Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
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7	
8	
9	
TOTAL	

General Certificate of Education
Advanced Subsidiary Examination
June 2012

Biology BIOL2

Unit 2 The variety of living organisms

Monday 21 May 2012 1.30 pm to 3.15 pm

For this paper you must have:
- a ruler with millimetre measurements.
- a calculator.

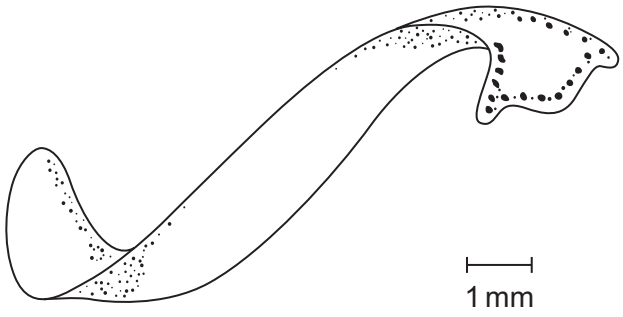
Time allowed
- 1 hour 45 minutes

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- You may ask for extra paper. Extra paper must be secured to this booklet.
- 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 85.
- You are expected to use a calculator, where appropriate.
- The marks for questions are shown in brackets.
- Quality of Written Communication will be assessed in all answers.
- You will be marked on your ability to:
  – use good English
  – organise information clearly
  – use scientific terminology accurately.

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

1 (a) Flatworms are small animals that live in water. They have no specialised gas exchange or circulatory systems.
The drawing shows one type of flatworm.



1 (a) (i) Name the process by which oxygen reaches the cells inside the body of this flatworm.

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(1 mark)

1 (a) (ii) The body of a flatworm is adapted for efficient gas exchange between the water and the cells inside the body.
Using the diagram, explain how **two** features of the flatworm's body allow efficient gas exchange.

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2 .....

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(2 marks)

1 (b) (i) A leaf is an organ. What is an organ?

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(1 mark)

1 (b) (ii) Describe how carbon dioxide in the air outside a leaf reaches mesophyll cells inside the leaf.

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(3 marks)

(Extra space) .....

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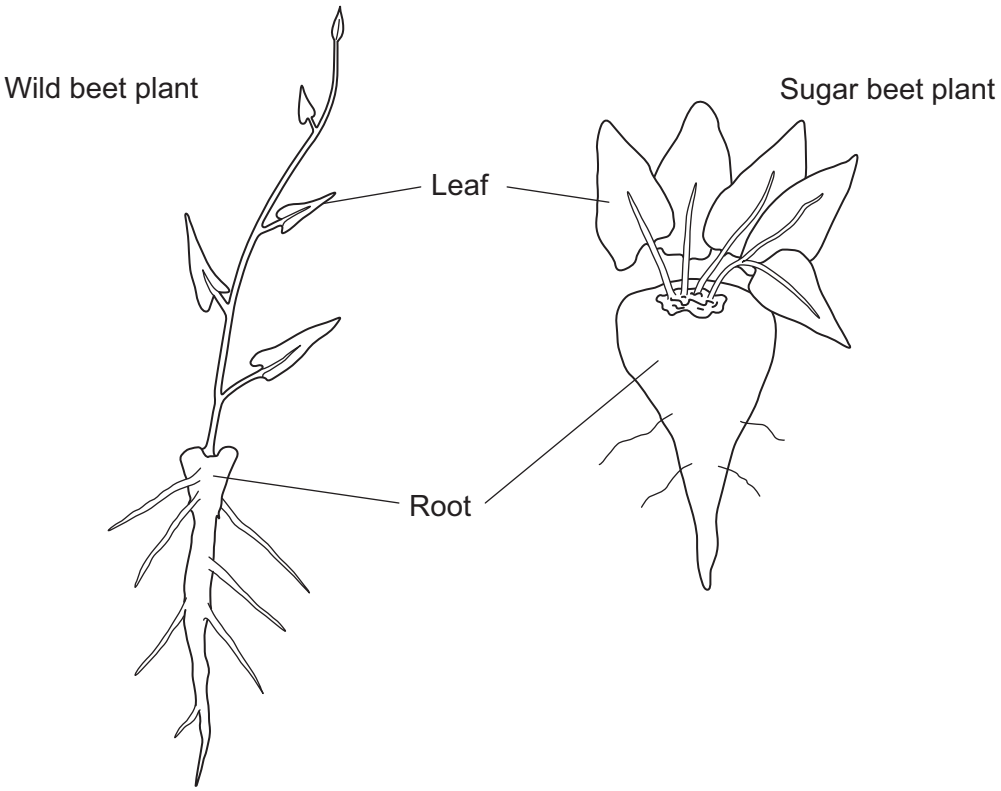
7

Turn over for the next question

2 Sugar beet is a crop grown for the sugar stored in its root. The sugar is produced by photosynthesis in the leaves of the plant. Plant breeders selected high-yielding wild beet plants. They used these plants to produce a strain of sugar beet to grow as a crop.

