Version 1.1

Surname		Other Names	
Centre Number			Candidate Number									
Candidate Signature												

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General Certificate of Education
June 2003
Advanced Subsidiary Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

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

Monday 2 June 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.

For Examiner's Use			
Number	Mark	Number	Mark
1			
2			
3			
4			
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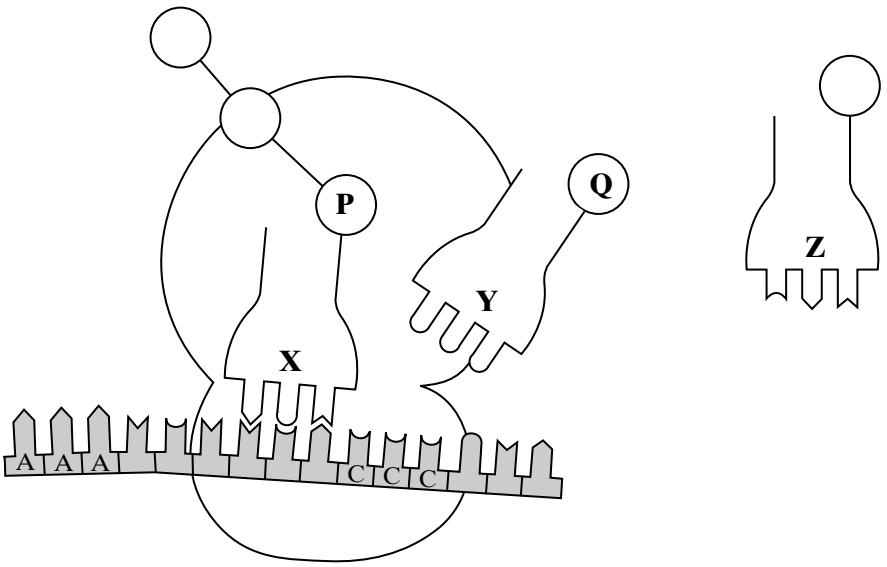
6			
7			
8			
9			
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

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

1 The diagram shows a stage in protein synthesis.



(a) (i) Name this stage.

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(1 mark)

(ii) What type of molecule is **Q**?

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(1 mark)

(b) Give the base sequence on the anticodon of molecule **Z**.

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(2 marks)

(c) Describe what will happen next to

(i) molecule **Y**;

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(ii) molecule **Q**.

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(3 marks)

7

2 (a) (i) What is an *antigen*?

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(2 marks)

(ii) Myeloid leukaemia is a type of cancer. Monoclonal antibodies are used in treating it. A monoclonal antibody will bind to an antigen on a myeloid leukaemia cell. It will not bind to other types of cell. Explain why this antibody binds only to an antigen on a myeloid leukaemia cell.

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(2 marks)

(b) Calichaemicin is a substance which is very toxic and kills cells. Scientists have made a drug by joining calichaemicin to the monoclonal antibody that attaches to myeloid leukaemia cells. Explain why this drug is effective in treating myeloid leukaemia.

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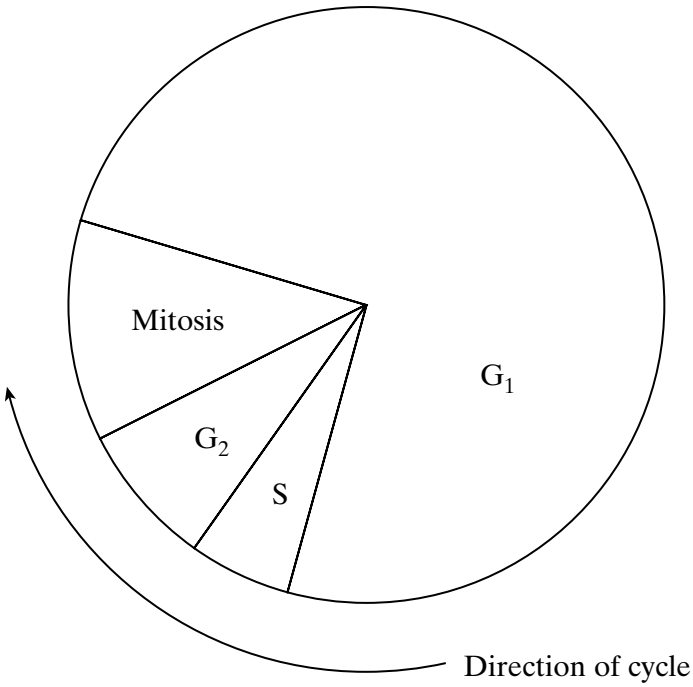
(2 marks)

