Surname		Other Names	
Centre Number			Candidate Number	
Candidate Signature			

For Examiner's Use

General Certificate of Education
January 2007
Advanced Subsidiary Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

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

Wednesday 10 January 2007 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 to be marked.

Information

- The maximum mark for this paper is 75.
- The marks for questions are shown in brackets.
- You will be marked on your ability to use good English, to organise information clearly and to use accurate scientific terminology where appropriate.

For Examiner's Use			
Question	Mark	Question	Mark
1		9	
2			
3			
4			
5			
6			
7			
8			
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

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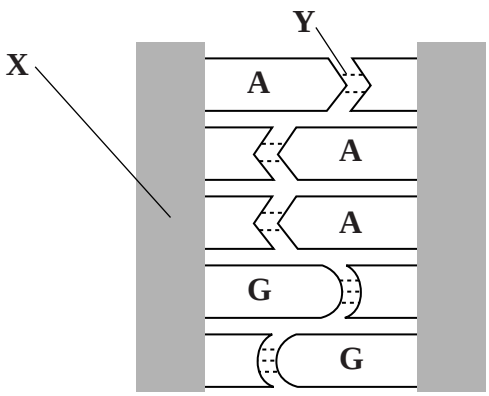
Answer **all** questions in the spaces provided.

1 (a) The diagram shows a section of a DNA molecule.



(i) The letters **A** and **G** represent the bases adenine and guanine. Complete the diagram by writing in the first letters of the remaining bases.

(1 mark)

(ii) Name the **two** components of part **X**.

..... and .....

(2 marks)

(iii) Name the type of bond found at **Y**.

.....

(1 mark)

(b) DNA is an information storage molecule.

(i) The organic bases present in DNA allow DNA to store information about the sequence of amino acids in a protein. Explain how.

.....

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.....

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(2 marks)

(ii) DNA molecules are double–stranded. Suggest **one** way in which this allows DNA to store information effectively.

.....

.....

(1 mark)

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2 (a) One type of antibiotic damages bacterial cells by disrupting reactions involved in the release of energy from glucose. Give **three** other ways in which antibiotics affect bacterial cells.

1. .....

.....

2. .....

.....

3. .....

.....

(3 marks)

(b) Antibiotics are **not** used to treat diseases caused by viruses.
Give **two** reasons why they are not used.

1. .....

.....

2. .....

.....

(2 marks)

5

Turn over for the next question

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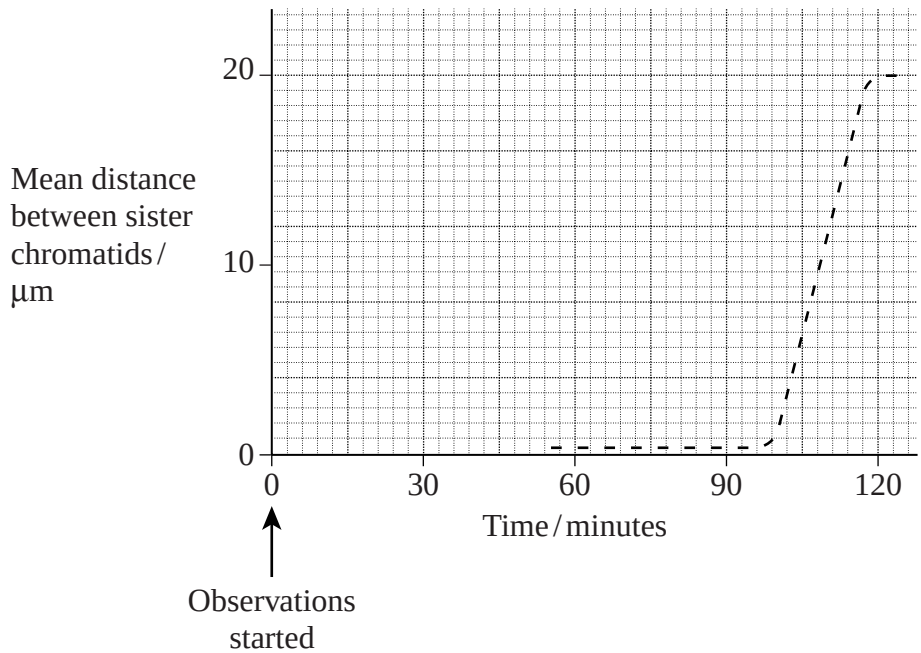
3 An investigator observed a cell during part of one cell cycle. The graph shows the mean distance between sister chromatids.



