

Surname						Other Names					
Centre Number						Candidate Number					
Candidate Signature											

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General Certificate of Education
 January 2001
 Advanced Subsidiary Examination



HUMAN BIOLOGY (SPECIFICATION A)
Unit 3 Pathogens and Disease

BYA3

Wednesday 10 January 2001 Afternoon Session

No additional materials are required.
 You may use a calculator.

For Examiner's Use			
Number	Mark	Number	Mark
1			
2			
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Total (Column 1)	→		
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TOTAL			
Examiner's Initials			

Time allowed: 1 hour 30 minutes

Instructions

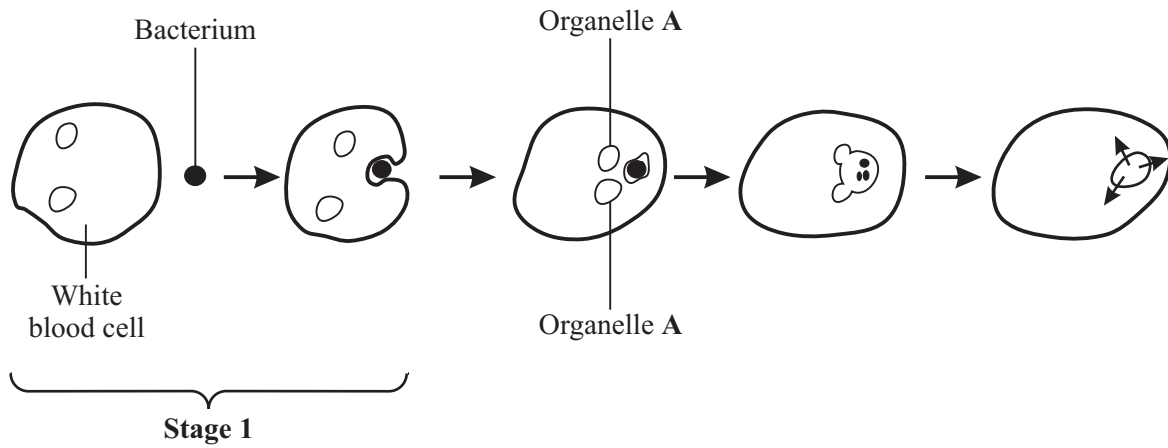
- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided. All working must be shown.
- Do all rough work in this book. Cross through any work you do not want marked.

Information

- The maximum mark for this paper is 75.
- Mark allocations are shown in brackets.
- You will be assessed on your ability to use an appropriate form and style of writing, to organise relevant information clearly and coherently, and to use specialist vocabulary, where appropriate.
- The degree of legibility of your handwriting and the level of accuracy of your spelling, punctuation and grammar will also be taken into account.

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

1 The diagram shows one way in which white blood cells protect the body against disease.



(a) Describe what is happening during **Stage 1**.

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(2 marks)

(b) (i) Name Organelle A.

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(1 mark)

(ii) Describe the role of Organelle A in the defence against disease.

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(2 marks)

2 Malaria is a disease caused by the parasite *Plasmodium*.

(a) Explain why *Plasmodium* is described as a parasite.

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(2 marks)

(b) Most of the life cycle of *Plasmodium* is spent inside a red blood cell of its main host. Suggest how each of the following is an adaptation to its way of life.

(i) *Plasmodium* has no locomotory structures.

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(1 mark)

(ii) *Plasmodium* has no mechanism for regulating its water content.

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(1 mark)

(c) *Plasmodium* survives for long periods in the blood of its main host. Explain how.

