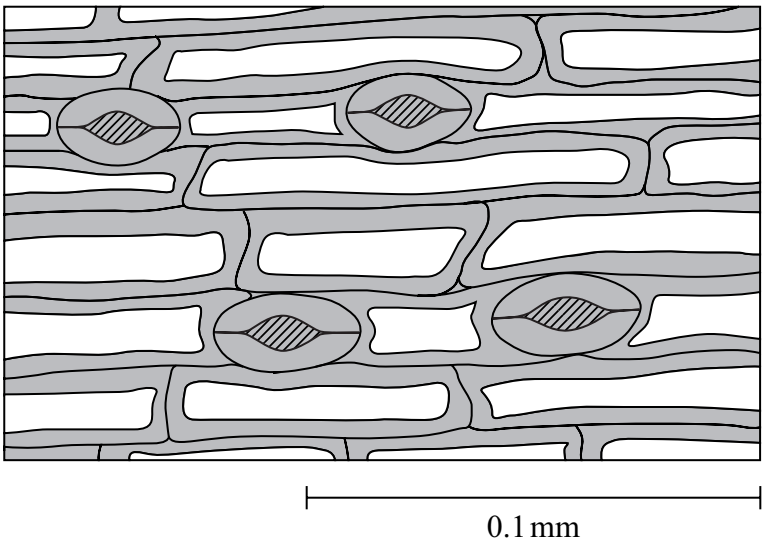
(2 marks)

(c) Draw **three** different structures that could be formed by incubating cut plasmids and lengths of foreign DNA with ligase. Use the spaces provided on the diagram.

(3 marks)

6

5 The drawing shows part of the lower leaf epidermis of sorghum.



(a) Calculate the number of stomata per mm^2 of the leaf surface. Show your working.

Answer ..... stomata per mm^2 *(2 marks)*

(b) (i) Sorghum has few stomata per mm^2 of leaf surface area. Explain how this is an adaptation to the conditions in which sorghum grows.

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(3 marks)

(ii) Give **two** other ways in which sorghum is adapted to the conditions in which it grows.

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2. .....

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(2 marks)

7

6 (a) What is meant by a gene?

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(2 marks)

The polymerase chain reaction (PCR) can be used to obtain many copies of a particular gene.

(b) Explain how the strands of DNA are separated during the PCR.

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(2 marks)

(c) In a particular PCR, two different primers are added to the DNA.

(i) Why are primers required?

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(1 mark)

(ii) Suggest why two different primers are required.

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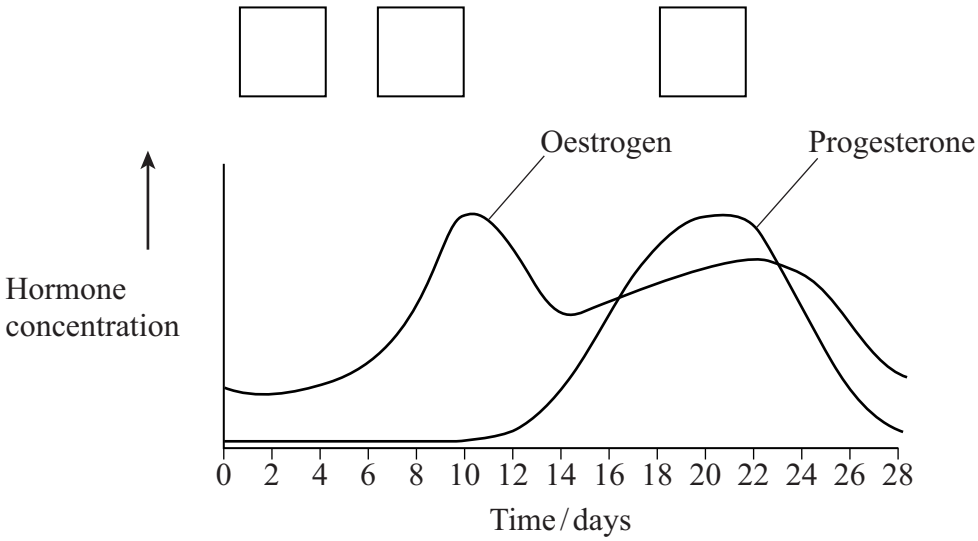
(1 mark)

(d) Starting with a single molecule of DNA, the polymerase chain reaction was allowed to go through three complete cycles. How many molecules of DNA would be produced?

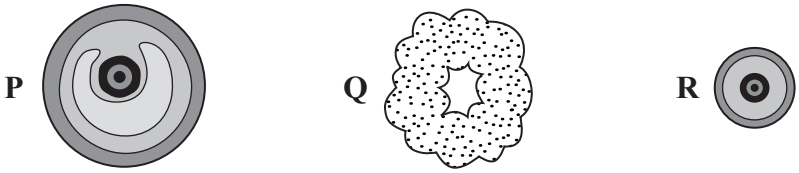
Answer ..... *(1 mark)*

7

7 (a) The graph shows the concentrations of two hormones during one sexual cycle of a human female. The diagram shows structures that produce these hormones.