6

3 The diagram shows the stages in the cell cycle.



(a) There are 40 units of DNA in a cell during stage G_2. How many units of DNA would you expect to find in this cell

(i) during stage G_1;

.....

(ii) at prophase of mitosis?

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(2 marks)

(b) Cytarabine is a drug which is used to treat cancer. The shape of a cytarabine molecule is very similar to that of a cytosine nucleotide but there are some differences.

(i) Cytarabine is incorporated into DNA. At what stage in the cell cycle would you expect cytarabine to be incorporated into DNA? Give a reason for your answer.

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(2 marks)

(ii) Explain why DNA which contains cytarabine instead of cytosine cannot produce mRNA.

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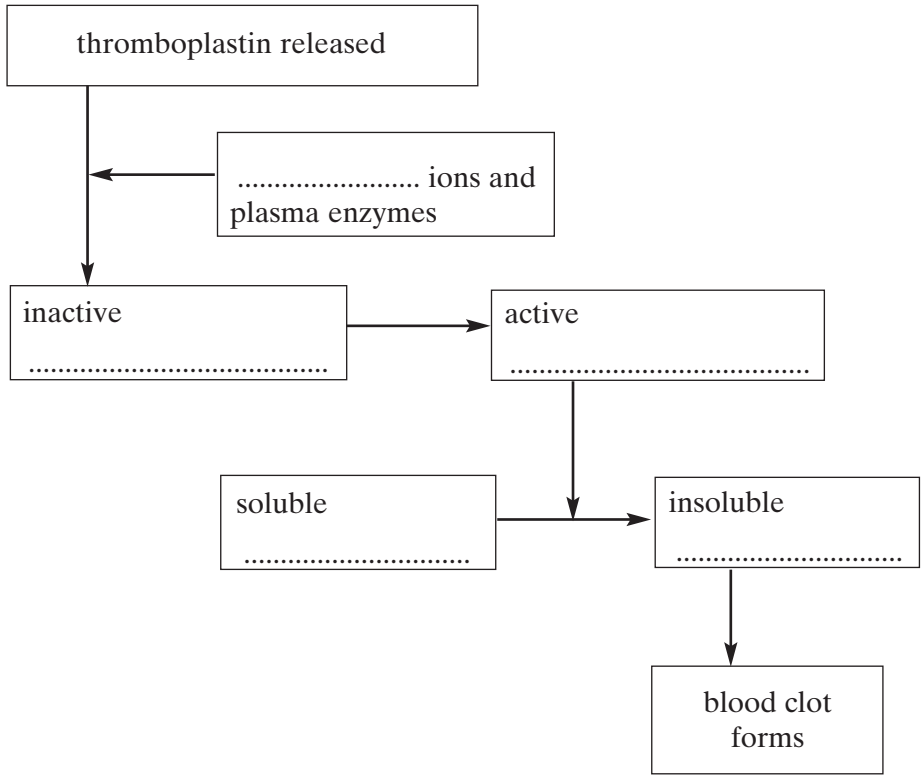
(2 marks)

6

TURN OVER FOR THE NEXT QUESTION

4 The diagram shows the main stages in blood clotting.



(a) Complete the boxes to show the names of the substances involved. *(3 marks)*

(b) (i) Explain why there may be large quantities of thromboplastin in blood after surgery.

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(1 mark)

(ii) Heparin is a drug which inhibits blood clotting. It is often used to treat patients who have had surgery. Explain why heparin is often given to patients after surgery.

