Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
TOTAL	

General Certificate of Education
Advanced Level Examination
June 2010

Biology BIOL5

Unit 5 Control in cells and in organisms

Friday 25 June 2010 1.30 pm to 3.45 pm

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

Time allowed
- 2 hour 15 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 boxes 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 100.
- 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 vocabulary accurately.

Do not write outside the box

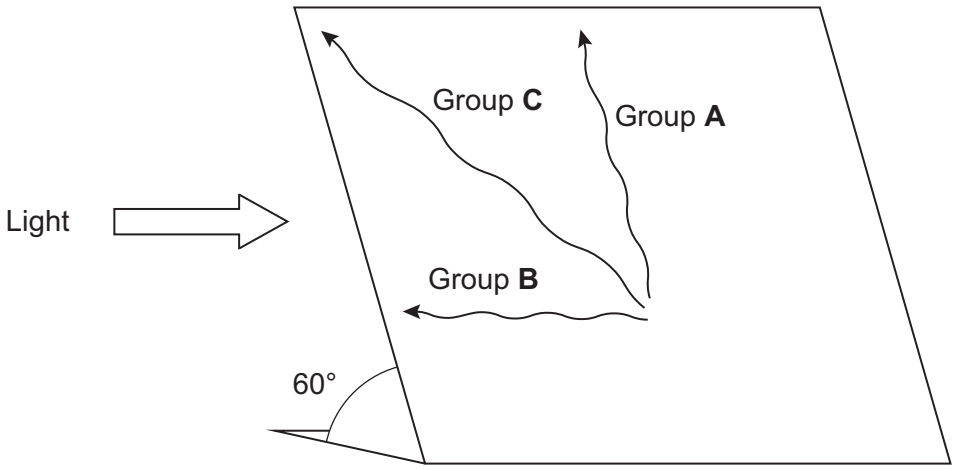
Answer **all** questions in the spaces provided.

1 Termites are insects. Some species live in colonies in the soil. Although most termites are wingless, winged termites are sometimes produced. The winged termites fly from the soil, mate and start new colonies.

A scientist studied the behaviour of winged termites. He divided these termites into three groups.

- Group **A** had their eyes covered.
- Group **B** had their antennae removed.
- Group **C** was the control group.

He put individual winged termites on a sloping board that was illuminated from one side. The diagram shows the direction of movement of a typical termite from each of the three groups.



1 (a) (i) What type of behaviour was shown by the termite from group **B**?

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(1 mark)

1 (a) (ii) Give the evidence for your answer.

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(1 mark)

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1 (b) Explain what the results from group **A** suggest about the factors controlling the behaviour of winged termites.

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(3 marks)

(Extra space).....

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1 (c) Suggest **one** advantage to the termites from group **C** of the behaviour shown in the investigation.

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(2 marks)

7

Turn over for the next question

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There are no questions printed on this page

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ANSWER IN THE SPACES PROVIDED

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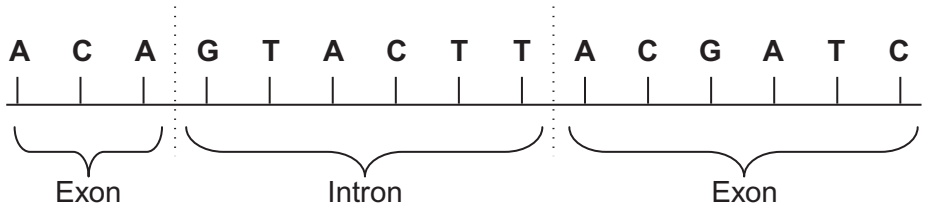
2 (a) Complete the table to show the differences between DNA, mRNA and tRNA.

Type of nucleic acid	Hydrogen bonds present (✓) or not present (✗)	Number of polynucleotide strands in molecule
DNA		
mRNA		
tRNA		

(2 marks)

2 (b) The diagram shows the bases on one strand of a piece of DNA.



2 (b) (i) In the space below, give the sequence of bases on the pre-mRNA transcribed from this strand.

(2 marks)

2 (b) (ii) In the space below, give the sequence of bases on the mRNA produced by splicing this piece of pre-mRNA.