Structures



(i) Write the appropriate letters in the boxes on the graph to show the order in which the structures labelled **P** to **R** appear during the cycle.

(1 mark)

(ii) Name the hormone that causes structure **Q** to develop.

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(1 mark)

(b) Describe **two** effects of progesterone on the uterus.

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(2 marks)

(c) Explain how oestrogen in contraceptive pills prevents fertilisation from taking place.

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(2 marks)

(d) The sexual cycles of some female farm animals can be synchronised by giving them low doses of progesterone. When this treatment is stopped the animals come into oestrus a few days later. Explain how the withdrawal of progesterone causes them to come into oestrus.

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(2 marks)

8

Turn over for the next question

8 Read the following passage.

Ethanol has been produced from plant material for many years. The first step uses amylase and maltase to break down starch into its component sugars. These sugars are then fermented by yeast to produce ethanol. However, as most of the plant tissue is cellulose as opposed to starch, yields have been low.

A more cost effective way to produce ethanol from plant material would be to use the cellulose. Once cellulose is broken down to its component sugars these can be fermented by yeast to produce ethanol. However, breaking down cellulose on a large scale is more difficult than breaking down starch. The existing industrial method of hydrolysing cellulose uses concentrated acid at 220 °C. The sugars produced must then be separated from the acid before being fermented by yeast to produce ethanol.

A new method is being developed to break down cellulose into its component sugars. This method uses cellulase enzymes. After crushing the plant material, the cellulose is broken down to sugars using cellulase. This process can take place at the same time as fermentation with yeast to produce ethanol.

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

(a) Explain the advantages of using the new enzyme-based method to produce ethanol from cellulose compared with the existing industrial method (lines 8–14).

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(4 marks)

(b) Explain why the break down of cellulose with cellulase can take place at the same time as yeast fermentation (lines 13–14).

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(2 marks)

(c) The plant material is crushed (line 12). Explain why.

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(2 marks)

(d) Cellulase is an extracellular enzyme secreted by a fungus.

(i) Describe how large amounts of this fungus could be produced and pure cellulase obtained.

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(6 marks)

(ii) When producing cellulase from the fungus, there is an advantage in cellulase being an extracellular enzyme. Suggest why.

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(1 mark)

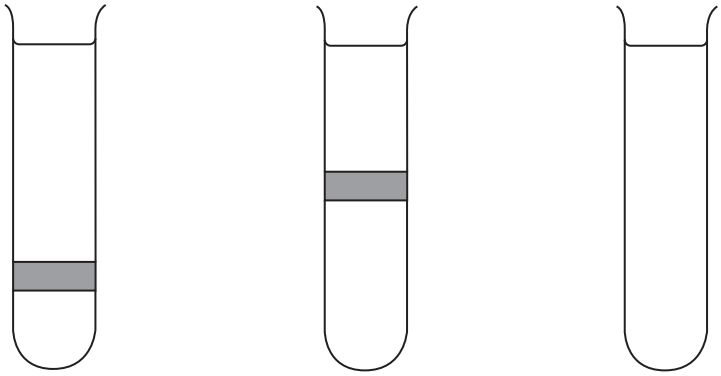
15

9 (a) There are two forms of nitrogen. These different forms are called isotopes. ^{15}N is a heavier isotope than the normal isotope ^{14}N.

In an investigation, a culture of bacteria was obtained in which all the nitrogen in the DNA was of the ^{15}N form. The bacteria (generation 0) were transferred to a medium containing only the normal isotope, ^{14}N, and allowed to divide once. A sample of these bacteria (generation 1) was then removed. The DNA in the bacteria of generation 1 was extracted and spun in a high-speed centrifuge.

The bacteria in the ^{14}N medium were allowed to divide one more time. The DNA was also extracted from these bacteria (generation 2) and spun in a high speed centrifuge.

The diagram shows the results of this investigation.



Generation 0 DNA from bacteria with ^{15}N only	Generation 1 DNA from bacteria which have divided once in a ^{14}N medium	Generation 2 DNA from bacteria which have divided twice in a ^{14}N medium

(i) Which part of the DNA molecule contains nitrogen?

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(1 mark)

(ii) Explain why the DNA from generation 1 is found in the position shown.

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(2 marks)

(iii) Complete the diagram to show the results for generation 2. *(2 marks)*

(b) The table shows the percentage of different bases in the DNA of different organisms.

Organism	Adenine %	Guanine %	Thymine %	Cytosine %
Human		19		
Bacterium	24	26	24	26
Virus	25	24	33	18

(i) Complete the table to show the percentages of different bases in human DNA.
(2 marks)

(ii) The structure of virus DNA is different from the DNA of the other two organisms. Giving evidence from the table, suggest what this difference might be.

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(2 marks)

(c) Describe how a protein is synthesised from the information carried on DNA.

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(6 marks)

END OF QUESTIONS

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