Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

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

General Certificate of Education
Advanced Subsidiary Examination
June 2009

Biology BIOL2

Unit 2 The variety of living organisms

Thursday 4 June 2009 1.30 pm to 3.15 pm

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

You may use a calculator.

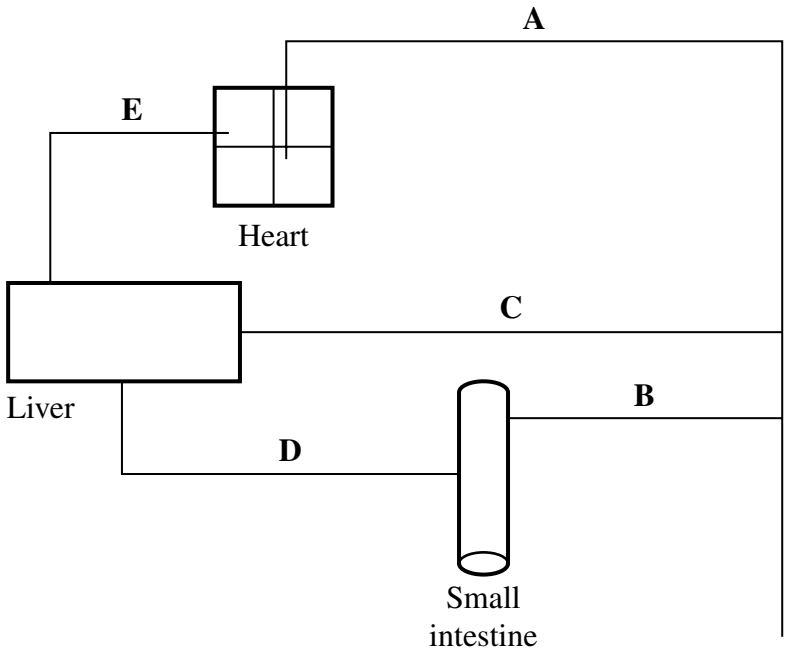
Time allowed
- 1 hour 45 minutes

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. **Answers written in margins or on blank pages will not be marked.**
- 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.
- 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 accurate scientific vocabulary where appropriate.

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

1 The diagram shows some of the large blood vessels in a mammal.



1 (a) Add arrows to the diagram to show the direction of blood flow in each of the blood vessels **A** to **E**. *(1 mark)*

1 (b) (i) Which of blood vessels **A** to **E** is the hepatic portal vein?

(1 mark)

1 (b) (ii) Which of blood vessels **A** to **E** contains blood at the lowest pressure?

(1 mark)

1 (c) Complete the table to show **two** differences between the structure of vessel **C** and the structure of vessel **E**.

Structural feature	Vessel C	Vessel E

(2 marks)

1 (d) Blood vessel **B** contains smooth muscle in its walls. Explain how this muscle may reduce the blood flow to the small intestine.

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(2 marks)

(*Extra space*).....

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1 (e) Elastic tissue in the walls of blood vessel **A** helps to even out the pressure of blood through this vessel. Explain how.

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(2 marks)

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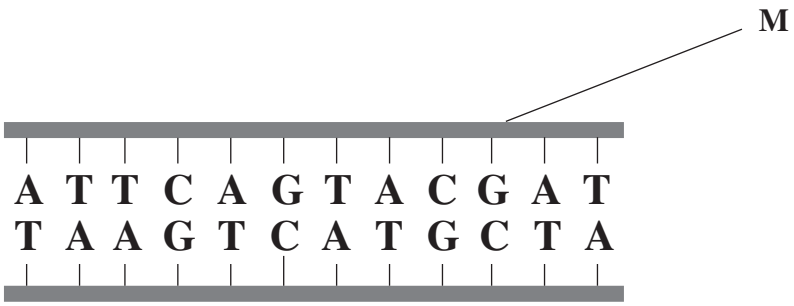
2 The diagram shows part of a DNA molecule.



2 (a) Name the **two** components of the part of the DNA molecule labelled **M**.

1 .....

2 .....

(2 marks)

2 (b) What is the maximum number of amino acids for which this piece of DNA could code?

(1 mark)

2 (c) Scientists calculated the percentage of different bases in the DNA from a species of bacterium. They found that 14% of the bases were guanine.

2 (c) (i) What percentage of the bases in this species of bacterium was cytosine?

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

2 (c) (ii) What percentage of the bases in this species of bacterium was adenine?