(1 mark)

5

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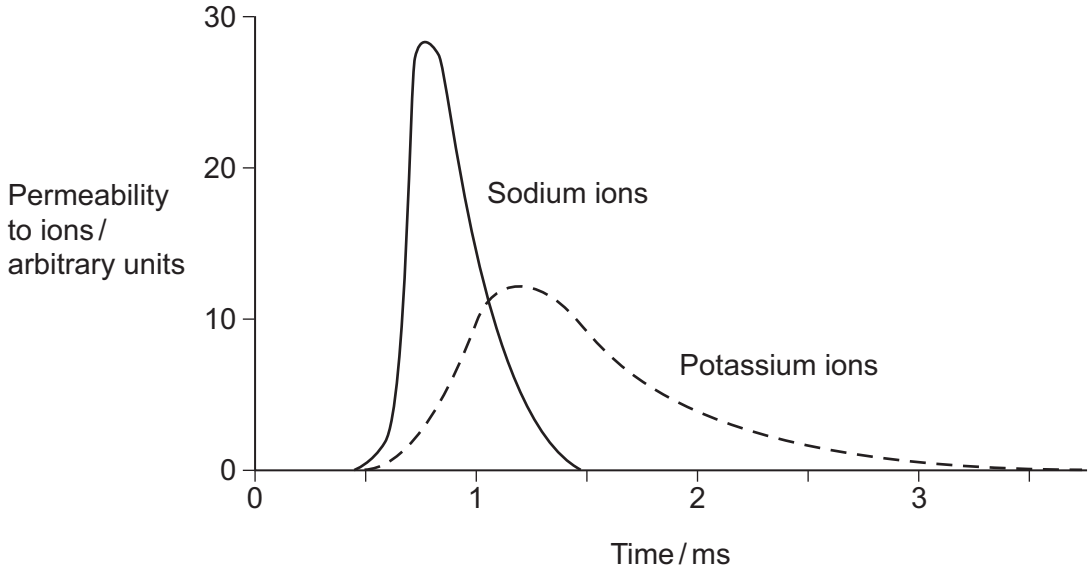
3 During an action potential, the permeability of the cell-surface membrane of an axon changes. The graph shows changes in permeability of the membrane to sodium ions (Na^+) and to potassium ions (K^+) during a single action potential.



3 (a) Explain the shape of the curve for sodium ions between 0.5 ms and 0.7 ms.

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(3 marks)

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3 (b) During an action potential, the membrane potential rises to +40 mV and then falls. Use information from the graph to explain the fall in membrane potential.

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(3 marks)

(Extra space).....

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3 (c) After exercise, some ATP is used to re-establish the resting potential in axons. Explain how the resting potential is re-established..

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(2 marks)

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Turn over for the next question

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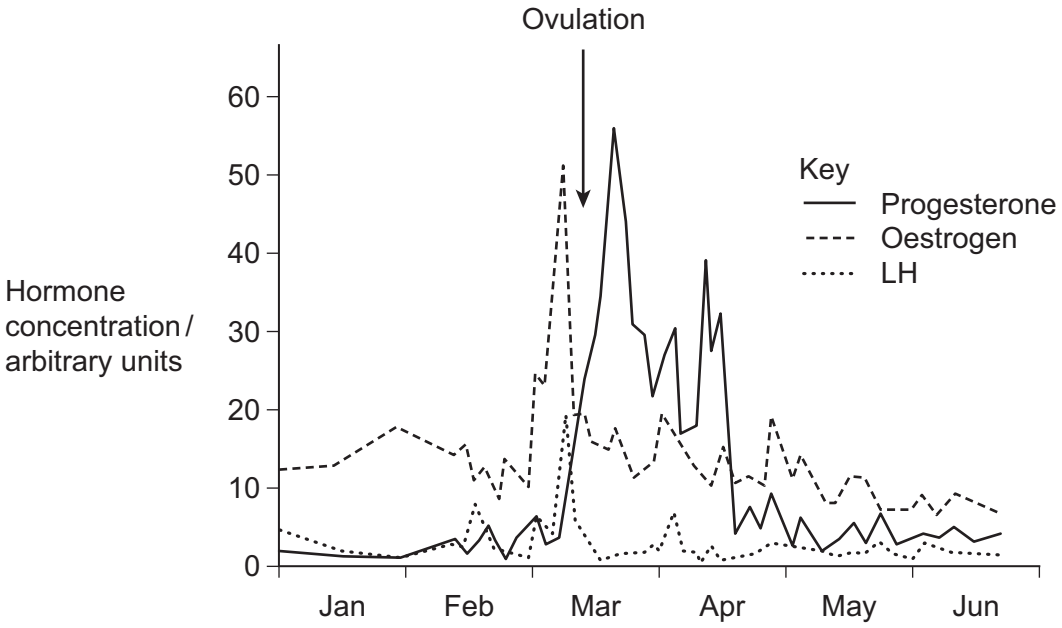
4 Scientists investigated control of ovulation in a species of mammal. They measured the concentration of some hormones in the blood of females between January and June. The graph shows the results for one animal.



