General Certificate of Education
January 2003
Advanced Subsidiary Examination

AQA

ASSESSMENT and
QUALIFICATIONS
ALLIANCE

HUMAN BIOLOGY (SPECIFICATION A)   BYA3
Unit 3   Pathogens and Disease

Thursday 9 January 2003   Morning Session

| **No additional materials are required.** |
| 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 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 (a) Complete the table to give **three** structural differences between a DNA molecule and an RNA molecule.

DNA molecule	RNA molecule

(3 marks)

(b) The diagram shows a molecule of transfer RNA (tRNA).
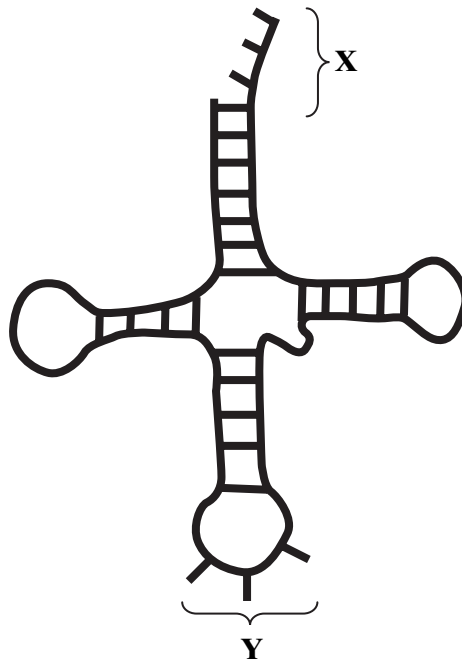
Describe the function of

(i)   part **X**;

....

....

(1 mark)

(ii)   part **Y**.

....

....

....

....

(2 marks)

(c)   Explain why the genetic code is described as

(i)   non-overlapping;

....

....

(1 mark)

(ii)   degenerate.

....

....

(1 mark)

8

TURN OVER FOR THE NEXT QUESTION

Turn over ▶

2 The graph shows the changes in the DNA content of cells during the cell cycle.
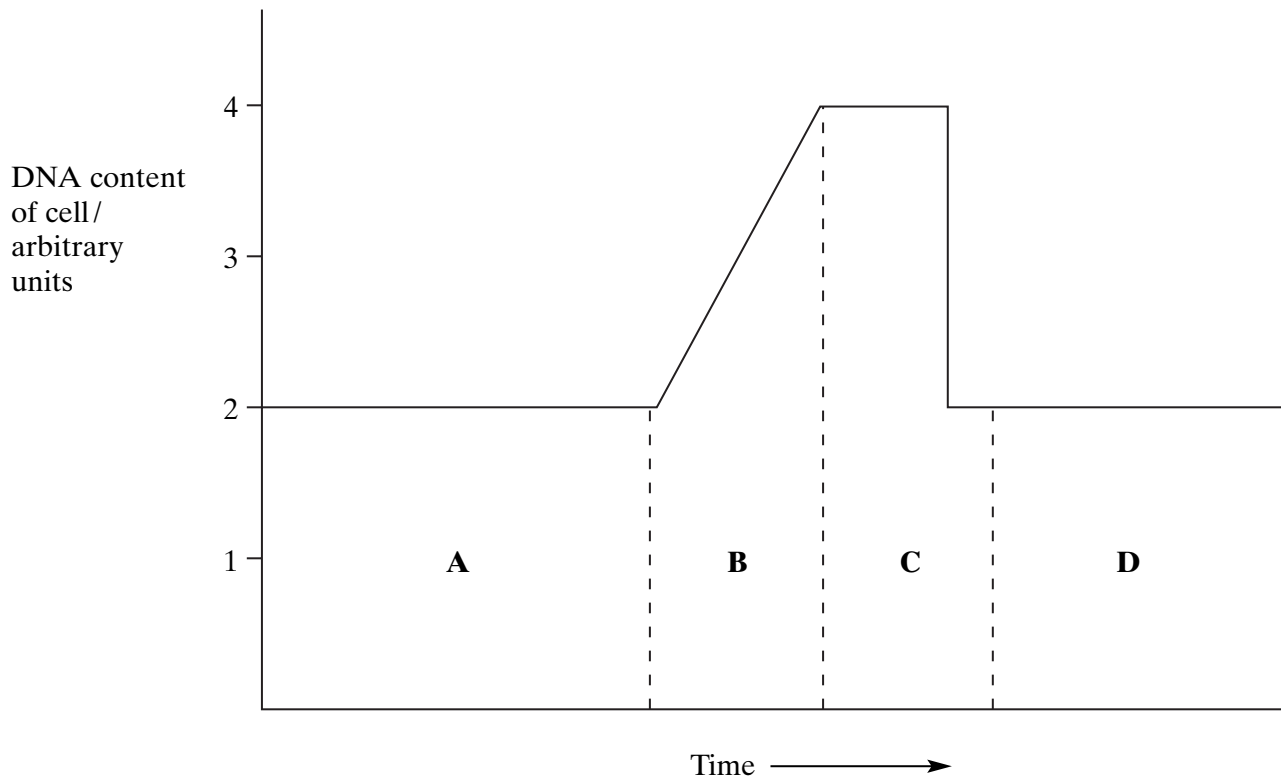
(a) In which of the stages, **A** to **D**, does each of the following take place?