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(1 mark)

5

5 **Figure 1** shows how the gene for human growth hormone (hGH) can be transferred into a bacterium.

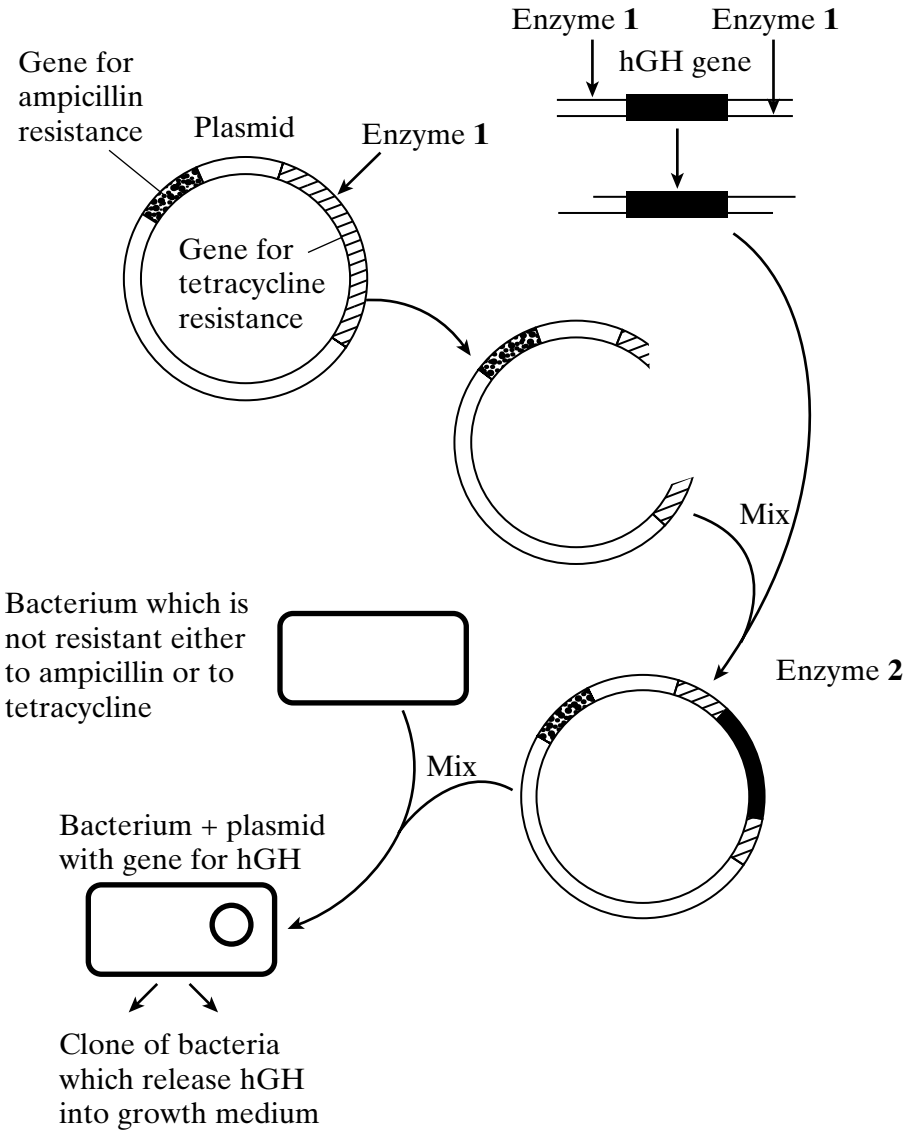

Figure 1

(a) Name

Enzyme **1**; .....

Enzyme **2**. .....

(2 marks)

(b) After mixing with the plasmid, the bacteria are first grown in Petri dishes of agar containing ampicillin. What is the reason for this?

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(2 marks)

QUESTION 5 CONTINUES ON THE NEXT PAGE

Turn over ▶

(c) **Figure 2** shows how colonies of bacteria can be transferred from a Petri dish of agar containing ampicillin to identical positions on a Petri dish of agar containing tetracycline.