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

2 (d) The scientists found that, in a second species of bacterium, 29% of the bases were guanine.

Explain the difference in the percentage of guanine bases in the two species of bacterium.

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(2 marks)

(*Extra space*).....

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7

3 (a) Give **one** way in which a DNA molecule in a prokaryote, such as a bacterium, is different from a DNA molecule in a eukaryote.

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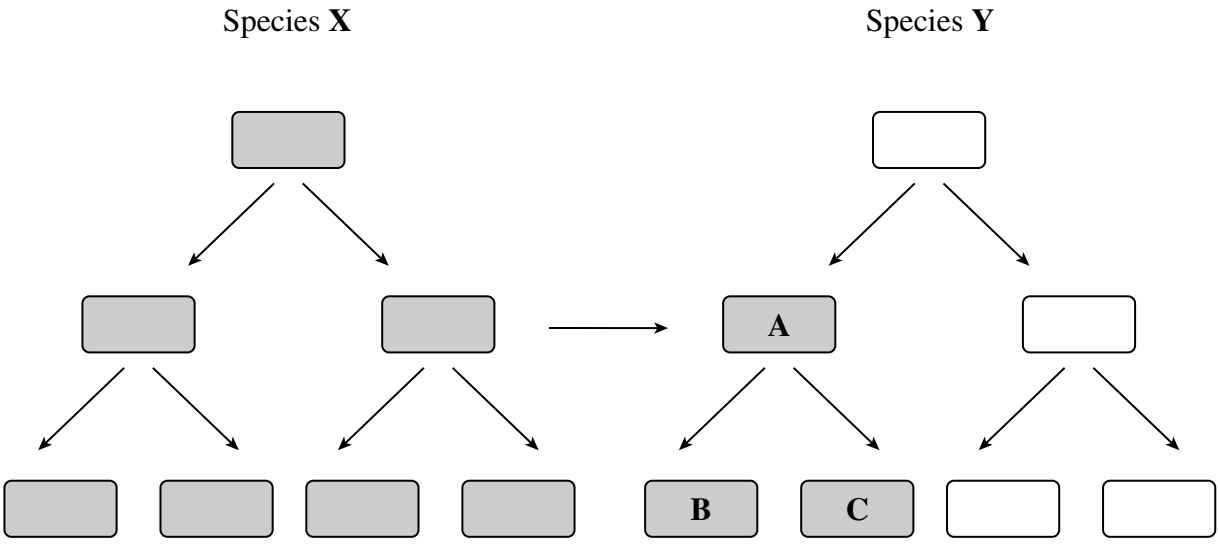
(1 mark)

Species **X** and **Y** are bacteria. The diagram shows gene transfer between bacteria in these two species. The bacteria that are shaded are resistant to the antibiotic penicillin.



3 (b) (i) Use the diagram to explain why bacterium **A** is resistant to penicillin.

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(3 marks)

(Extra space) .....

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3 (b) (ii) Use the diagram to explain why bacteria **B** and **C** are resistant to penicillin.

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(2 marks)

(Extra space) .....

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3 (c) A person is infected with bacteria of species **Y**. Some of these bacteria are resistant to penicillin. A doctor gives the person a course of penicillin.

What would happen to the proportion of species **Y** bacteria that are resistant to penicillin? Explain your answer.

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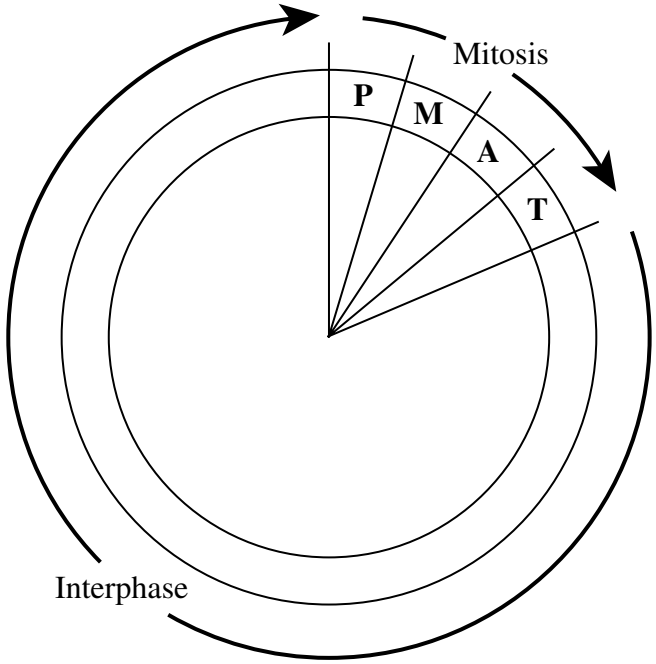
8

4 The diagram shows a cell cycle.



Key

P prophase

M metaphase

A anaphase

T telophase

4 (a) The table shows the number of chromosomes and the mass of DNA in different nuclei. All the nuclei come from the same animal. Complete this table.