The drawings show a wild beet plant and a sugar beet plant. The drawings are to the same scale.



2 (a) Use the drawings to describe **two** ways in which a sugar beet plant is different from a wild beet plant.

Explain how each of these differences would give an increased yield of sugar.

Difference 1 .....

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Explanation .....

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Difference 2 .....

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Explanation .....

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(4 marks)

2 (b) Sugar beet plants have been selected for a faster rate of growth.

Suggest how the faster rate of growth may increase profit for a farmer.

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(1 mark)

2 (c) Describe and explain how selection will have affected the genetic diversity of sugar beet.

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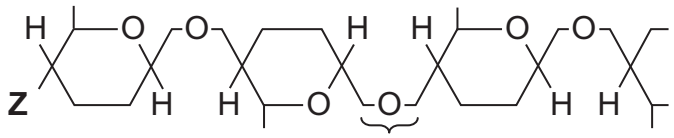
(2 marks)

7

Turn over for the next question

3 The diagram shows one end of a cellulose molecule.



3 (a) (i) Name the monomers that form a cellulose molecule.

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(1 mark)

3 (a) (ii) Name bond **Y**.

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(1 mark)

3 (a) (iii) What chemical group is at position **Z**?

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(1 mark)

3 (b) (i) Complete the table to show **two** ways in which the structure of cellulose is different from the structure of starch.

Starch	Cellulose

(2 marks)

3 (b) (ii) Explain **one** way in which the structure of cellulose is linked to its function.

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(2 marks)

7

Turn over for the next question

4 (a) Mitosis is important in the life of an organism. Give **two** reasons why.

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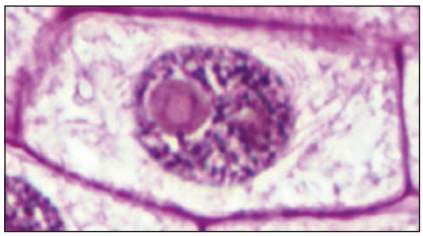
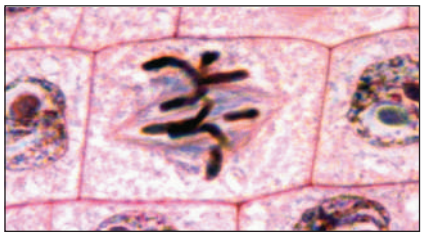
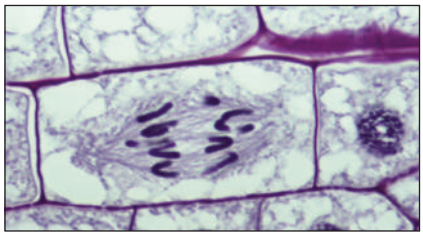
(2 marks)

A biologist used a microscope to investigate plant tissue where some of the cells were dividing by mitosis. She examined 200 cells and counted the number of cells in interphase and in each stage of mitosis.

The table shows some of the cells she saw, and the percentage of cells in interphase and in two stages of mitosis, **A** and **B**.

Stage of cell cycle	Percentage of cells
Interphase 	90
Stage **A** 	3
Stage **B** 	1

4 (b) (i) Explain why the biologist chose to examine 200 cells.

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(1 mark)

4 (b) (ii) Name Stage **A** and Stage **B**. Give the evidence from the photograph that you used to identify the stage.

Name of Stage **A** .....

Evidence .....

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Name of Stage **B** .....

Evidence .....