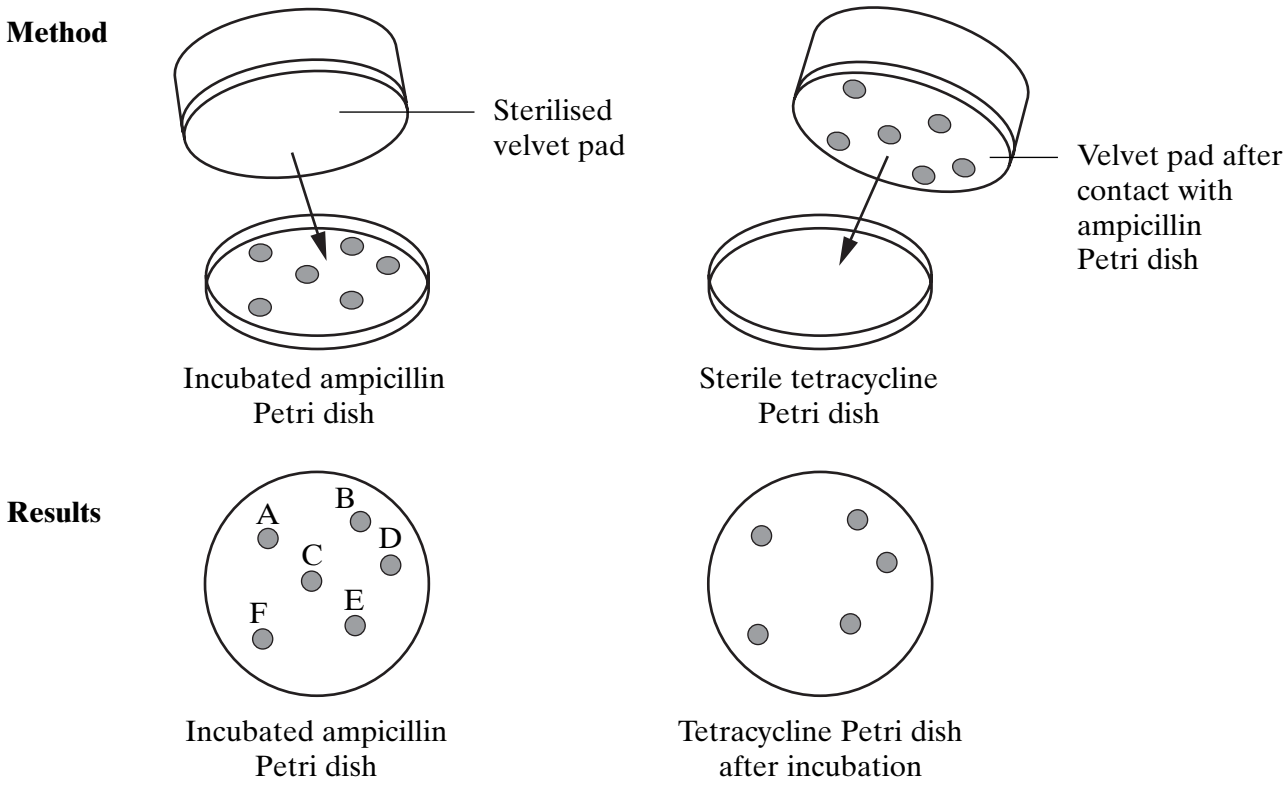

Figure 2

(i) Give the **letter** of **one** bacterial colony which contained a modified plasmid with the gene for hGH.

..... *(1 mark)*

(ii) Explain your answer to part (i).

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(2 marks)

(d) Describe **one** possible danger of using plasmids which contain genes for antibiotic resistance.

