

Surname						Other Names					
Centre Number						Candidate Number					
Candidate Signature											

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General Certificate of Education
June 2006
Advanced Subsidiary Examination



HUMAN BIOLOGY (SPECIFICATION A)
Unit 3 Pathogens and Disease

BYA3

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			
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6			
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8			
Total (Column 1) →			
Total (Column 2) →			
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Examiner's Initials			

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

1 (a) What is an antigen?

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(2 marks)

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

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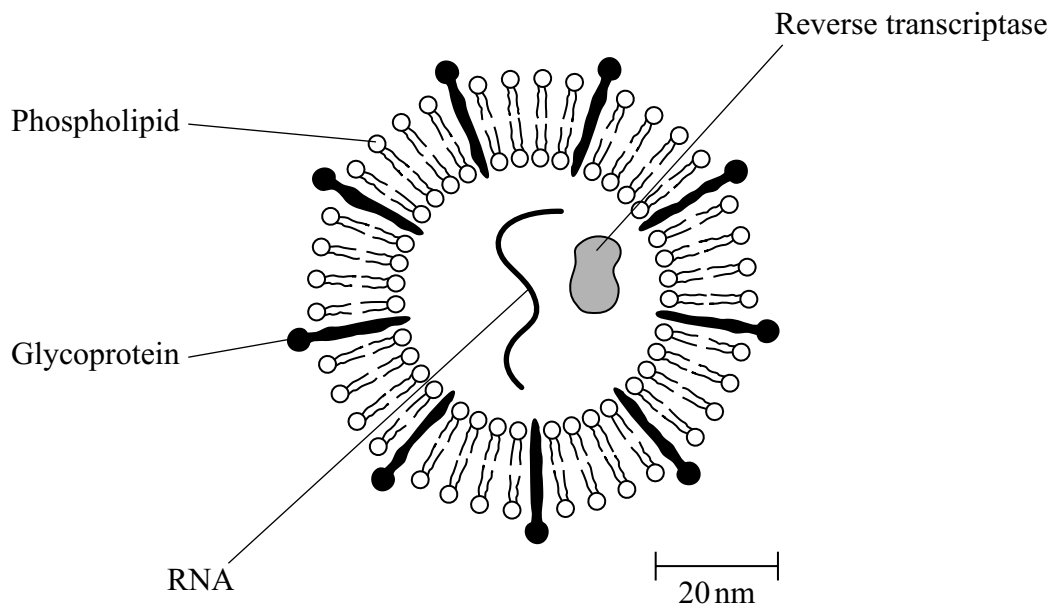
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(4 marks)

(c) The diagram shows some components of a human immunodeficiency virus (HIV).



- (i) Suggest which labelled component of the virus is most likely to act as an antigen. Give a reason for your answer.

Component

Reason

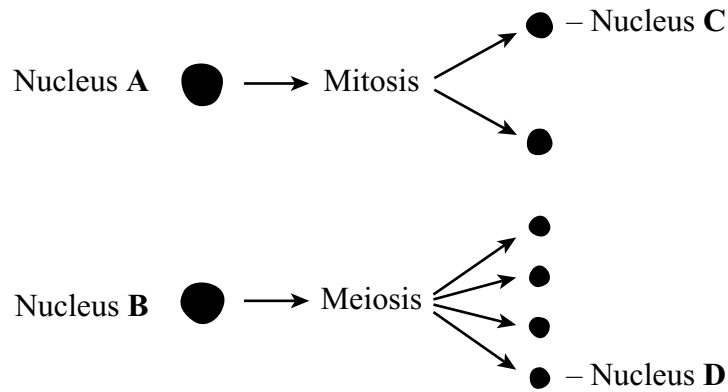
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(1 mark)

- (ii) A cell that HIV infects is $15\text{ }\mu\text{m}$ in diameter. Calculate how many times larger in diameter this cell is than an HIV particle. Show your working.

Answer times larger (2 marks)

Turn over for the next question

- 2 (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.

