Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
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TOTAL	

General Certificate of Education
Advanced Subsidiary Examination
June 2010

Biology BIOL2

Unit 2 The variety of living organisms

Tuesday 8 June 2010 9.00 am to 10.45 am

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.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- 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.
- 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.

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

1 (a) Give **one** feature of starch and explain how this feature enables it to act as a storage substance.

Feature .....

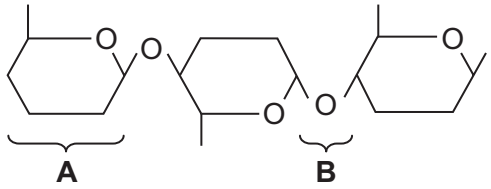
Explanation .....

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(2 marks)

1 (b) The diagram shows part of a cellulose molecule.



1 (b) (i) Name part **A**.

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(1 mark)

1 (b) (ii) Name bond **B**.

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(1 mark)

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1 (c) The structure of cellulose is related to its role in plant cell walls. Explain how.

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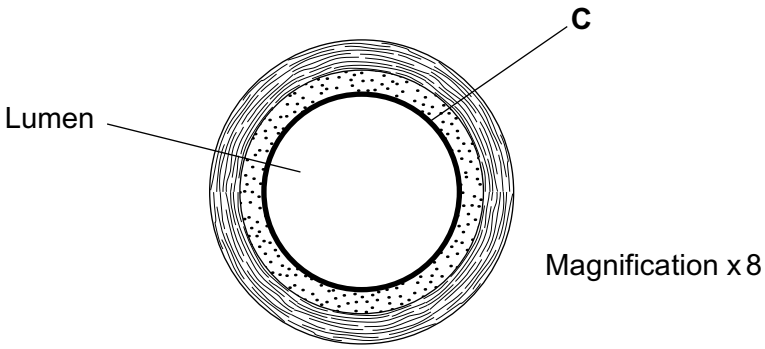
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Turn over for the next question

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2 The diagram shows a cross-section of a blood vessel.



2 (a) Name layer **C**.

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(1 mark)

2 (b) Calculate the actual diameter of the lumen of this blood vessel in millimetres. Show your working.

Answer ..... mm

(2 marks)

2 (c) The aorta has many elastic fibres in its wall. An arteriole has many muscle fibres in its wall.

2 (c) (i) Explain the importance of elastic fibres in the wall of the aorta.

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(2 marks)

2 (c) (ii) Explain the importance of muscle fibres in the wall of an arteriole.

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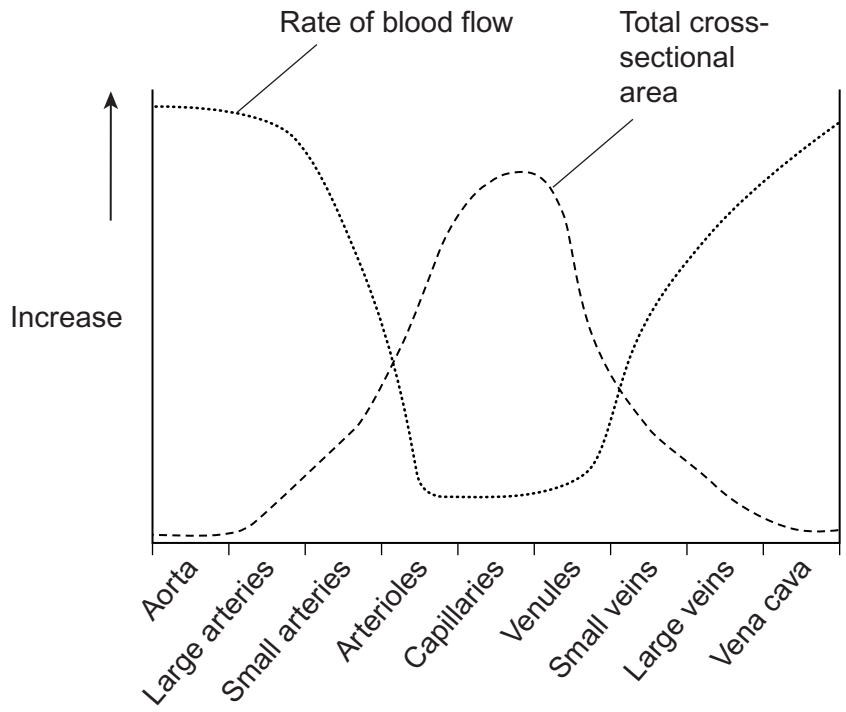
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(2 marks)