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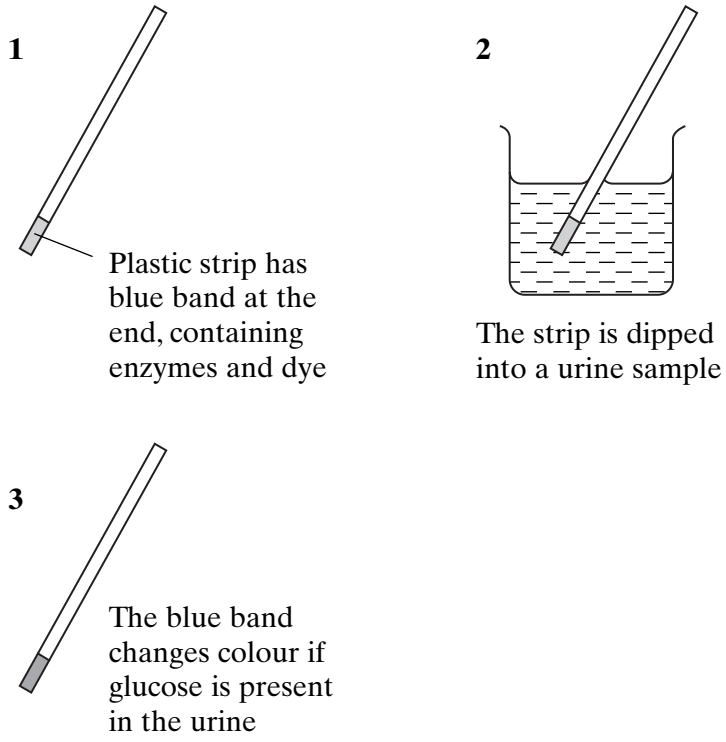
(2 marks)

9

TURN OVER FOR THE NEXT QUESTION

6 The diagram shows how a test strip is used to detect glucose in urine.



Two enzymes are present on the strip: glucose oxidase and peroxidase. They catalyse the following reactions:

$$\text{glucose} + \text{oxygen} + \text{water} \xrightarrow{\textit{glucose oxidase}} \text{gluconic acid} + \text{hydrogen peroxide}$$

$$\text{blue dye} + \text{hydrogen peroxide} \xrightarrow{\textit{peroxidase}} \text{brown dye} + \text{water}$$

(a) (i) Explain why this strip will detect glucose, but not other sugars.

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(2 marks)

(ii) Explain why peroxidase is needed on the strip, in addition to glucose oxidase.

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(2 marks)

(b) Suggest **two** advantages of having these enzymes attached to a plastic strip, rather than adding them to a urine sample in a test tube.

1 .....

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2 .....

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(2 marks)

6

TURN OVER FOR THE NEXT QUESTION

7

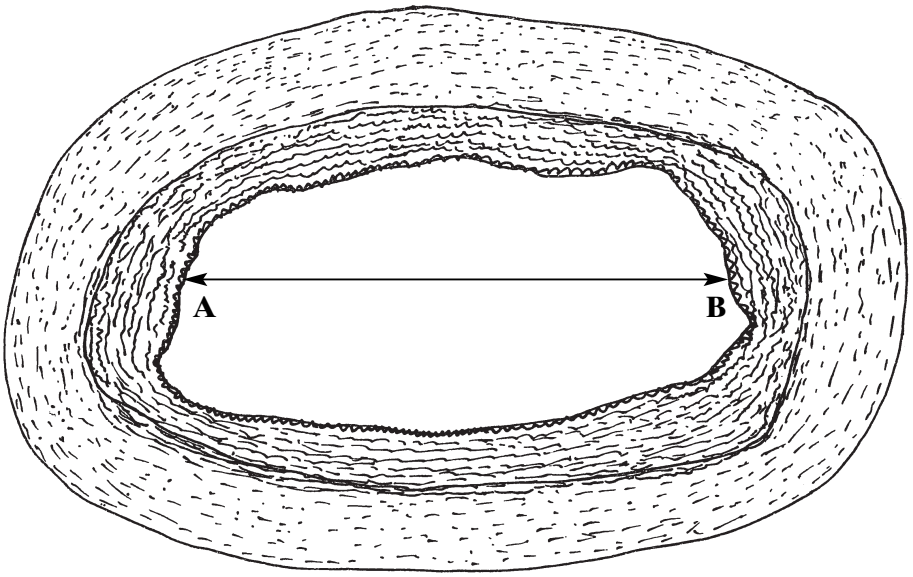

Figure 1

(a) **Figure 1** shows a section through a healthy coronary artery. The actual diameter of the lumen of the artery along line AB is 1.94 mm. Explain how you would calculate the magnification of this drawing.