   (i) DNA replicates. ....

   (ii) The chromosomes become visible. ....

(2 marks)

(b) Describe and explain how the amount of DNA in the cell changes during stage **C**.

   ....

   ....

   ....

   ....

   ....

   ....

(3 marks)

(c) (i) Cytarabine is a drug used to treat cancer. It inhibits an enzyme needed to synthesise new DNA. Suggest how the graph would be different if cytarabine was present during the cell cycle.

....

....

(1 mark)

(ii) Explain why cytarabine is effective in treating cancer.

....

....

....

....

(2 marks)

$\dfrac{}{8}$

TURN OVER FOR THE NEXT QUESTION

Turn over ▶

3 (a) What is *atheroma*?

....

....

....

....

(2 marks)

(b) Describe how atheroma can lead to an aneurysm.

....

....

....

....

(2 marks)

(c) Warfarin is a drug which may be taken by a person with atheroma. It slows down the conversion of prothrombin to thrombin. Explain how warfarin reduces the chance of a myocardial infarction in a person with atheroma.

....

....

....

....

....

....

(3 marks)

7

4 Scientists have found a new disease in a small population of rabbits. They believe that this disease is caused by a particular species of bacterium. This bacterium has been isolated from every case of the disease found.

(a) Describe how the scientists could use Koch's postulates to show that the disease is caused by this bacterium.

....

....

....

....

....

....

(3 marks)

(b) The disease AIDS affects humans. It is caused by the human immunodeficiency virus, HIV. Explain why it would be difficult to use Koch's postulates to show that HIV causes AIDS.

....

....

....

....
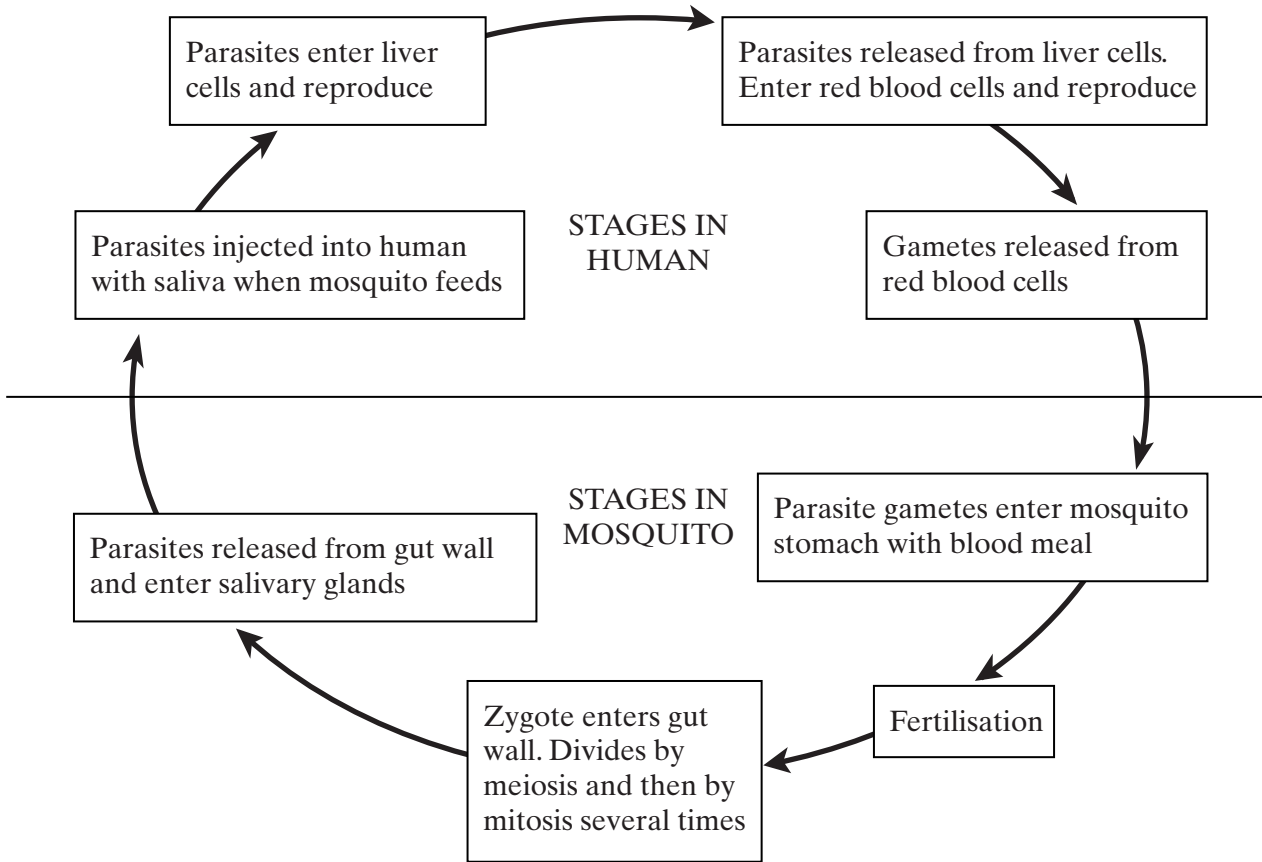
(2 marks)