Nucleus	Number of chromosomes	Mass of DNA / arbitrary units
At prophase of mitosis	26	60
At telophase of mitosis		
From a sperm cell		

(4 marks)

4 (b) If the DNA of the cell is damaged, a protein called p53 stops the cell cycle.

Mutation in the gene for p53 could cause cancer to develop. Explain how.

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(3 marks)

(Extra space).....

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4 (c) Drugs are used to treat cancer. At what phase in the cell cycle would each of the following drugs act?

4 (c) (i) A drug that prevents DNA replication

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(1 mark)

4 (c) (ii) A drug that prevents spindle fibres shortening

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(1 mark)

9

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5 (a) What is a tissue?

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(1 mark)

5 (b) A student cut a thin section of tissue from a potato and examined it with an optical microscope.

5 (b) (i) Starch was present in the cells of this tissue. Describe how the student could find out where in the cells the starch was present.

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(2 marks)

5 (b) (ii) The student cut a thin section of the tissue. Explain why it was important that the section was thin.

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(2 marks)

5 (c) The cell walls of potato cells contain cellulose. Cellulose and starch are both carbohydrates. Describe **two** ways in which molecules of cellulose are similar to molecules of starch.

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(2 marks)

7

Turn over ▶

6 (a) An order is a taxonomic group. All seals belong to the same order. Name **one** other taxonomic group to which all seals belong.

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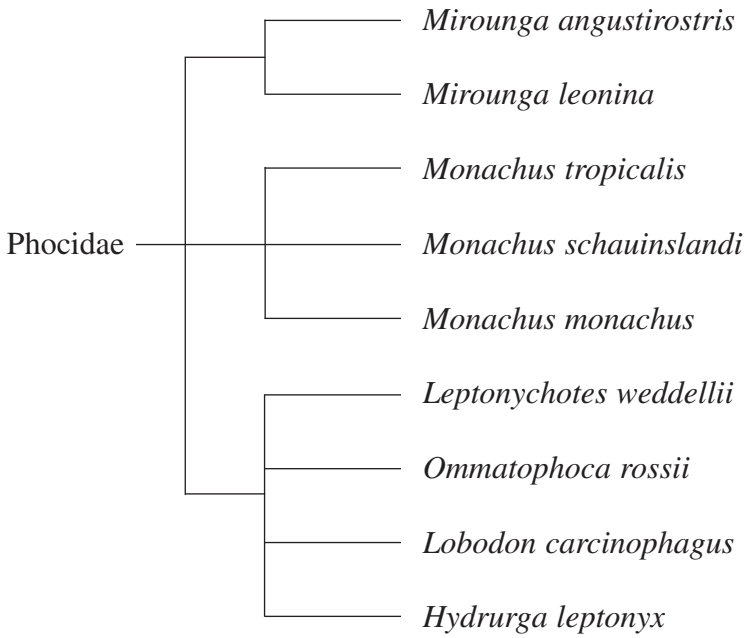
(1 mark)

6 (b) The diagram shows how some species of seal are classified.



6 (b) (i) How many different genera are shown in this diagram?

(1 mark)

6 (b) (ii) All the seals shown in the diagram are members of the Phocidae. Phocidae is an example of a taxonomic group. Of which taxonomic group is it an example?

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(1 mark)

6 (b) (iii) The diagram is based on the evolutionary history of the seals. What does the information in the diagram suggest about the common ancestors of *Mirounga angustirostris*, *Mirounga leonina* and *Monachus tropicalis*?

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(1 mark)

6 (c) A species of seal shows genetic diversity. Explain what is meant by genetic diversity.

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(1 mark)

6 (d) In the late 18th century, the population of northern elephant seals was estimated to be about 150 000. These seals lived in different colonies in different places. The seals were then hunted. By 1910, the total population had fallen to under 100. All these seals lived in a single colony on one island. Hunting then stopped. Numbers increased and there are now approximately 150 000 seals living in many different colonies.