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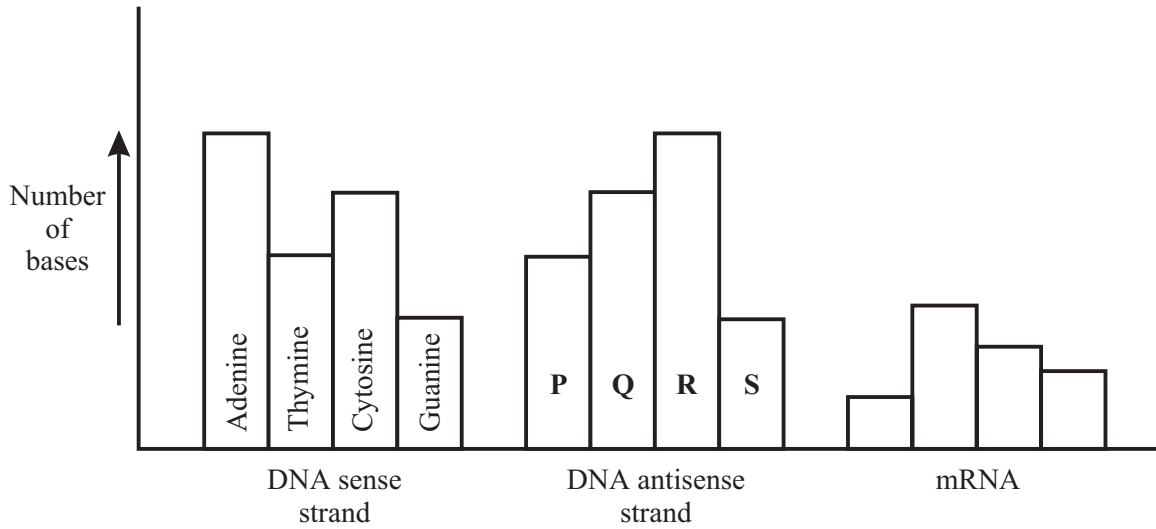
(1 mark)



Turn over ►

3 DNA is made up of two polynucleotide strands, the sense strand and the antisense strand. Messenger RNA is transcribed from the DNA sense strand, which contains the genetic code.

(a) The graph shows the number of bases found in the sense strand and the antisense strand of a short piece of DNA, and the mRNA transcribed from it.



(i) Identify the base represented by each of the following letters.

- P
- Q
- R
- S

(2 marks)

(ii) Explain why the total number of bases in the DNA sense strand and the total number of bases in the DNA antisense strand are the same.

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(1 mark)

(iii) Explain why the total number of bases in the DNA sense strand and the total number of bases in the mRNA are different.

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(1 mark)

(b) The mRNA has a sequence of 1824 bases. How many amino acids will join to form the polypeptide chain?

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(1 mark)

(c) Although DNA is double-stranded, only the sense strand determines the specific amino acid sequence of a polypeptide. Suggest a role of the antisense strand.

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(1 mark)

6

TURN OVER FOR THE NEXT QUESTION

Turn over ►

4 (a) Describe how a particular gene can be removed from the DNA of an animal cell.

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(2 marks)

(b) Describe how this gene can then be inserted into the genetic material of a bacterium.

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(4 marks)

5 The pancreas produces the protein-digesting enzyme, trypsin, which becomes active on release from the pancreas. It also produces the starch-digesting enzyme, amylase. Pancreatitis is a disease of the pancreas. It occurs when trypsin becomes active before release from the pancreas.

(a) Explain why amylase may be found in the blood during the early stages of pancreatitis.

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(3 marks)

(b) Enzymes secreted into the gut can be detected in the faeces released at the end of the gut. Explain why the amount of trypsin in the faeces can be used as a measure of the success of treatment of pancreatitis.