TURN OVER FOR THE NEXT QUESTION

5

Turn over ▶

5 The diagram shows the main stages in the life-cycle of the malarial parasite, *Plasmodium*.

Parasites enter liver cells and reproduce	Parasites released from liver cells. Enter red blood cells and reproduce

STAGES IN HUMAN

Parasites injected into human with saliva when mosquito feeds	Gametes released from red blood cells

STAGES IN MOSQUITO

Parasites released from gut wall and enter salivary glands	Parasite gametes enter mosquito stomach with blood meal

Zygote enters gut wall. Divides by meiosis and then by mitosis several times

Fertilisation

(a) Explain the importance of meiosis in the life cycle of *Plasmodium*.

....

....
(1 mark)

(b) Explain the advantage to *Plasmodium* of each of the following features of its life-cycle.

(i) It spends part of its life-cycle in a mosquito.

....

....
(1 mark)

(ii) It produces many parasites from each one entering the mosquito's gut wall.

....

....
(1 mark)

(c)   Explain how the absence of a locomotory structure is linked to the way of life of *Plasmodium*.

....

....

....

....

(2 marks)

(d)   The malarial parasites spend part of their life-cycle inside human liver cells. Explain why this makes it difficult to control malaria with a vaccine.

....

....

....

....

(2 marks)

7

TURN OVER FOR THE NEXT QUESTION

Turn over ▶

6 Beta-blockers are used to treat hypertension.

(a) Explain, in terms of molecular shape, how beta-blockers reduce hypertension.

....

....

....

....

....