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(1 mark)

(b) **Figure 2** shows a section through a coronary artery from a person with atheroma.

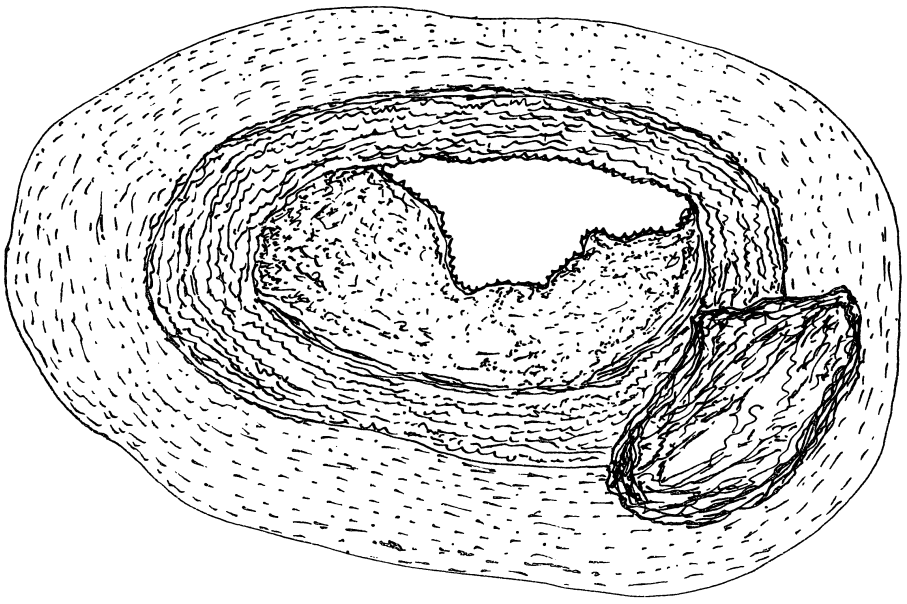

Figure 2

(i) Give **two** ways in which the artery of the person with atheroma differs from the artery of the healthy person.

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2 .....

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(2 marks)

(ii) Describe and explain how atheroma can lead to myocardial infarction.

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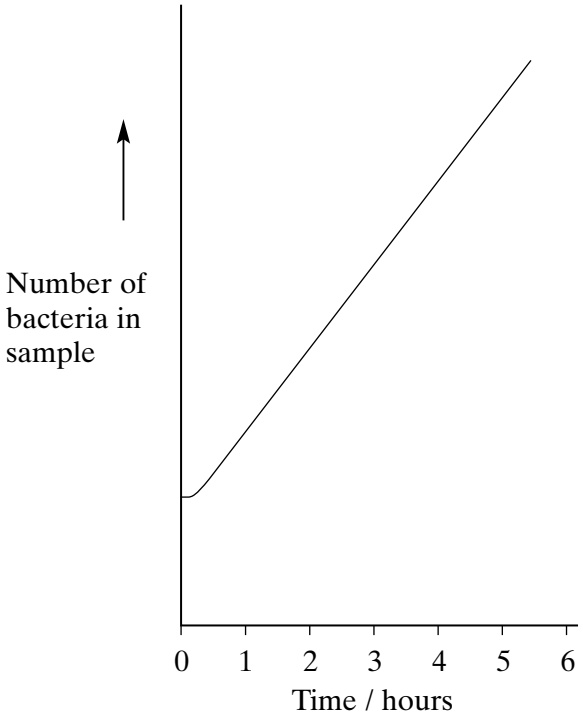
(3 marks)

6

TURN OVER FOR THE NEXT QUESTION

8 An investigation into the growth of a bacterial population was carried out. The graph shows the growth of the population in a medium containing glucose. It was incubated at 37 °C.