Use this information to explain

6 (d) (i) what is meant by a genetic bottleneck

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(2 marks)

(Extra space) .....

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6 (d) (ii) how you would expect the founder effect to have influenced the genetic diversity of northern elephant seals after 1910.

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(2 marks)

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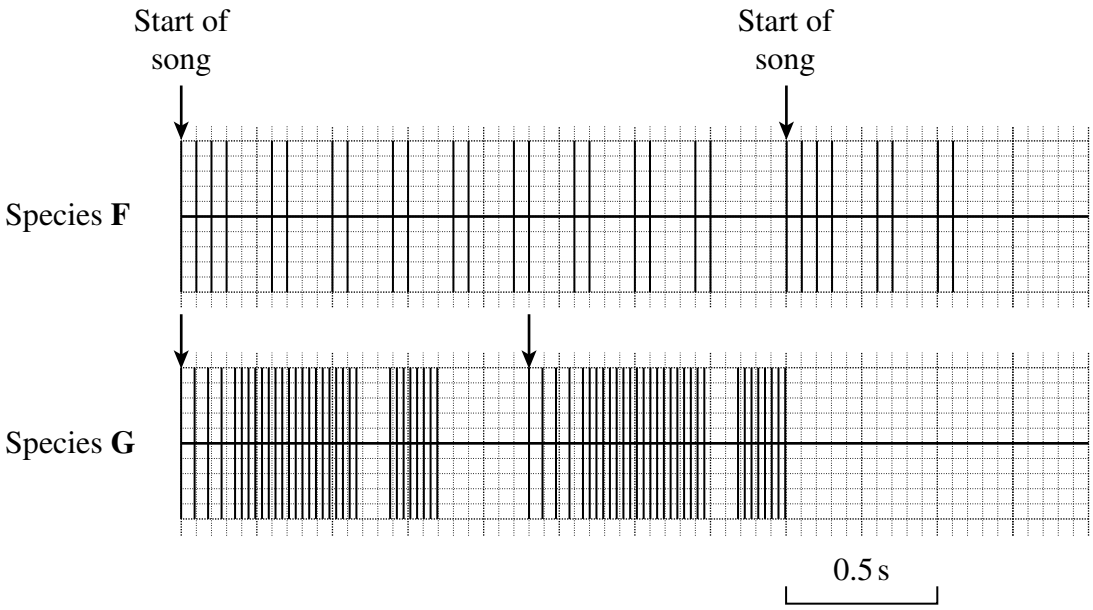
7 Mole crickets are insects that live underground. At night, a male cricket produces a courtship song. A female cricket is attracted by this song and mates with the male.

Scientists investigated courtship in two species of mole cricket. They found that female mole crickets were only attracted to the song produced by a male of the same species.

The charts show recordings of typical songs of two species of mole cricket.



7 (a) The song of species **F** is repeated at regular intervals. The arrows on the chart show the beginning of each song.

7 (a) (i) Calculate the time taken for one complete song.

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

7 (a) (ii) Calculate the rate of singing in songs per minute.

Answer.....songs per minute *(1 mark)*

7 (b) Explain why courtship song is an important part of species recognition in mole crickets.

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(2 marks)

(Extra space).....

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7 (c) The scientists produced hybrids between the two crickets by fertilising eggs from one species with sperms from the other. The male hybrids had songs that had some features of one parent species and some features of the other. Suggest why the male hybrids were not able to reproduce.

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(2 marks)

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Turn over for the next question

8 (a) A fish uses its gills to absorb oxygen from water. Explain how the gills of a fish are adapted for efficient gas exchange.

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(6 marks)

(Extra space).....

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Mackerel live in the surface waters of the sea. Toadfish live on the seabed in deep water.

8 (b) The concentration of oxygen is higher in the surface waters than it is in water close to the seabed. Suggest why.