(a) (i) At what time did anaphase start?

..... minutes *(1 mark)*

(ii) Explain the evidence from the graph that supports your answer.

.....

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(2 marks)

(b) The investigator was not able to obtain measurements between 0 and 60 minutes. Use your knowledge of the cell cycle to explain why.

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(2 marks)

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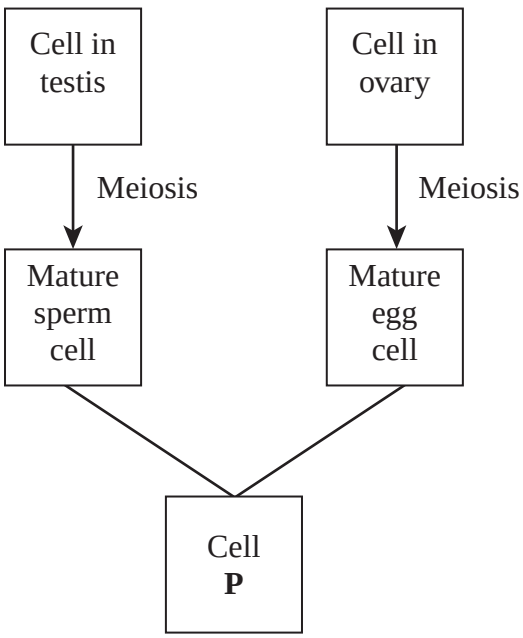
(c) The diagram summarises gamete formation and fertilisation in humans.



(i) Name cell **P**.

.....

(1 mark)

(ii) Meiosis halves the chromosome number. Explain why this is important.

.....

.....

(1 mark)

7

Turn over for the next question

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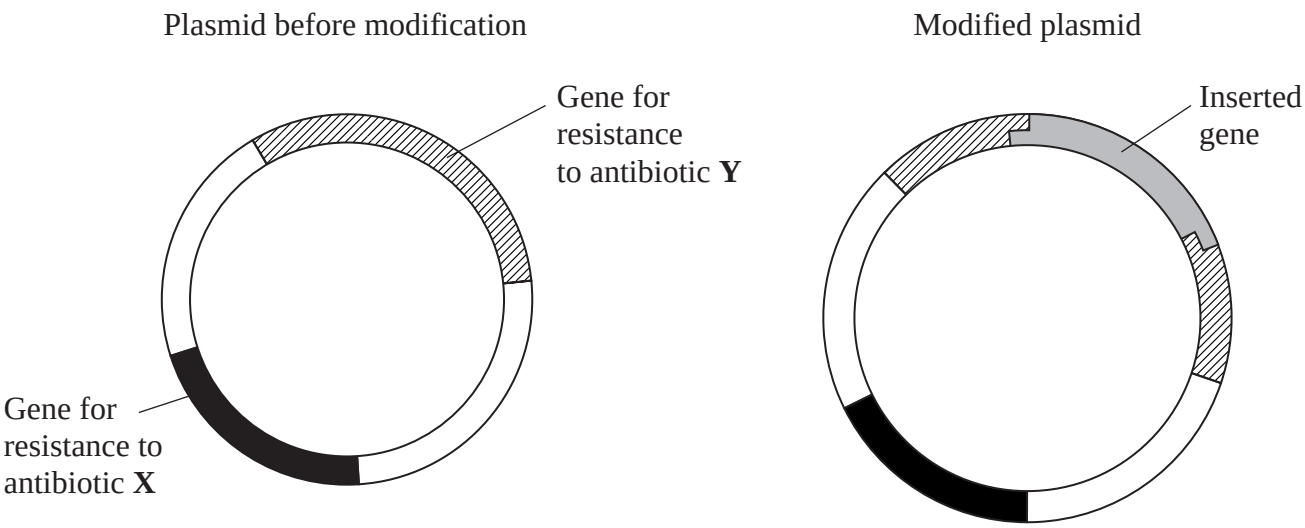
4 The diagram shows

- a plasmid that contains two genes for resistance to antibiotic before modification
- the same plasmid after it has been modified by inserting a gene from another organism.