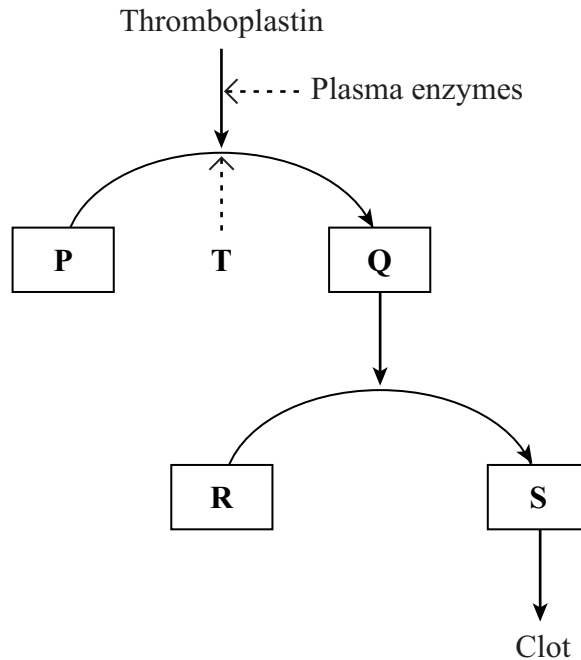
- (i) Name an organ from which the cells may have been obtained.

.....
(1 mark)

- (ii) Explain why a stain was used.

.....
.....
(1 mark)

3 The diagram shows some of the events in blood clotting.



(a) Name

substance **P**,

substance **Q**,

substance **R**,

substance **S**,

ions **T**.

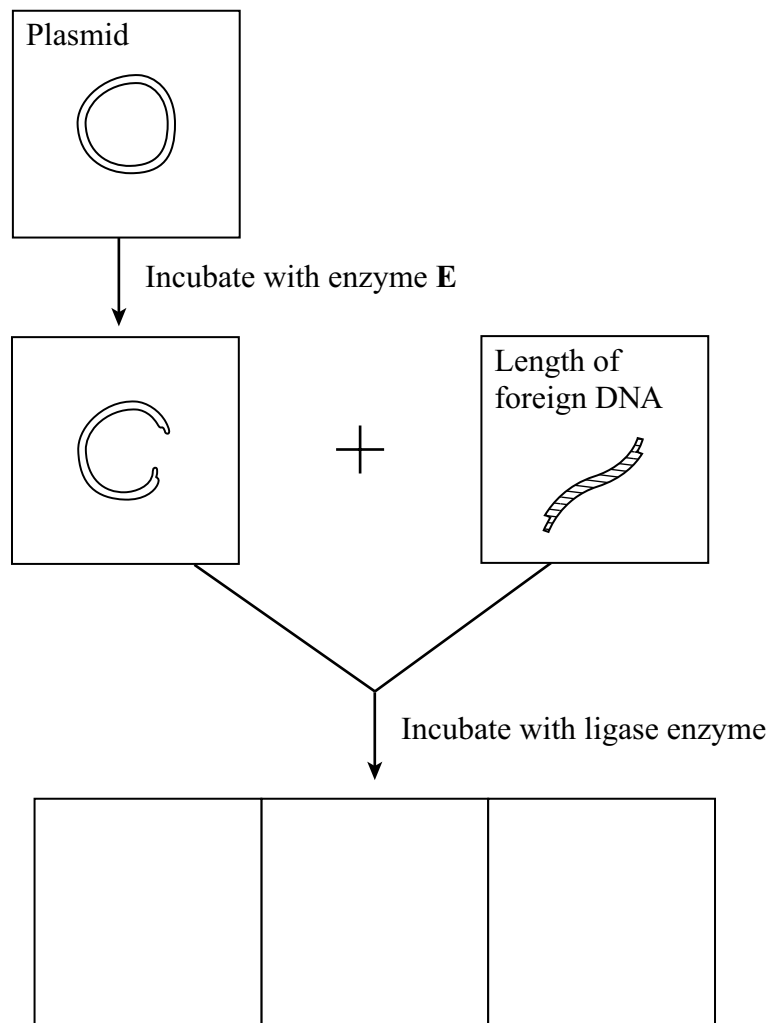
(3 marks)

(b) Aspirin is a drug that inhibits blood clotting. In the UK the treatment, with aspirin, of people who have atheroma has reduced the number of cases of myocardial infarctions. Explain why.