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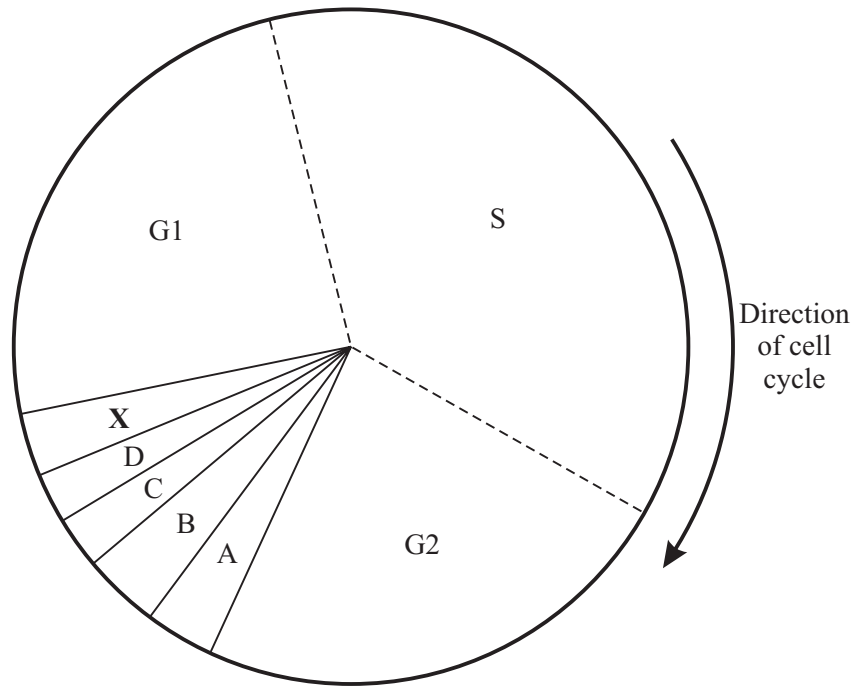
(2 marks)

TURN OVER FOR THE NEXT QUESTION

5

Turn over ►

6 The diagram shows the main stages of the cell cycle. The letters A to D represent the four stages of mitosis.



(a) Identify the stage when each of the following events is taking place.

(i) DNA replication

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(ii) Individual chromatids from a chromatid pair move to opposite poles of the cell.

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(2 marks)

(b) What is happening during Stage X?

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(1 mark)

(c) *Vinblastine* is an anti-cancer drug that prevents the formation of a spindle.

(i) What is the function of the spindle?

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..... (1 mark)

(ii) How would a drug like vinblastine help prevent the growth of a tumour?

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..... (2 marks)

6

7 Smoking is a risk factor associated with coronary heart disease. Smoking is known to raise the concentration of fibrinogen in the blood, promote the aggregation of platelets and reduce the ability of arteries to dilate.

Use this information to:

(a) explain the effect of smoking on blood pressure;

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..... (2 marks)

(b) explain how smoking might lead to the formation of a blood clot.

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..... (3 marks)

Turn over ►

5

8 MMR is the combined vaccine used against measles, mumps and rubella. It contains attenuated microorganisms.

(a) What is an *attenuated* microorganism?

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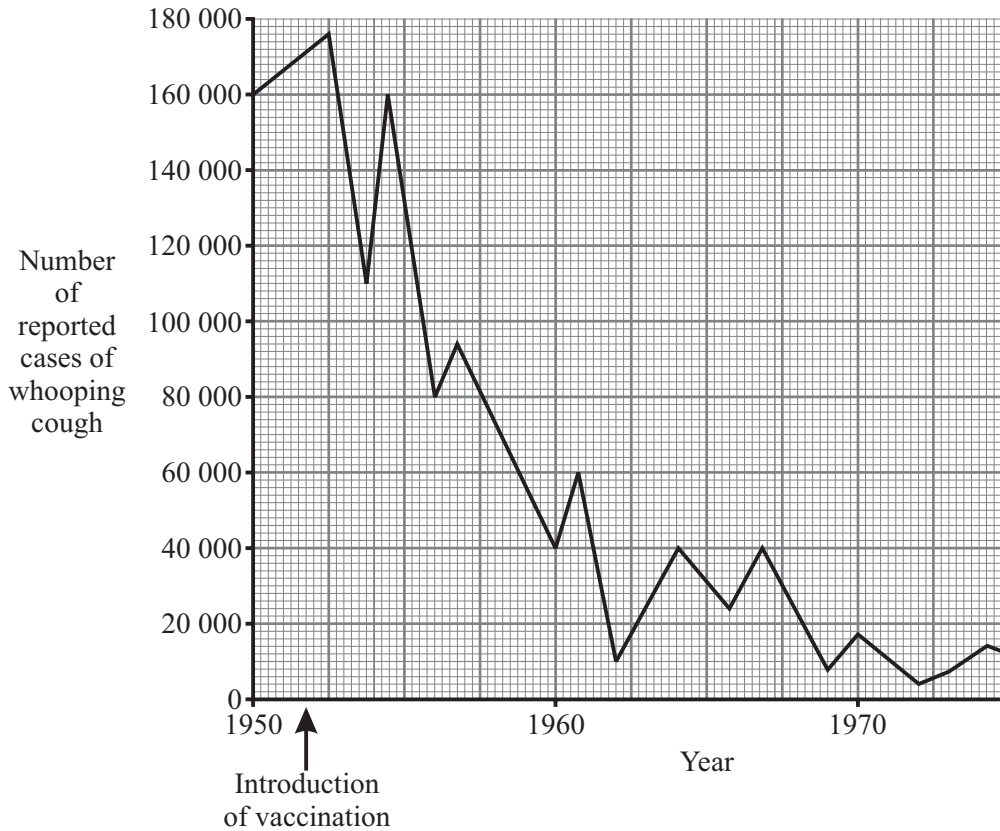
(1 mark)