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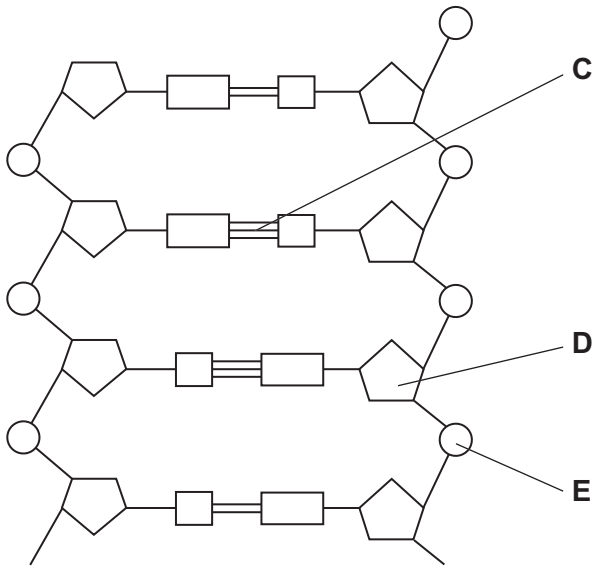
(4 marks)

4 (c) In this tissue one complete cell cycle took 20 hours.
Using information from the table, calculate the mean time for these cells to complete mitosis. Show your working.

Answer ..... *(2 marks)*

9

5 The diagram shows part of a DNA molecule.



5 (a) (i) DNA is a polymer. What is the evidence from the diagram that DNA is a polymer?

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(1 mark)

5 (a) (ii) Name the parts of the diagram labelled **C**, **D** and **E**.

Part **C** .....

Part **D** .....

Part **E** .....

(3 marks)

5 (a) (iii) In a piece of DNA, 34% of the bases were thymine.

Complete the table to show the names and percentages of the other bases.

Name of base	Percentage
Thymine	34
	34

(2 marks)

5 (b) A polypeptide has 51 amino acids in its primary structure.

5 (b) (i) What is the minimum number of DNA bases required to code for the amino acids in this polypeptide?

(1 mark)

5 (b) (ii) The gene for this polypeptide contains more than this number of bases.

Explain why.

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(1 mark)

8

Turn over for the next question

6 Hummingbirds belong to the order Apodiformes. One genus in this order is *Topaza*.

6 (a) (i) Name **one** other taxonomic group to which all members of the Apodiformes belong.

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(1 mark)

6 (a) (ii) Name the taxonomic group between order and genus.

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(1 mark)

The crimson topaz and the fiery topaz are hummingbirds.

Biologists investigated whether the crimson topaz and the fiery topaz are different species of hummingbird, or different forms of the same species.

They caught large numbers of each type of hummingbird. For each bird they

- recorded its sex
- recorded its mass
- recorded the colour of its throat feathers
- took a sample of a blood protein.

The table shows some of their results.

	Crimson topaz		**Fiery topaz**	
	Male	**Female**	**Male**	**Female**
Mean mass / g (± standard deviation)	13.6 (±1.9)	10.8 (±1.3)	14.2 (±1.6)	11.6 (±0.63)
Colour of throat feathers	Green	Grey edges	Yellowish green	No grey edges

6 (b) (i) Explain how the standard deviation helps in the interpretation of these data.

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(2 marks)

6 (b) (ii) In hummingbirds throat colour is important in courtship. Explain the evidence in the table that shows that the crimson topaz and the fiery topaz may be different species of hummingbird.

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(2 marks)

6 (c) The biologists analysed the amino acid sequences of the blood protein samples from these hummingbirds.

Explain how these sequences could provide evidence as to whether the crimson topaz and the fiery topaz are different species.

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(2 marks)

8

Turn over for the next question

7 Scientists investigated the species of insects found in a wood and in a nearby wheat field. The scientists collected insects by placing traps at sites chosen at random both in the wood and in the wheat field.

The table shows the data collected in the wood and in the wheat field.

Species of insect	Number of organisms of each species	
	Wood	Wheat field
Bird-cherry oat aphid	0	216
Beech aphid	563	0
Large white butterfly	20	0
Lacewing	12	3
7-spot ladybird	36	0
2-spot ladybird	9	1
Total number of organisms of all species	640	220

7 (a) The scientists collected insects at sites chosen at random. Explain the importance of the sites being chosen at random.

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(1 mark)

7 (b) (i) Use the formula

$$d = \frac{N(N-1)}{\sum n(n-1)}$$

to calculate the index of diversity for the insects caught in the wood, where

d = index of diversity
N = total number of organisms of all species
n = total number of organisms of each species

Show your working.

Answer .....

(2 marks)

7 (b) (ii) Without carrying out any further calculations, estimate whether the index of diversity for the wheat field would be higher or lower than the index of diversity for the wood.