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2 (d) The graph shows the rate of blood flow in different blood vessels. It also shows the total cross-sectional area of these blood vessels.



2 (d) (i) The rate of blood flow decreases from the aorta to the capillaries. Use information from the graph to explain why.

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(1 mark)

2 (d) (ii) Efficient exchange of substances in the capillaries is linked to the rate of blood flow. Explain how.

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(1 mark)

9

Turn over ▶

Do not write outside the box

3 (a) What name is used for the non-coding sections of a gene?

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(1 mark)

Figure 1 shows a DNA base sequence. It also shows the effect of two mutations on this base sequence. **Figure 2** shows DNA triplets that code for different amino acids.

Figure 1

Original DNA base sequence	A	T	T	G	G	C	G	T	G	T	C	T
Amino acid sequence												
Mutation **1** DNA base sequence	A	T	T	G	G	A	G	T	G	T	C	T
Mutation **2** DNA base sequence	A	T	T	G	G	C	C	T	G	T	C	T

Figure 2

DNA triplets	Amino acid
GGT, GGC, GGA, GGG	Gly
GTT, GTA, GTG, GTC	Val
ATC, ATT, ATA	Ile
TCC, TCT, TCA, TCG	Ser
CTC, CTT, CTA, CTG	Leu

3 (b) Complete **Figure 1** to show the sequence of amino acids coded for by the original DNA base sequence. *(1 mark)*

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3 (c) Some gene mutations affect the amino acid sequence. Some mutations do not. Use the information from **Figure 1** and **Figure 2** to explain

3 (c) (i) whether mutation **1** affects the amino acid sequence

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(2 marks)

3 (c) (ii) how mutation **2** could lead to the formation of a non-functional enzyme.

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(3 marks)

(Extra space) .....

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3 (d) Gene mutations occur spontaneously.

3 (d) (i) During which part of the cell cycle are gene mutations most likely to occur?

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(1 mark)

3 (d) (ii) Suggest an explanation for your answer.

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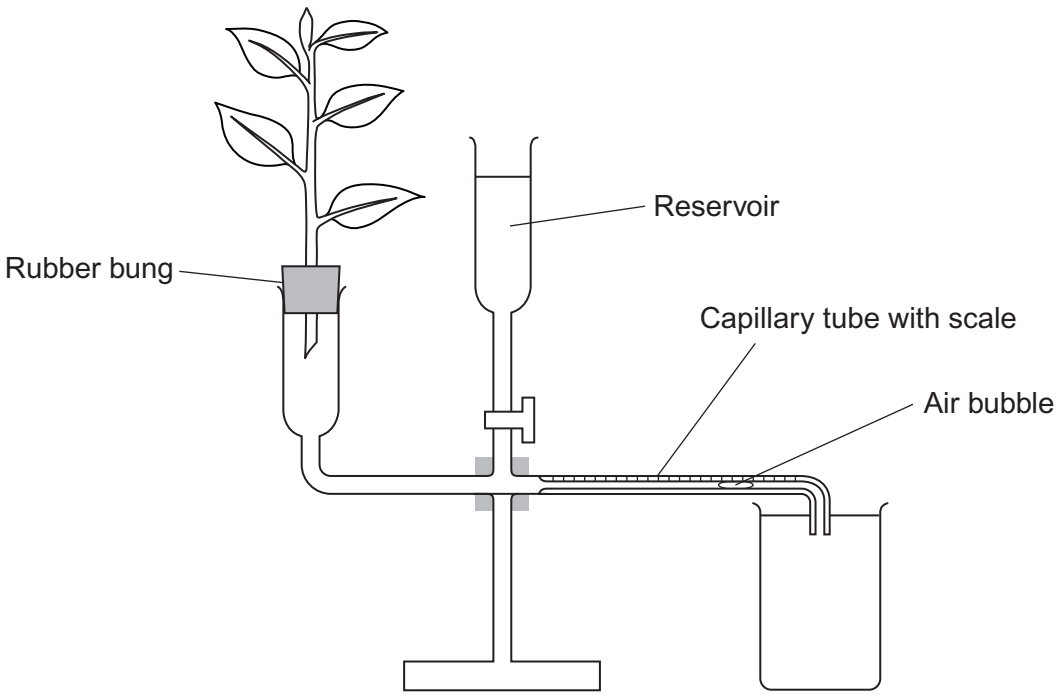
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(1 mark)