(a) Two different enzymes are required to produce the modified plasmid. Name these **two** enzymes. Describe the function of each in producing the modified plasmid.

Enzyme 1 .....

Function .....

.....

Enzyme 2 .....

Function .....

.....

(2 marks)

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(b) Bacteria took up the modified plasmids. Explain why these bacteria were

(i) resistant to antibiotic **X**,

.....

.....

(1 mark)

(ii) not resistant to antibiotic **Y**.

.....

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(2 marks)

5

Turn over for the next question

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5 (a) Enzymes may be used as analytical reagents. A test strip containing two enzymes was used to detect glucose in urine. The enzymes were present on the test strip along with dye molecules.

(i) Explain the role of the dye molecules.

.....

.....

(1 mark)

(ii) Explain why the strip will detect glucose but will not detect other sugars.

.....

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.....

(2 marks)

(b) Amylase is an enzyme secreted from the pancreas.

A healthy woman developed pancreatitis. What changes would you expect in the concentration of amylase in her blood and her faeces?
In each case, give a reason for your answer.

Change in blood .....

Reason .....

.....

Change in faeces .....

Reason .....

.....

(3 marks)

6

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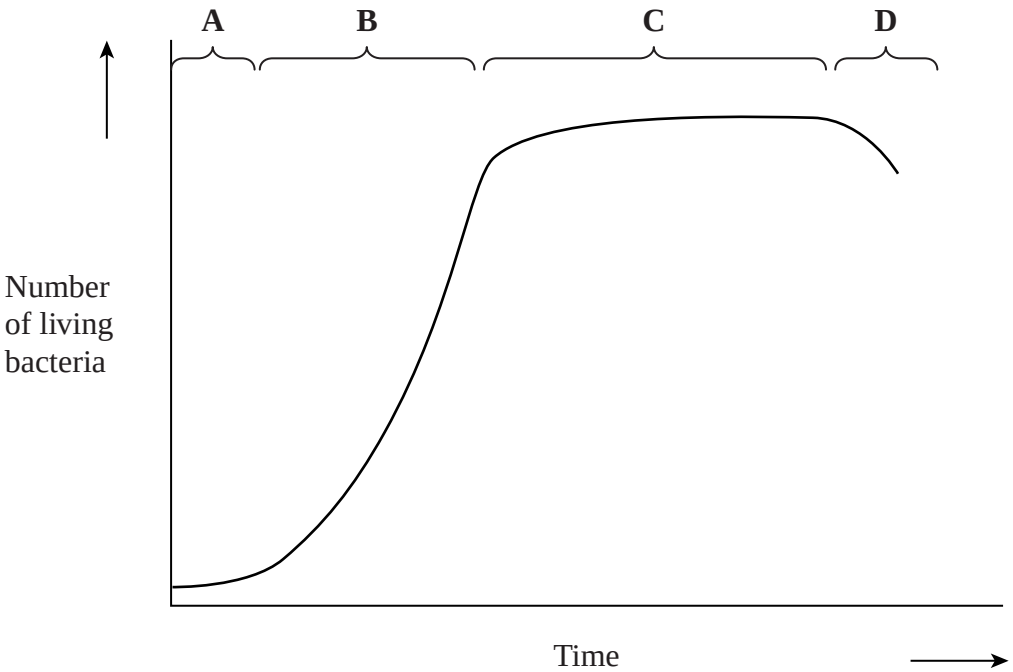
6 (a) The graph shows the changes in the number of living bacteria in a bacterial population.



Give **one** explanation for

(i) the slow initial rise in the number of bacteria during **A**,

.....

.....

(1 mark)

(ii) the rapid rise in numbers during **B**,

.....

.....

(1 mark)

(iii) the decrease in numbers during **D**.