....
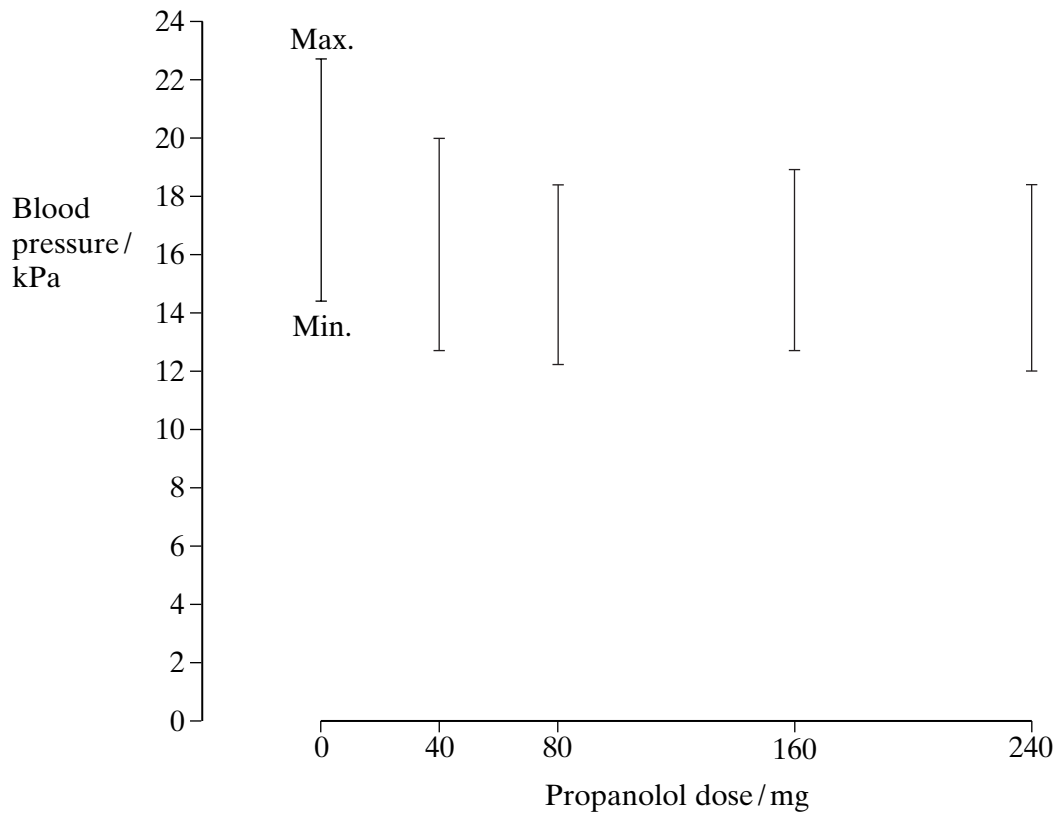
(3 marks)

(b) Propanolol is a beta-blocker. The chart shows the effect of different doses of propanolol on blood pressure in a group of people with hypertension.

Source: adapted from J. HAMER (ed.), *Drugs for Heart Disease* (Chapman and Hall) 1987

Use the chart to suggest the dose of propanolol you would recommend for these people. Explain your answer.

Dose .... mg

Explanation ....

....

....

....

(2 marks)

$\boxed{\dfrac{}{5}}$

7 (a) (i) Explain why people with pancreatitis may have a decreased concentration of digestive enzymes in their faeces.

....

....

....

....

(2 marks)

(ii) People with pancreatitis sometimes have increased concentrations of protease and lipase enzymes in their blood. Suggest how these increased enzyme concentrations may lead to problems with blood clotting.

....

....

(1 mark)

(b) Lactate dehydrogenase is an enzyme found in heart muscle. Suggest why a high concentration of lactate dehydrogenase in the blood is a sign that a person has had a myocardial infarction.

....

....

....

....

(2 marks)

$\boxed{\dfrac{}{5}}$

Turn over ▶

8 Every year, farmers in North America lose billions of dollars when their cattle get shipping fever. This is a disease caused by the bacterium *Mannheimia haemolytica*. It is often triggered by the stress of being transported and this is why it is called shipping fever. Unfortunately, controlling shipping fever by conventional vaccination is expensive, and also causes stress to the cattle.

The protein leukotoxin from *Mannheimia haemolytica* causes the symptoms of the disease. Scientists are working to develop an edible vaccine. They used a vector to insert part of the gene for leukotoxin into the DNA of white clover. White clover is a favourite food for cattle. Using the inserted DNA, the modified clover makes a polypeptide, which is part of the protein. Cattle injected with this polypeptide produce antibodies and these antibodies neutralise the leukotoxin.

(a) (i) Describe how an enzyme is used to remove part of the leukotoxin gene from *Mannheimia haemolytica*.

....

....

....

....

(2 marks)

(ii) Describe how this DNA could be inserted into white clover cells.

....

....

(1 mark)

(b) Only part of the leukotoxin gene was inserted into clover. Suggest **one** reason why the scientists did not attempt to insert the whole gene.

....

....

....

....

(2 marks)

(c) Describe how the modified clover plants made a polypeptide from the inserted DNA.

....

....

....

....

....

....

....

....

....

....

....

(6 marks)

(d) The polypeptide produced by the modified clover plants is able to pass through the gut wall into the blood of the cattle. Explain how

(i) the cattle would produce antibodies to leukotoxin after eating the modified clover;

....

....

....

(2 marks)

(ii) eating the modified clover could give the cattle long term immunity against shipping fever.

....

....

....

....

(2 marks)

Turn over ▶

9 The table shows the number of deaths from various causes in a group of individuals of the same age. Individuals were identified as smokers or non-smokers.