4 (a) The concentration of LH in the blood is controlled by negative feedback. Use the curves for progesterone and LH to explain how.

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(3 marks)

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4 (b) (i) Explain how the change in progesterone concentration in March shows that ovulation took place at the time indicated.

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(2 marks)

4 (b) (ii) **Two** pieces of information from the graph, other than the change in progesterone concentration, show that ovulation took place at the time indicated. Explain how.

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(4 marks)

9

Turn over for the next question

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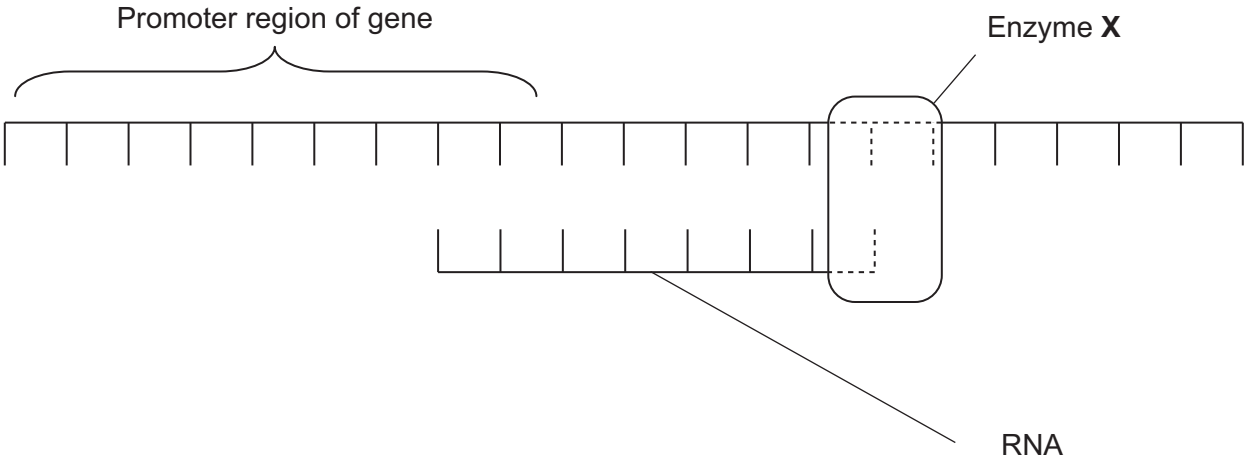
5 **Figure 1** shows part of a gene that is being transcribed.

Figure 1



5 (a) Name enzyme **X**.

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(1 mark)

5 (b) (i) Oestrogen is a hormone that affects transcription. It forms a complex with a receptor in the cytoplasm of target cells. Explain how an activated oestrogen receptor affects the target cell.

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(2 marks)

5 (b) (ii) Oestrogen only affects target cells. Explain why oestrogen does not affect other cells in the body.

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(1 mark)

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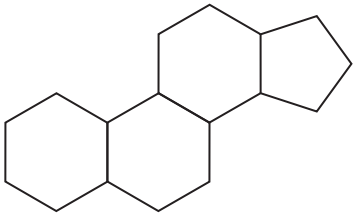
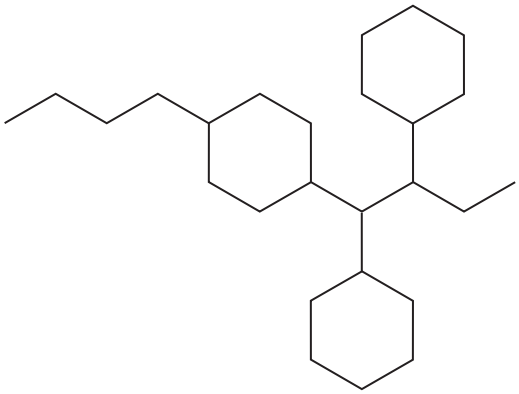
5 (c) Some breast tumours are stimulated to grow by oestrogen. Tamoxifen is used to treat these breast tumours. In the liver, tamoxifen is converted into an active substance called endoxifen.
Figure 2 shows a molecule of oestrogen and a molecule of endoxifen.

Figure 2

Oestrogen



Endoxifen



Use **Figure 2** to suggest how endoxifen reduces the growth rate of these breast tumours.

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(2 marks)

6

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6 SCID is a severe inherited disease. People who are affected have no immunity. Doctors carried out a trial using gene therapy to treat children with SCID. The doctors who carried out the trial obtained stem cells from each child's umbilical cord.

6 (a) Give **two** characteristic features of stem cells.