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4 A student investigated the rate of transpiration from a leafy shoot. She used a potometer to measure the rate of water uptake by the shoot. The diagram shows the potometer used by the student.



4 (a) Give **one** environmental factor that the student should have kept constant during this investigation.

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(1 mark)

4 (b) The student cut the shoot and put it into the potometer under water. Explain why.

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(1 mark)

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4 (c) The student wanted to calculate the rate of water uptake by the shoot in cm^3 per minute. What measurements did she need to make?

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(2 marks)

4 (d) The student assumed that water uptake was equivalent to the rate of transpiration. Give **two** reasons why this might **not** be a valid assumption.

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2. .....

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(2 marks)

4 (e) The student measured the rate of water uptake three times.

4 (e) (i) Suggest how the reservoir allows repeat measurements to be made.

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(1 mark)

4 (e) (ii) Suggest why she made repeat measurements.

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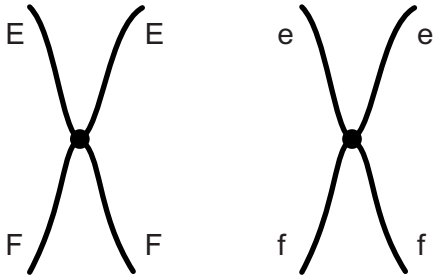
(1 mark)

8

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5 **Figure 3** shows a pair of chromosomes at the start of meiosis. The letters represent alleles.

Figure 3



5 (a) What is an allele?

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(1 mark)

5 (b) Explain the appearance of one of the chromosomes in **Figure 3**.

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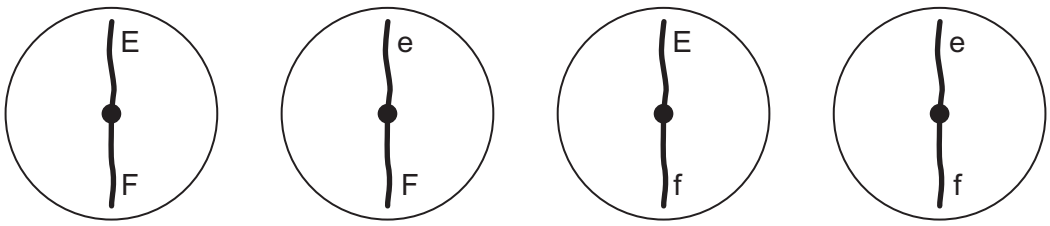
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(2 marks)

5 (c) The cell containing this pair of chromosomes divided by meiosis. **Figure 4** shows the distribution of chromosomes from this pair in four of the gametes produced.

Figure 4



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5 (c) (i) Some of the gametes formed during meiosis have new combinations of alleles. Explain how the gametes with the combinations of alleles Ef and eF have been produced.