Cause of death	Number of deaths among smokers	Number of deaths among non-smokers
Total deaths (all causes)	7316	4651
Coronary artery disease	3361	1973
Strokes	556	428
Aneurysm	86	29
Lung cancer	397	37
Other causes	2916	2184

(a) Why was it necessary for the smokers and the non-smokers to be the same age?

....

....

....

....
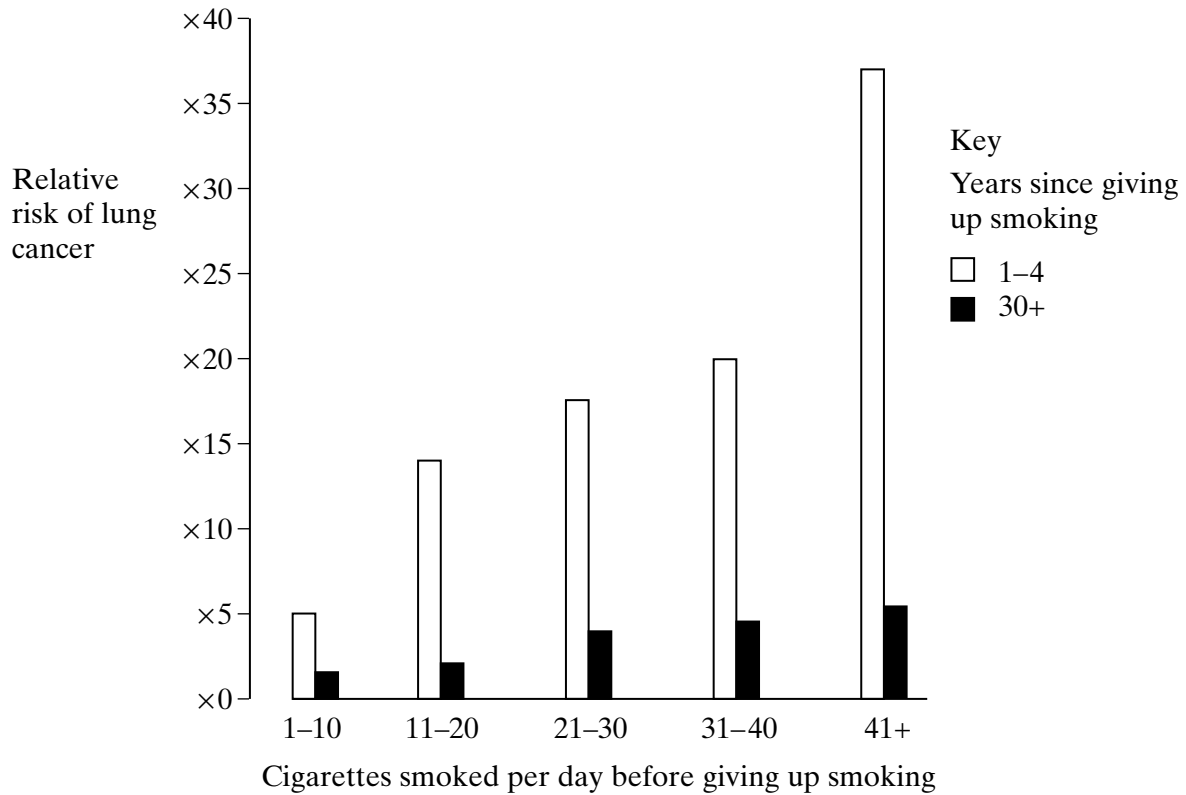
(2 marks)

(b) Do the figures in the table show that smokers were more likely to have died from a stroke than non-smokers? Use suitable calculations to support your answer.

(3 marks)

(c) The bar chart shows the risk of developing lung cancer in relation to the number of cigarettes smoked per day before stopping, and the number of years since giving up smoking.

Source: adapted from P. BANNASCH (ed.), *Cancer Risks* (Springer-Verlag) 1987

(i) Give **two** conclusions that can be drawn from the information in the bar chart.

1 ....

....

2 ....

....

(2 marks)

(ii) Explain what is meant by "relative risk" on the y-axis of the bar chart.

....

....

....

....

(2 marks)

QUESTION 9 CONTINUES ON THE NEXT PAGE

Turn over ▶

(d)   Explain what is meant by a malignant tumour and describe how exposure to cigarette smoke may result in the formation of a malignant tumour.

....

....

....

....

....

....

....

....

....

....

....

....

(6 marks)

15

END OF QUESTIONS