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(2 marks)

The doctors mixed the stem cells with viruses. The viruses had been genetically modified to contain alleles of a gene producing full immunity. The doctors then injected this mixture into the child's bone marrow.

The viruses that the doctors used had RNA as their genetic material. When these viruses infect cells, they pass their RNA and two viral enzymes into the host cells.

6 (b) One of the viral enzymes makes a DNA copy of the virus RNA. Name this enzyme.

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(1 mark)

Do not write outside the box

The other viral enzyme is called integrase. Integrase inserts the DNA copy anywhere in the DNA of the host cell. It may even insert the DNA copy in one of the host cell's genes.

6 (c) (i) The insertion of the DNA copy in one of the host cell's genes may cause the cell to make a non-functional protein. Explain how.

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(2 marks)

6 (c) (ii) Some of the children in the trial developed cancer. How might the insertion of the DNA have caused cancer?

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(2 marks)

6 (d) Five out of the 20 children in the trial developed cancer. Although the cancer was treated successfully, the doctors decided to stop the trial in its early stages. They then reviewed the situation and decided to continue. Do you agree with their decision to continue? Explain your answer.

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(2 marks)

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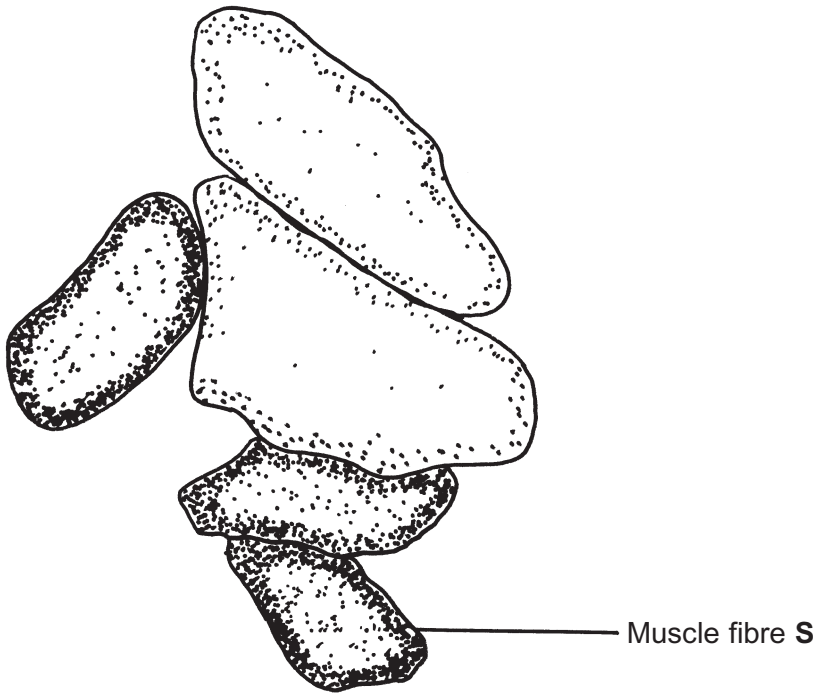
7 The drawing is a tracing of a cross-section through skeletal muscle tissue. This muscle contains fast muscle fibres and slow muscle fibres. The section has been stained to show the distribution of the enzyme succinate dehydrogenase. This enzyme is found in mitochondria.



7 (a) (i) Succinate dehydrogenase catalyses one of the reactions in the Krebs cycle. What is the evidence from the drawing that muscle fibre **S** is a slow muscle fibre? Explain your answer.

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7 (a) (ii) Use evidence from the diagram to describe the distribution of mitochondria inside the slow muscle fibres. Explain the importance of this distribution.

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(3 marks)

(Extra space).....

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7 (b) (i) You could use an optical microscope and a slide of stained muscle tissue to find the diameter of one of the muscle fibres. Explain how.

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(2 marks)

7 (b) (ii) A student found the mean diameter for the slow muscle fibres in a section. Give **two** precautions that she should have taken when sampling the fibres. Give a reason for each precaution.