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(2 marks)

5 (c) (ii) Only a few gametes have the new combination of alleles Ef and eF. Most gametes have the combination of alleles EF and ef. Suggest why only a few gametes have the new combination of alleles, Ef and eF.

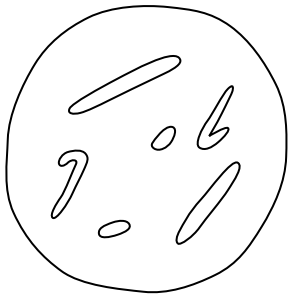
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(1 mark)

5 (d) **Figure 5** shows a cell with six chromosomes.

Figure 5



5 (d) (i) This cell produces gametes by meiosis. Draw a diagram to show the chromosomes in one of the gametes.

(2 marks)

5 (d) (ii) How many different types of gametes could be produced from this cell as a result of different combinations of maternal and paternal chromosomes? *(1 mark)*

9

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ANSWER IN THE SPACES PROVIDED

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6 Cytochrome c is a protein found in all eukaryotes. In humans it consists of 102 amino acids. Biologists have compared the amino acid sequence in some other species with that in humans. The table shows amino acids 9 to 13 in the amino acid sequences of cytochrome c from four species.

	Amino acid in this position in cytochrome c				
Species	9	10	11	12	13
Human	Ile	Phe	Ile	Met	Lys
Chicken	Ile	Phe	Val	Gln	Lys
Dogfish	Val	Phe	Val	Gln	Lys
Chimpanzee	Ile	Phe	Ile	Met	Lys

6 (a) What do the results suggest about the relationship between humans and the other three species?

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(2 marks)

6 (b) Suggest **one** advantage of using cytochrome c to determine relationships between species.

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(1 mark)

6 (c) Comparing the base sequence of a gene provides more information than comparing the amino acid sequence for which the gene codes. Explain why.

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(2 marks)

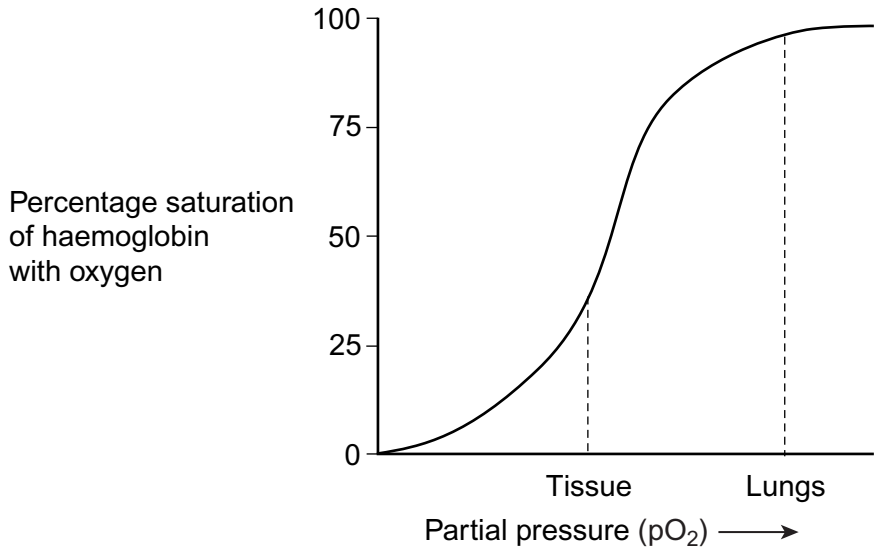
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7 (a) **Figure 6** shows the oxygen dissociation curve for human haemoglobin.

Figure 6



Use **Figure 6** to describe how haemoglobin loads and unloads oxygen in the body.