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(2 marks)

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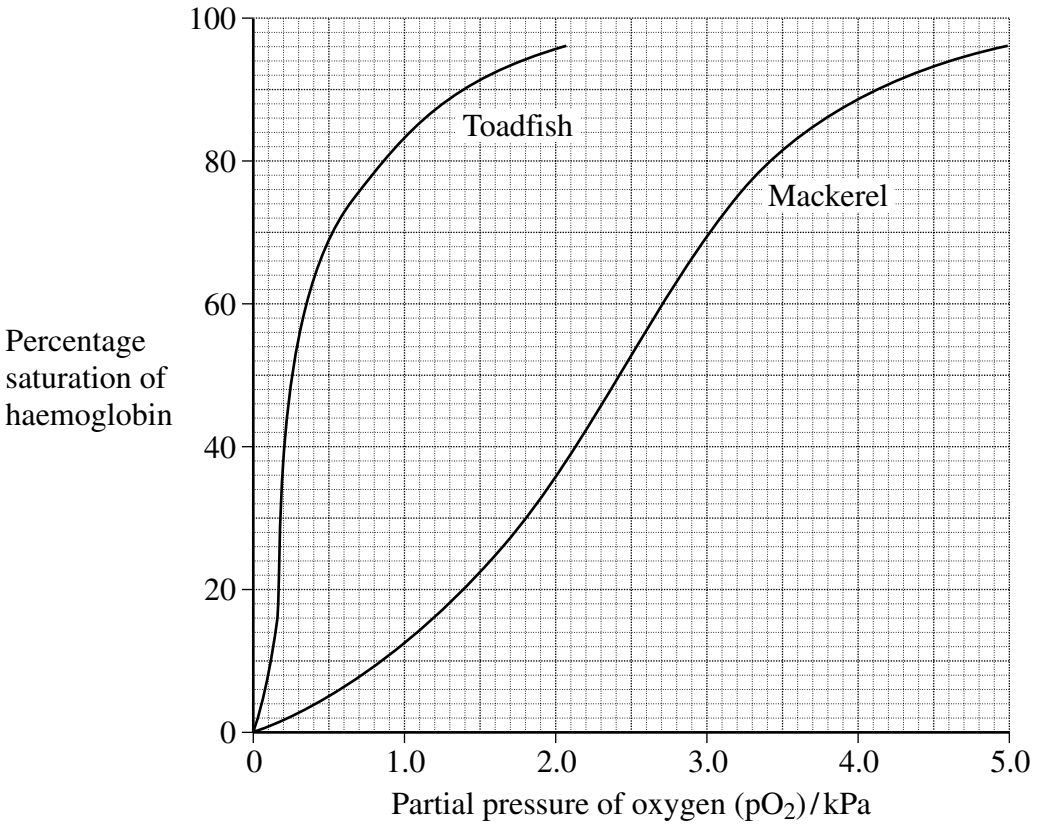
Question 8 continues on the next page

8 (c) The graph shows oxygen dissociation curves for toadfish haemoglobin and for mackerel haemoglobin.



Explain how the shape of the curve for toadfish haemoglobin is related to where the toadfish is normally found.

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(2 marks)

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8 (d) Scientists analysed the sequence of amino acids in one polypeptide chain in the haemoglobin of four different species of ape. The only difference they found affected the amino acids at three positions in the polypeptide chain. Their results are shown in the table. The letters are abbreviations for particular amino acids.

Species	Position 87	Position 104	Position 125
Chimpanzee	T	R	P
Bonobo	T	R	P
Gorilla	T	K	P
Orang utan	K	R	Q

8 (d) (i) What information do the data in the table suggest about the relationships between the chimpanzee, the bonobo and the gorilla? Explain your answer.

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(2 marks)

8 (d) (ii) Hybrid DNA was made from the gene for chimpanzee haemoglobin and the genes for the haemoglobin of the other three species of ape. Which of the three samples of hybrid DNA would separate into two strands at the lowest temperature?
Explain your answer.

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(3 marks)

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9 (a) In the USA, members of the public found many frogs with deformed legs. Scientists investigated this. They collected samples of the frogs. They wanted to get reliable data. Give **one** feature of the sample, other than a large sample size, that would help to make sure that their data were reliable.