Explain how you arrived at your answer.

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(2 marks)

7 (c) A journalist concluded that this investigation showed that farming reduces species diversity.
Evaluate this conclusion.

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(2 marks)

7 (d) Farmers were offered grants by the government to plant hedges around their fields.
Explain the effect planting hedges could have on the index of diversity for animals.

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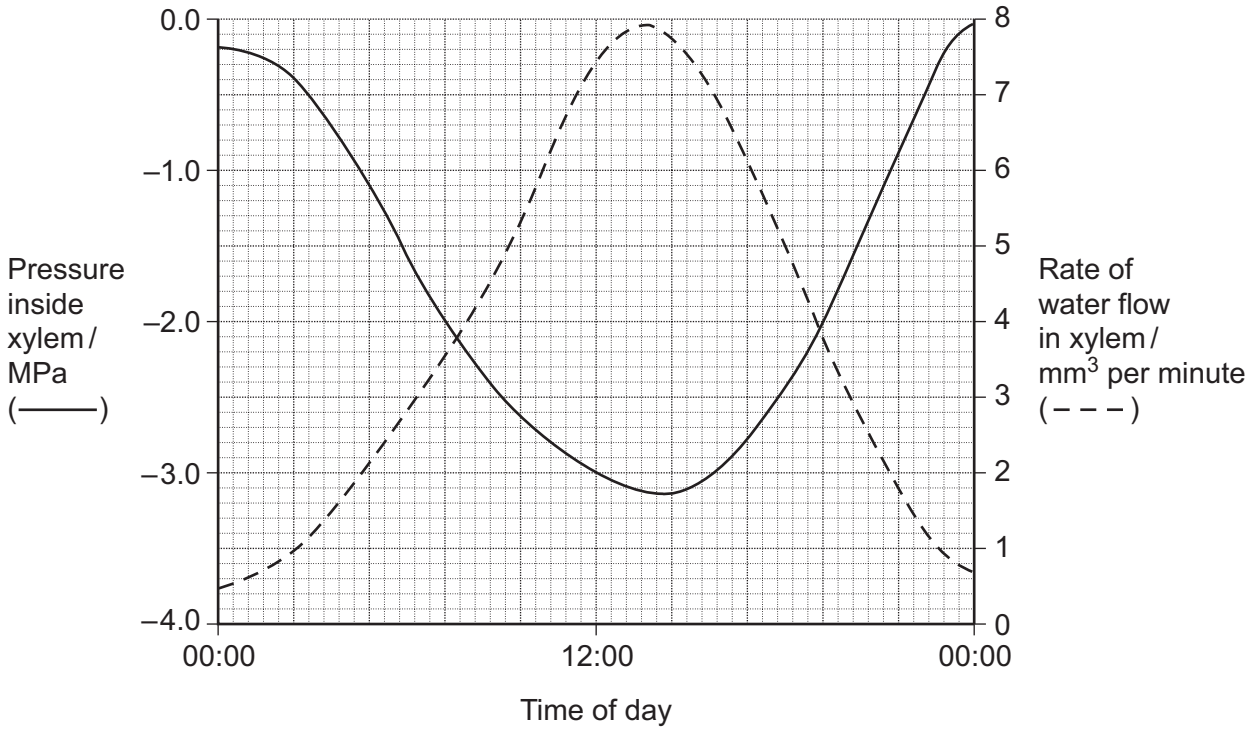
(2 marks)

9

8 (a) Scientists measured the rate of water flow and the pressure in the xylem in a small branch. Their results are shown in the graph.



8 (a) (i) Use your knowledge of transpiration to explain the changes in the rate of flow in the xylem shown in the graph.

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(3 marks)

(Extra space) .....

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8 (a) (ii) Explain why the values for the pressure in the xylem are negative.

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(1 mark)

Question 8 continues on the next page

8 (b) Doctors measured the thickness of the walls of three blood vessels in a large group of people. Their results are given in the table.

Name of vessel	Mean wall thickness / mm (± standard deviation)
Aorta	5.7 ± 1.2
Pulmonary artery	1.0 ± 0.2
Pulmonary vein	0.5 ± 0.2

8 (b) (i) Explain the difference in thickness between the pulmonary artery and the pulmonary vein.

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(1 mark)

8 (b) (ii) The thickness of the aorta wall changes all the time during each cardiac cycle. Explain why.

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(3 marks)

(Extra space) .....