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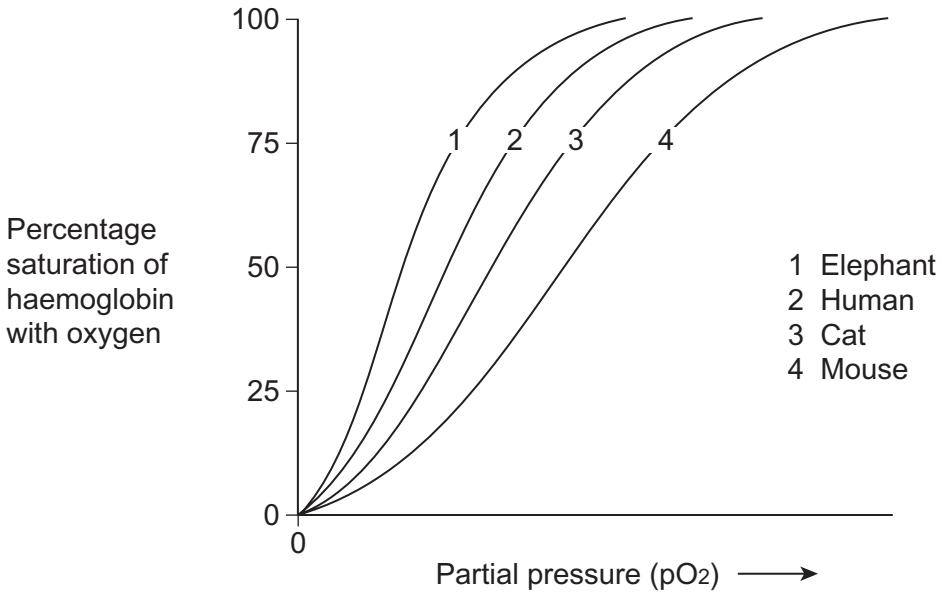
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7 (b) **Figure 7** shows oxygen dissociation curves from mammals of different size.

Figure 7



7 (b) (i) Describe the relationship between the size of mammals and the oxygen dissociation curves of their haemoglobins.

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(1 mark)

7 (b) (ii) Heat from respiration helps mammals to maintain a constant body temperature. Use this information to explain the relationship between the surface area to volume ratio of mammals and the oxygen dissociation curves of their haemoglobins.

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(4 marks)

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8

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8 (a) The number of patients infected with the bacterium MRSA has increased in some hospitals. Scientists have suggested ways to reduce the transmission of MRSA in hospitals. Suggest **two** ways to reduce the transmission of MRSA in hospitals.

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(2 marks)

8 (b) The minimum inhibitory concentration (MIC) is the lowest concentration of a substance that prevents the growth of a microorganism.

When antibiotics are prescribed for treating patients, higher doses than the MIC are recommended. Suggest **two** reasons why.

1 .....

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(2 marks)

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Scientists tested a new group of drugs for their effectiveness against four species of bacteria. The scientists used MICs to compare the effectiveness of four drugs. The results are shown in the table.

Drug	Minimum inhibitory concentration / μg cm^{-3}			
	Escherichia coli	*Staphylococcus aureus*	*Enterococcus faecalis*	*Pseudomonas aeruginosa*
P	0.39	0.049	0.049	3.13
Q	1.54	0.049	0.195	3.13
R	0.39	0.049	0.195	1.56
S	1.56	0.098	0.390	12.50

8 (c) Which of the four drugs is

8 (c) (i) most effective against *Enterococcus faecalis*?

(1 mark)

8 (c) (ii) least effective against all the species of bacteria used?

(1 mark)

8 (d) The effectiveness of these drugs was tested in double-blind trials using human volunteers. In a double-blind trial neither the volunteers nor the scientists know which treatment a particular volunteer is receiving.

8 (d) (i) Suggest **two** ways in which a double-blind trial improves reliability.

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(2 marks)

8 (d) (ii) Suggest **two** factors the scientists should have considered when selecting adult volunteers for this trial.

1 .....