.....

(2 marks)

- 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)

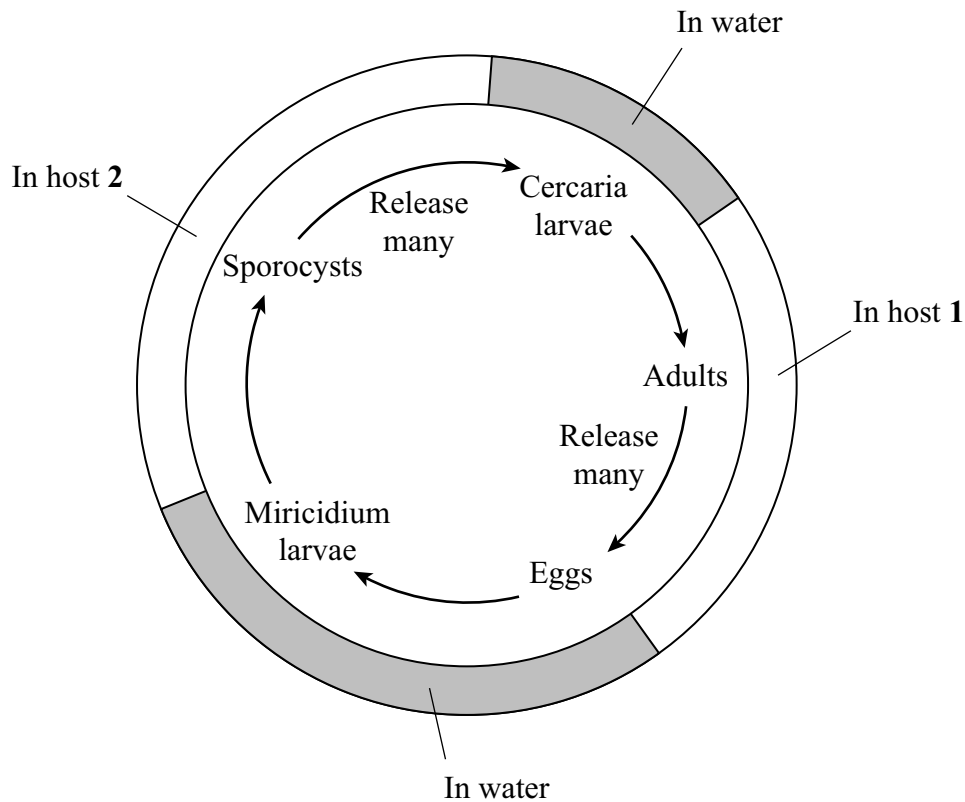
- (c) Draw **three** different structures that could be formed by incubating cut plasmids and lengths of foreign DNA with ligase. Use the spaces provided on the diagram.

(3 marks)

6

Turn over for the next question

5 The diagram shows the main stages in the life cycle of the parasite *Schistosoma*.



(a) (i) Name

host 1,

host 2.

(2 marks)

(ii) The adults release large numbers of eggs and the sporocysts produce large numbers of larvae. Explain how releasing large numbers of eggs and larvae is an advantage to the parasite.

.....

(2 marks)

- (b) (i) Give **two** adaptations of the adult stage of the *Schistosoma* lifecycle and for each explain the advantage to *Schistosoma*.

adaptation

advantage

.....

adaptation

advantage

.....

(2 marks)

- (ii) The larvae have cilia or tail pieces. Suggest an advantage of this to *Schistosoma*.

.....

.....

(1 mark)

- (iii) The eggs have a spike on their outer surface. Suggest an advantage of this to *Schistosoma*.

.....

.....