.....

.....

(1 mark)

Question 6 continues on the next page

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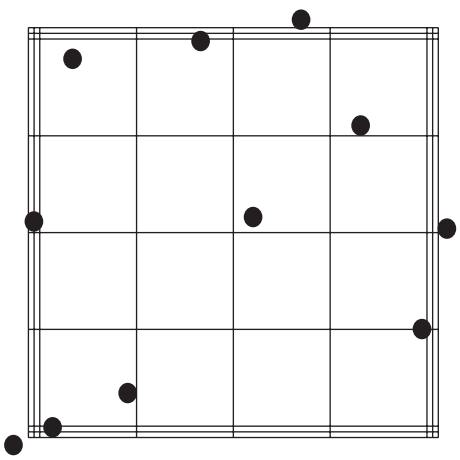
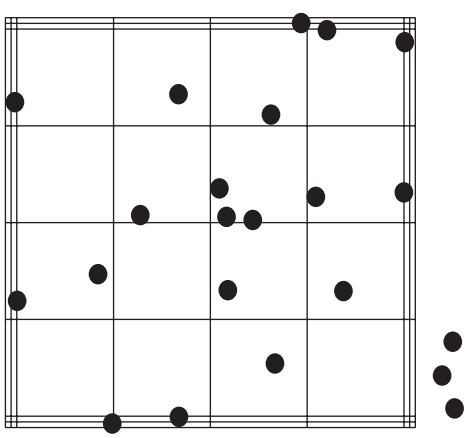
(b) Students investigated the growth of a population of yeast. They used a haemocytometer to estimate the number of yeast cells present in the culture at different times. The diagrams show a representative part of the haemocytometer grid at the start of the investigation (0 hours) and at 4 hours.

At 0 hours



At 4 hours



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(i) The volume of a triple-lined square on the haemocytometer grid is 0.004 mm^3. How many yeast cells were there in 0.004 mm^3 at 4 hours?

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

(ii) Calculate the rate of growth between 0 and 4 hours. Give your answer as the number of yeast cells per mm^3 per hour.

Answer ..... yeast cells per mm^3 per hour *(2 marks)*

6

Turn over for the next question

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7 (a) What is a parasite?

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(2 marks)

(b) Explain **two** ways in which each of the following parasites is able to survive the hostile environment within the human body.

(i) The fluke *Schistosoma*

1. .....

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2. .....

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(2 marks)

(ii) The malarial parasite *Plasmodium*

1. .....

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2. .....

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(2 marks)

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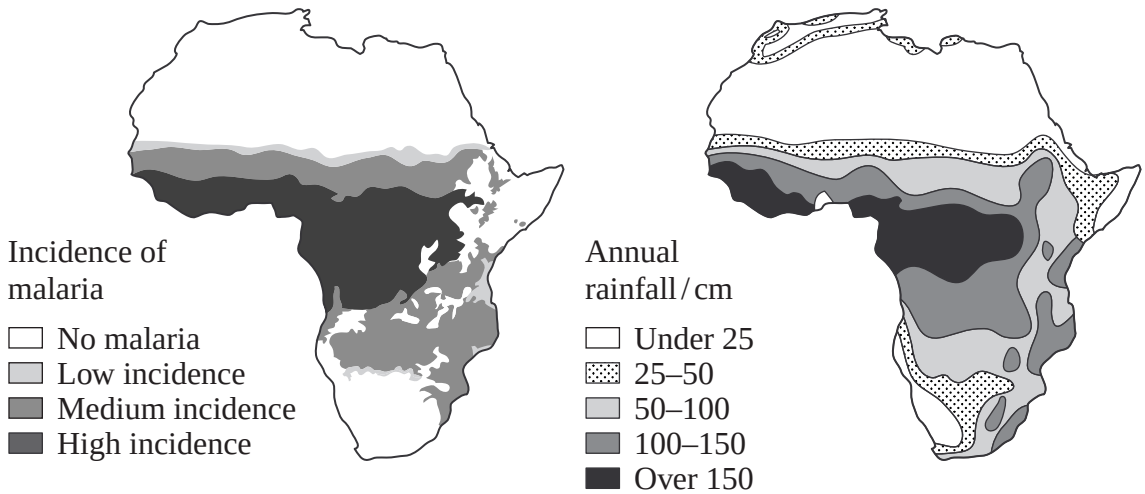
(c) The maps show the incidence of malaria and the annual rainfall in Africa.