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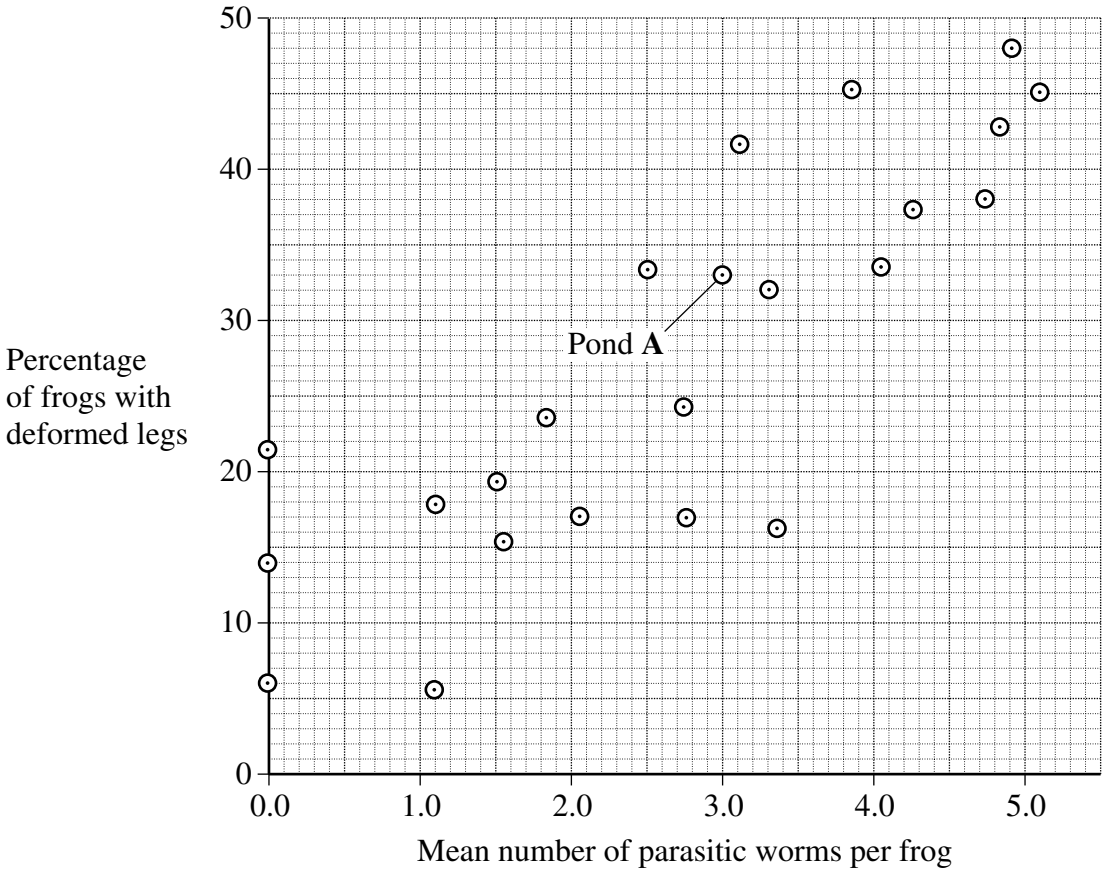
(1 mark)

The team of scientists then investigated frogs in ponds. The team measured many different factors and then analysed their results. The graph shows the relationship between the percentage of frogs with deformed legs and the mean number of parasitic worms found in the frogs.



9 (b) The scientists collected a sample of three frogs from pond **A**. What was the total number of parastic worms found in these three frogs?

(1 mark)

9 (c) One scientist suggested that the parasites caused the deformed legs found in frogs. Does the graph support this suggestion? Explain your answer.

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(4 marks)

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9 (d) The scientists wrote a paper. In their discussion they wrote that they found very few ponds that were free from human influence. The few that they did find were only in mountainous areas.

The scientists could not draw any reliable conclusions about whether human influence contributed to the frogs' deformed legs. Explain why each of the following meant that they could not draw reliable conclusions.

9 (d) (i) There were very few ponds free from human influence.

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(1 mark)

Question 9 continues on the next page

9 (d) (ii) The ponds free from human influence were found only in mountainous areas.

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(2 marks)

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In a second investigation, another research team investigated deformed legs in frogs in a different way.

- They chose six ponds, all of which contained parasitic worms. Three of the ponds were close to fields and received agricultural run-off from these fields. The other three ponds did not receive agricultural run-off.
- They built two cages in each of the six ponds. One cage in each pond allowed parasitic worms to enter and one cage did not.
- They put frogs that were not infected with parasitic worms into all twelve cages.

The table shows the results of this second investigation.

	Percentage of frogs with deformed limbs					
	Ponds with agricultural run-off			Ponds with no agricultural run-off		
Pond number	1	2	3	4	5	6
Cage with mean mesh diameter of 500 µm	22	27	24	3	4	7
Cage with mean mesh diameter of 75 µm	0	0	0	0	0	0

9 (e) One of the boxes in the table has been shaded. Describe the information given in the shaded box.

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(2 marks)

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9 (f) What conclusions can you draw from the data in the table about the factors causing deformed leg in frogs? Explain your answer.

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(4 marks)

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END OF QUESTIONS

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