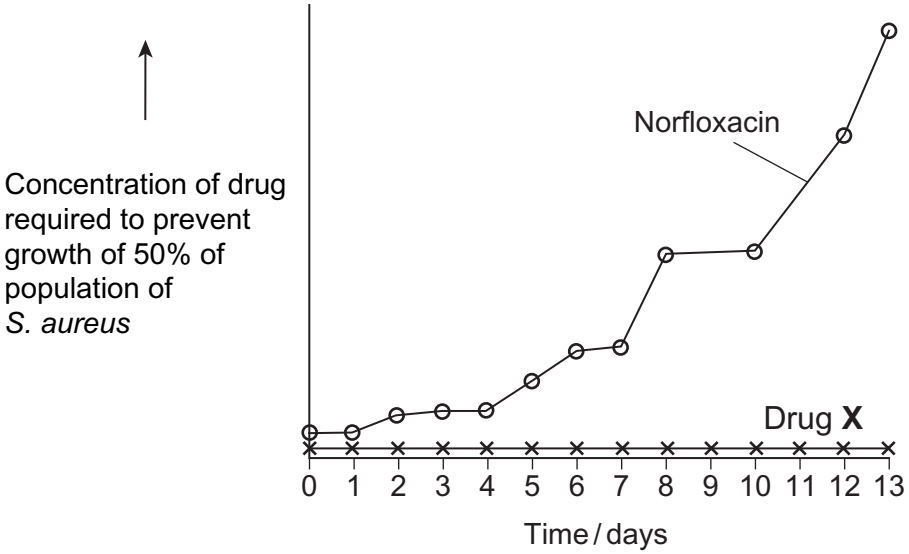
2 .....

(2 marks)

Question 8 continues on the next page

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8 (e) Scientists investigated resistance of the bacterium, *S. aureus* to the antibiotic Norfloxacin. They grew the bacteria in a medium containing a low concentration of Norfloxacin. The concentration of Norfloxacin that they added killed some of the bacteria. It did not kill all of them. Every 24 hours, they removed a sample of the bacteria from the culture. They tested the sample to find the concentration of Norfloxacin that prevented the growth of 50 % of the bacteria in the sample.
The scientists then used the same method to investigate the resistance of *S. aureus* to a new drug, drug **X**. The results of both investigations are shown in the graph.



8 (e) (i) Describe the results obtained with Norfloxacin.

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(1 mark)

8 (e) (ii) Use your knowledge of resistance to explain the results obtained with Norfloxacin and drug **X**.

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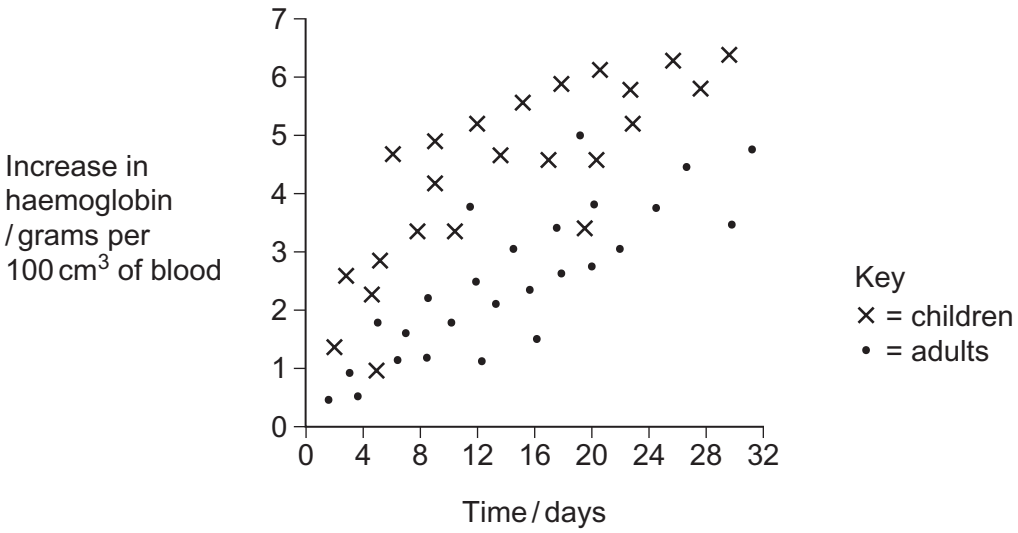
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9 (a) Haemoglobin contains iron. One type of anaemia is caused by a lack of iron. This type of anaemia can be treated by taking tablets containing iron. A number of patients were given a daily dose of 120 mg of iron. **Figure 8** shows the effect of this treatment on the increase in the concentration of haemoglobin in their red blood cells.