(1 mark)

Turn over for the next question

6 Antibiotics are used in the treatment of bacterial infections. They affect a range of processes in bacteria.

(a) Describe **three** ways in which antibiotics may act on bacteria.

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(3 marks)

(b) Bacteriostatic antibiotics do not kill bacteria but allow patients to recover from a bacterial infection. Explain why they allow patients to recover.

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(2 marks)

- 7 (a) Describe how Koch's postulates could be used to prove that a particular bacterium is responsible for causing a particular disease.

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(4 marks)

- (b) Common symptoms of tuberculosis (TB) are coughing up blood and chest pains. Tuberculosis is spread by droplet infection. Explain how the common symptoms of tuberculosis are related to this method of spread.

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.....

.....

(2 marks)

- (c) Give **two** ways in which HIV infection can spread.

1.

2.

(1 mark)

- (d) Suggest why people infected with HIV have an increased likelihood of dying from TB.

.....

.....

(1 mark)

8 Read the following passage.

Body cells have elaborate control systems that regulate their division. If these control systems break down, cells start to grow and divide in an unregulated way and produce a tumour. Some tumours are benign but others are malignant.

- 5 Cancer is not caused by a single mutation to the genes controlling cell multiplication but rather by between 3 and 20 mutations of these genes in a single cell. It is for this reason that cancer is more common in older people and in people heavily exposed to mutagens.

Cancer cells differ in appearance and function from non-cancerous cells from the same tissue. Cancer cells are less well differentiated, only synthesise a few proteins, and cannot perform the usual functions of healthy cells.

- 10 Cancer symptoms often occur only after the time when effective treatment is possible. However, some cancers change the concentration of certain substances in body fluids. Early diagnosis is possible using analytical enzymes to test body fluids.

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

- (a) Give **two** types of mutagen that can lead to cancer (line 6).

1.

2.
(2 marks)

- (b) Cancer is more common in older people (line 6). Explain why.

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(2 marks)

- (c) During which stage of the cell cycle does most protein synthesis occur (line 8)?

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.....
(1 mark)

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-

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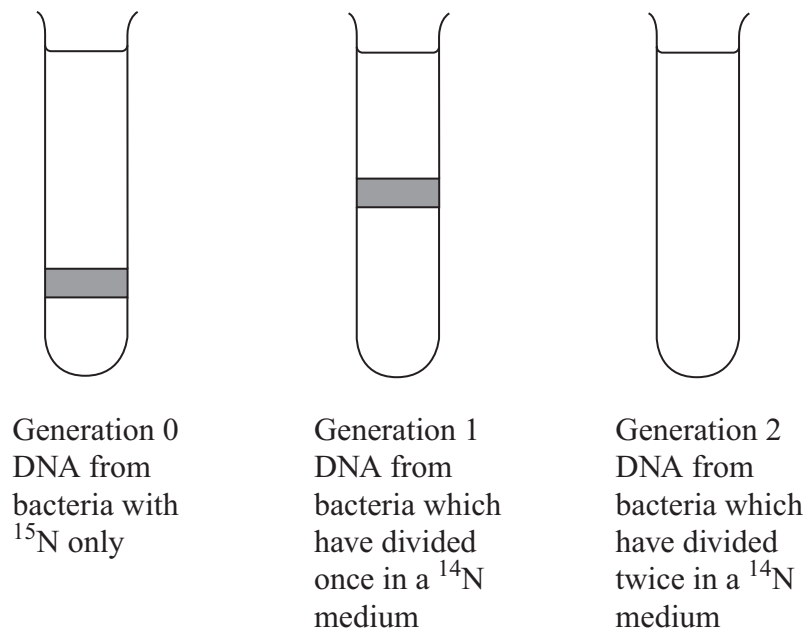
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- 9 (a) There are two forms of nitrogen. These different forms are called isotopes. ^{15}N is a heavier isotope than the normal isotope ^{14}N .

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.



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

.....
(1 mark)

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

.....
.....
.....
.....
(2 marks)

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

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

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-
-
- (2 marks)*

(6 marks)

15

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