(i) Describe the relationship between the incidence of malaria and the annual rainfall in Africa.

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(1 mark)

(ii) Suggest an explanation for this relationship.

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(2 marks)

9

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8 Read the following passage.

Platelets are small cell fragments. They release thromboplastin which initiates blood clotting. Platelets can be extracted and stored for use in transfusions. Platelets are normally stored at 22 °C. This is because at low temperatures they soon release their thromboplastin and can no longer cause clotting. Unfortunately, at 22 °C the platelets are soon damaged by bacteria.

Some species of fish that live in very cold water produce proteins that lower the temperature at which their blood freezes. These antifreeze proteins prevent the fish freezing in icy water.

In an investigation, platelets stored with antifreeze proteins were still able to cause clotting of blood after being kept at 4 °C for 21 days. In a control, platelets only retained their activity for 5 days.

It is hoped that commercial antifreeze protein production may be possible using genetically modified yeast. The gene for antifreeze protein production could be obtained using mRNA from a fish. The gene could be inserted into yeast which would then produce the protein.

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

(a) Normally platelets stored at low temperature would not bring about clotting (lines 3–4). Explain why.

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(2 marks)

(b) Cold storage would reduce the effect of damage caused by bacteria (lines 4–5). Explain how.

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(2 marks)

(c) Heat sterilisation cannot be used to prevent bacteria from growing on the platelets (lines 4–5). Explain why.

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(1 mark)

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(d) Describe how the control should have been set up in the investigation showing that antifreeze protein was able to protect platelets at low temperatures (lines 10–11).

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(2 marks)

(e) The gene for antifreeze protein could be obtained using mRNA from fish cells (lines 13–14). Describe how.

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(2 marks)

(f) A protein such as antifreeze protein is synthesised from the gene which codes for it (line 12). Describe how.

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(6 marks)