(a) (i) Give **two** reasons why it would be important to use sterile techniques during this investigation.

1 .....

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2 .....

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(2 marks)

(ii) Describe how you would calculate the rate of growth of the bacterial population between 2 and 5 hours.

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(1 mark)

(iii) Sketch a curve on the graph to show the expected effect of adding a bacteriostatic antibiotic at 3 hours. *(1 mark)*

(b) Suggest why a bacterial population grown in a xylose medium would have a longer lag phase than the population grown in the glucose medium.

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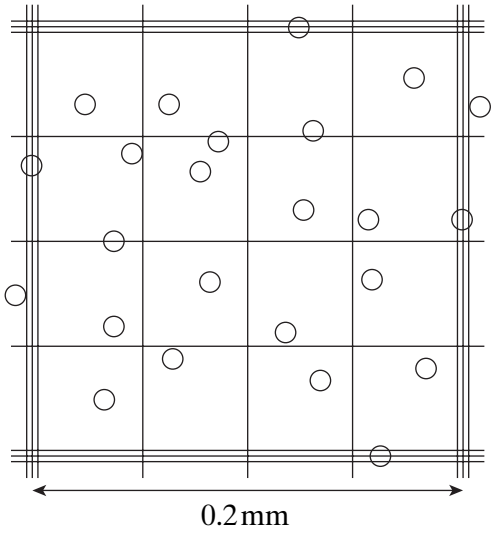
(1 mark)

(c) In this investigation, a haemocytometer was used to estimate the number of bacteria. The diagram shows part of the haemocytometer grid. The depth of the chamber is 0.1 mm.



Calculate the number of bacteria in 1 mm^3 of the bacterial sample. Show your working.

Number of bacteria .....

(4 marks)

QUESTION 8 CONTINUES ON THE NEXT PAGE

(d) Describe how *Salmonella spp*. and *Mycobacterium tuberculosis* enter the human body and cause disease.

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(6 marks)

15

9 Read the following passage.

The Ancient Egyptians preserved the bodies of their rulers. These preserved bodies are known as mummies. Museums can take samples of tissue from mummies. A research project is to be carried out to find out how many mummies are infected with the blood flukes that cause the disease schistosomiasis. The researchers will use antibodies against the parasite to detect the flukes' presence in the samples.

Later, researchers hope to begin to study DNA samples to work out the family relationships among Egyptian mummies. The project may even solve the mystery of the identity of the father of Tutankhamen, the boy Pharaoh. The mummified body of Pharaoh Akhenaten, who is thought to be Tutankhamen's father, is missing. However, historians believe that Akhenaten suffered from a genetic disorder called Frohlich's disease. If Tutankhamen is shown to carry the gene which causes Frohlich's disease, it will be very likely that Akhenaten was his father.

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

(a) It is known that many Ancient Egyptians had schistosomiasis. The area where they lived had many streams and rivers.

(i) Explain why schistosomiasis may be common in areas where there are many streams and rivers.

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(1 mark)

(ii) *Schistosoma* is a parasite. What is meant by a *parasite*?

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(2 marks)

(iii) Describe **one** adaptation of a mature *Schistosoma* fluke and explain how it allows the fluke to live in the blood vessels of a human.

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(2 marks)

(b) Explain how antibodies can be used to discover which mummies were infected with schistosomiasis. (lines 4-5).

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(2 marks)

(c) The DNA sequence of the gene that causes Frohlich's disease is known. Explain how a DNA probe and electrophoresis could be used to find out whether Tutankhamen carried this gene.

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(6 marks)

QUESTION 9 CONTINUES ON THE NEXT PAGE

(d) Explain why half Tutankhamen's DNA came from his mother and half from his father.

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(2 marks)

15

END OF QUESTIONS