(b) Vaccines protect against disease by stimulating the production of memory cells. Describe how memory cells protect the body from disease.

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(3 marks)

- (c) The graph shows the number of reported cases of whooping cough during the period 1950 to 1975.



Describe and explain what the graph shows about the number of reported cases of whooping cough during the period 1952 to 1960.

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(2 marks)

- (d) The number of reported cases of whooping cough increased during the 1980s. Suggest **one** reason why.

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(1 mark)

9 Read the following passage.

Cystic fibrosis affects epithelial cells lining organs such as the lungs and intestines. In 1989, the mutated gene responsible for cystic fibrosis was identified. This has opened the way for the development of gene therapy to reduce the symptoms of the disease. The idea has been to introduce a normal copy of the gene into the cells of patients who only have the mutant gene.

5 Clinical trials have used viruses, called adenoviruses. In an aerosol spray, these viruses can introduce normal genes into epithelial cells of the lungs of cystic fibrosis sufferers. Adenoviruses are thought to be safe since they are not associated with human malignancies. Adenoviruses normally cause throat infections, so they must be modified before use in gene therapy. Despite this precaution, some patients have produced an immune response to the
10 modified adenoviruses.

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

(a) Suggest how the adenoviruses must be modified before use in gene therapy (lines 8 – 9).

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(2 marks)

(b) Explain what is meant by *malignancies* (line 7).

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(1 mark)

(c) Describe how the presence of adenoviruses will produce a primary immune response.

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(6 marks)

- (d) The adenovirus is used as a vector to introduce the normal gene into the human cell. Explain why it is described as a *vector*.

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(2 marks)

- (e) The normal gene allows the epithelial cells to produce a protein known as CFTR. The CFTR protein enables these cells to secrete chloride ions through the plasma membrane. What does each of the following observations suggest about the effectiveness of the gene therapy treatment?

- (i) Messenger RNA, coding for the CFTR protein, is found inside the epithelial cells.

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(2 marks)

- (ii) An increased amount of chloride ions is detected outside the epithelial cells.

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(2 marks)

(ii) Suggest an explanation for the shape of the curve between 24 and 30 hours.

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(1 mark)

(b) Bacteria are most susceptible to bactericidal antibiotics during phase **B**.

(i) What is a *bactericidal* antibiotic?

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(1 mark)

(ii) Suggest why bacteria are most susceptible during this phase.

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(3 marks)

(c) Describe **one** way in which bacteria might produce the symptoms of disease.

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(1 mark)

QUESTION 10 CONTINUES ON THE NEXT PAGE

Turn over ►

(d) Gonorrhoea bacteria are sexually transmitted pathogens that respond to the antibiotic penicillin. Chlamydia is another sexually transmitted disease that produces similar symptoms to gonorrhoea. Diagnosis, before treatment, is important because chlamydia does not respond to the antibiotic penicillin. A quick diagnosis is possible by the addition of monoclonal antibodies to a sample taken from the infected region.

(i) What is a monoclonal antibody?

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(1 mark)

(ii) With reference to gonorrhoea and chlamydia, suggest why monoclonal antibodies can be used to help to make the diagnosis.

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(2 marks)

END OF QUESTIONS