Figure 8



9 (a) (i) Give **one** difference in the response of adults and children to this treatment.

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(1 mark)

9 (a) (ii) You could use the graph to predict the effect of this treatment on the increase in haemoglobin content of an adult after 40 days. Explain how.

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(2 marks)

9 (a) (iii) Haemoglobin has a quaternary structure. Explain what is meant by a quaternary structure.

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(1 mark)

Question 9 continues on the next page

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9 (b) (i) Pernicious anaemia is another type of anaemia. One method of identifying pernicious anaemia is to measure the diameter of the red blood cells in a sample of blood that has been diluted with an isotonic salt solution. Explain why an isotonic salt solution is used to dilute the blood sample.

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(3 marks)

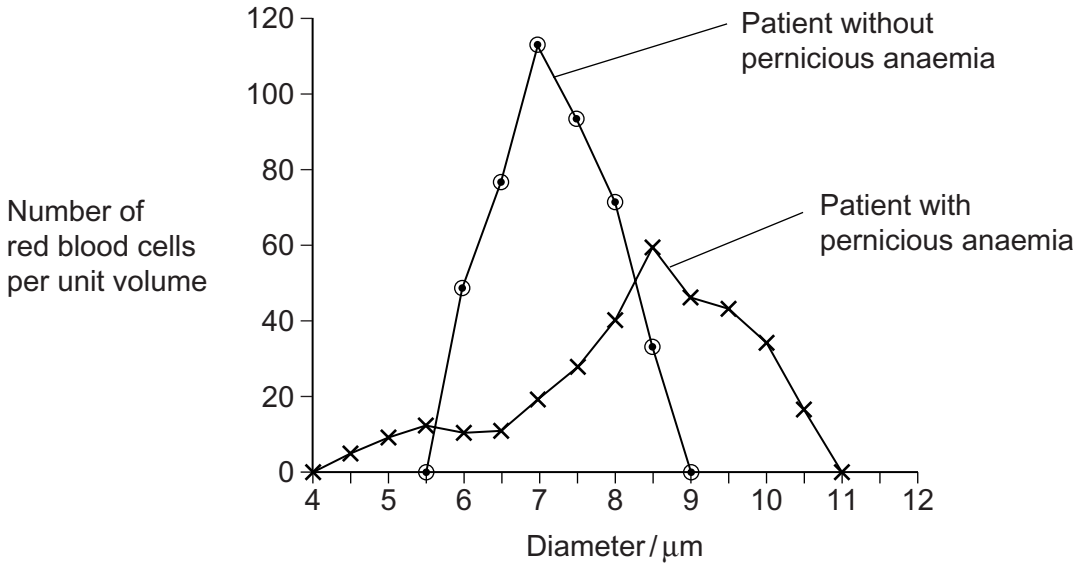
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9 (b) (ii) A technician compared the red blood cells in two blood samples of equal volume. One sample was from a patient with pernicious anaemia, the other was from a patient who did not have pernicious anaemia. **Figure 9** shows some of the results she obtained.

Figure 9



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Describe **two** differences between the blood samples.

1 .....

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(2 marks)

9 (c) Scientists' analysis of blood proteins has indicated a lack of genetic diversity in populations of some organisms. Describe the processes that lead to a reduction in the genetic diversity of populations of organisms.

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