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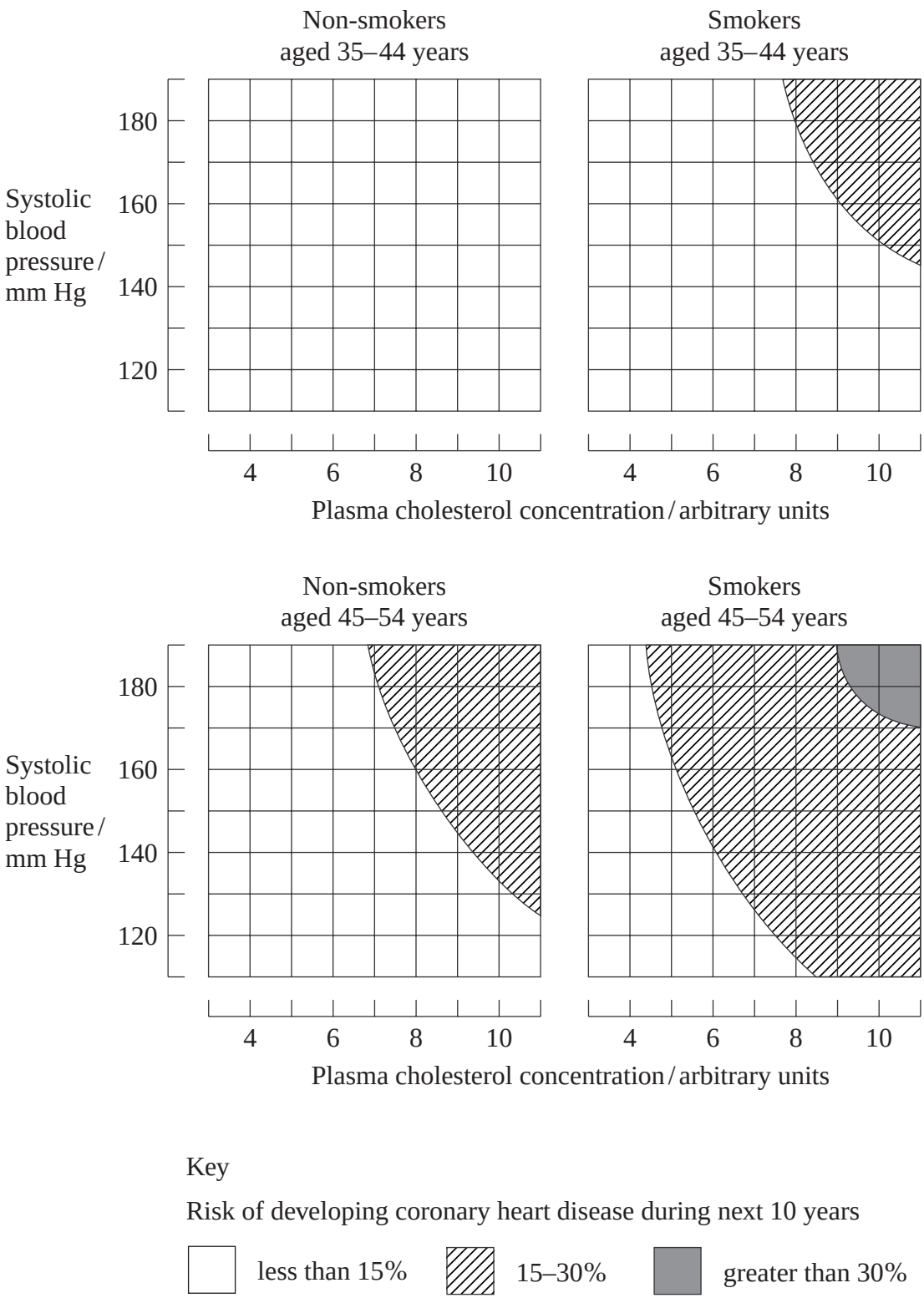
9 **Figure 1** shows the influence of different risk factors on the incidence of coronary heart disease in women. 7.5 mmHg is equal to 1 kilopascal.

Figure 1



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(a) Use **Figure 1** to give the characteristics of women with the highest risk of developing coronary heart disease.

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(2 marks)

(b) **Figure 1** only has limited value in predicting whether a particular woman might develop coronary heart disease. Explain why.

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(3 marks)

Question 9 continues on the next page

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(c) The three risk factors, high blood pressure, smoking and high plasma cholesterol, increase the risk of coronary heart disease. Explain how each risk factor increases the risk of coronary heart disease.

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(6 marks)

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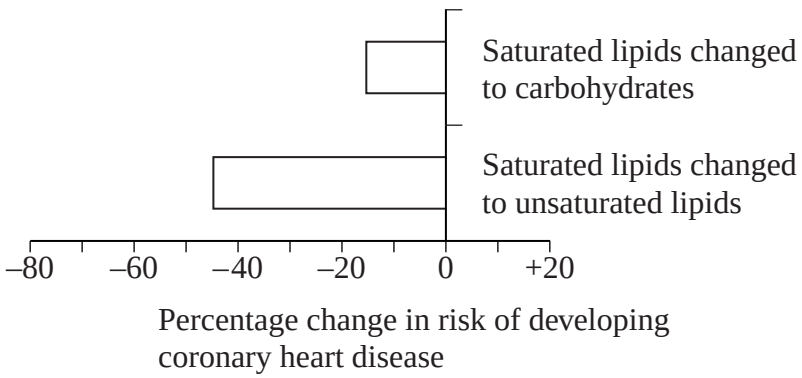
In an investigation, volunteers changed 5 % of their energy intake from one food source to another. Their total energy intake remained constant. The effect of this change on their risk of developing coronary heart disease was measured.

Figure 2 shows the results of this investigation.

Figure 2



(d) Explain why it was necessary to ensure that the total energy intake remained constant.

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(2 marks)

(e) Suggest an explanation for the results shown in **Figure 2**.

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(2 marks)

15

END OF QUESTIONS

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