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8 (b) (iii) Which of the three blood vessels shows the greatest variation in wall thickness? Explain your answer.

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(1 mark)

8 (c) Describe how tissue fluid is formed **and** how it is returned to the circulatory system.

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(6 marks)

(Extra space) .....

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Turn over for the next question

9 *Staphylococcus aureus* is a bacterium that causes disease in humans. Scientists carried out an investigation to find the most effective concentration of antibiotic to treat this disease.

The scientists put equal volumes of a culture of *S. aureus* in five flasks.

- They added nothing further to one flask. This was the control.
- They added different concentrations of antibiotic to the other four flasks.

The scientists incubated all the flasks at 35 °C for 3 hours. They then estimated the number of living bacteria in each flask.

9 (a) (i) The flasks were incubated at 35 °C. Suggest why they were incubated at this temperature.

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(1 mark)

9 (a) (ii) The scientist put the same volume of bacterial culture into each flask. Explain why.

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(1 mark)

9 (a) (iii) What was the purpose of the control flask?

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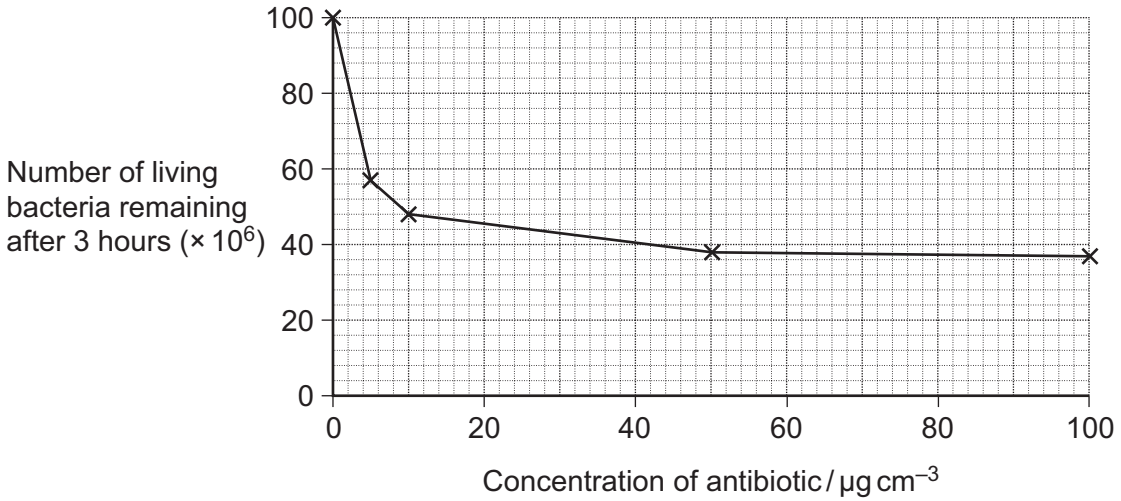
(1 mark)

9 (b) The graph shows the scientists' results.



9 (b) (i) Describe the pattern of results shown in the graph.

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(2 marks)

9 (b) (ii) A student concluded from these results that an antibiotic dose equivalent to 50 µg cm^{-3} would be the most effective in treating disease caused by *S. aureus*.

Evaluate his conclusion.

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(3 marks)

(Extra space) .....

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Question 9 continues on the next page

9 (c) Give **two** ways in which a bacterium could become resistant to an antibiotic.

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(2 marks)

9 (d) *S. aureus* lives inside people's mouths. Some dentists believe that this bacterium can get into the blood of people who have had teeth extracted and infect their heart valves.

Doctors carried out a survey to find out whether there was a risk of developing infected heart valves after tooth extraction. They asked patients whether they had had any teeth extracted in the last 2 or 3 months. They collected this information from patients who had infected heart valves. They also collected this information from the same number of other patients who did not have infected heart valves.

The information is summarised in the table.

Hospital patients	**Percentage of patients who had teeth extracted within the past**	
	2 months	**3 months**
Group that had infected heart valves	16.8	23.0
Group that did **not** have infected heart valves	14.4	23.0

The people chosen to be included in the survey were all of a similar age. Suggest why.

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(1 mark)

9 (e) Some dentists recommend a course of antibiotics when someone has a tooth extracted. Does the information in parts **(b)**, **(c)** and **(d)** support this recommendation? Explain your answer.

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(4 marks)

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15

END OF QUESTIONS

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