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(2 marks)

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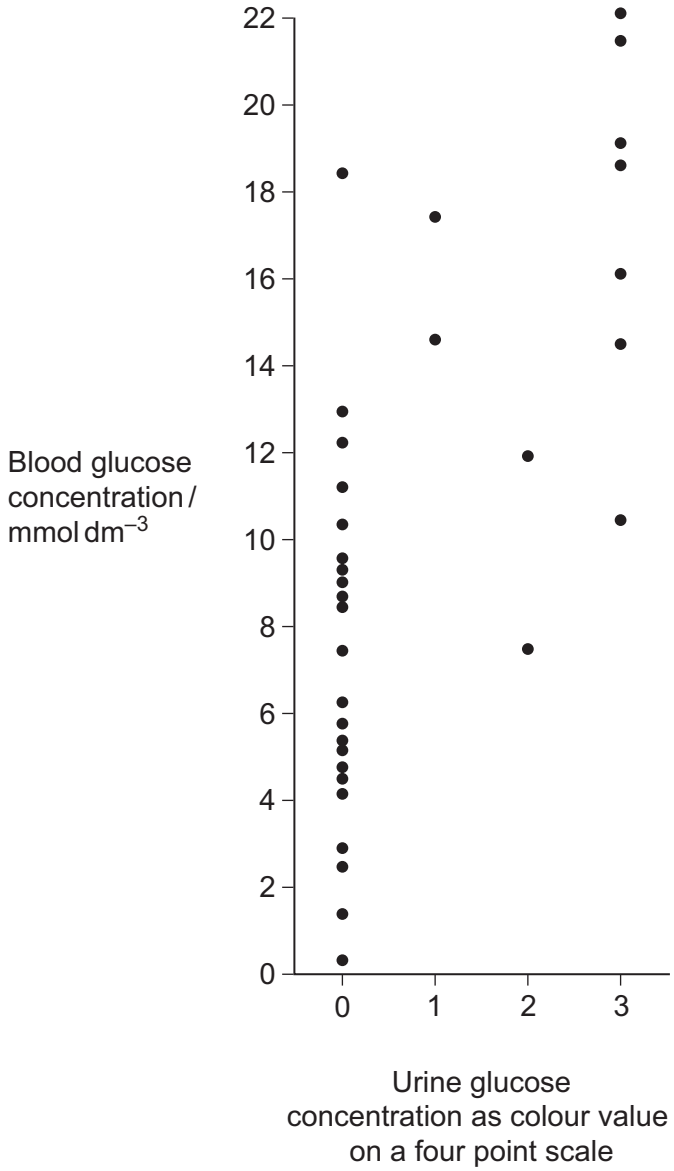
8 (a) Technicians in a hospital laboratory tested urine and blood samples from a girl with diabetes at intervals over a one-year period. Each time the technicians tested her urine, they also measured her blood glucose concentration. Their results are shown in the graph.



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8 (a) (i) The girl who took part in this investigation was being successfully treated with insulin. The graph shows that on some occasions, the concentration of glucose in her blood was very high. Suggest why.

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(2 marks)

8 (a) (ii) Use the graph to evaluate the use of the urine test as a measure of blood glucose concentration.

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(3 marks)

(Extra space).....

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8 (b) Diabetic people who do not control their blood glucose concentration may become unconscious and go into a coma. A doctor may inject a diabetic person who is in a coma with glucagon. Explain how the glucagon would affect the person's blood glucose concentration.

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(2 marks)

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9 There are wolves in many European countries. Scientists investigated the genetic diversity of these wolves. They collected samples of DNA from the mitochondria of wolves from different countries. For each sample they identified which haplotypes were present in the DNA. A haplotype is a particular sequence of bases on DNA. Mutations can produce new haplotypes.

Country	Number of wolves sampled	Number of different haplotypes in mitochondrial DNA
Spain	84	3
Portugal	19	2
Italy	101	1
France	7	1
Bulgaria	29	6
Sweden	93	1

The scientists wanted to find out whether one of the haplotypes in the Portuguese wolves was the same as one of those in the Spanish wolves. They used a restriction endonuclease, electrophoresis and a labelled DNA probe.

9 (a) For what purpose did they use

9 (a) (i) the restriction endonuclease

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(1 mark)

9 (a) (ii) electrophoresis?

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(1 mark)

9 (b) Explain why the labelled DNA probe could be used to find out whether the haplotypes were the same.

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(2 marks)

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9 (c) Two hundred years ago there were many wolves in Italy. By the 1970s there were fewer than 100 wolves left. Since 1980, wolves have increased in number and have spread to France.

9 (c) (i) Use this information to explain the number of haplotypes in the Italian wolves.

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(2 marks)

9 (c) (ii) Suggest an explanation for the number of haplotypes in the wolves that have spread to France.

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(1 mark)

9 (d) The scientists analysed the DNA on the Y chromosome and the DNA in the mitochondria of the Swedish wolves. They concluded that the Swedish wolf population descended from one male wolf from Finland and one female wolf from Russia.

9 (d) (i) Explain why DNA on the Y chromosome helped them to reach this conclusion.

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(1 mark)

9 (d) (ii) Suggest why DNA in the mitochondria helped them to reach this conclusion.

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(1 mark)

Question 9 continues on the next page

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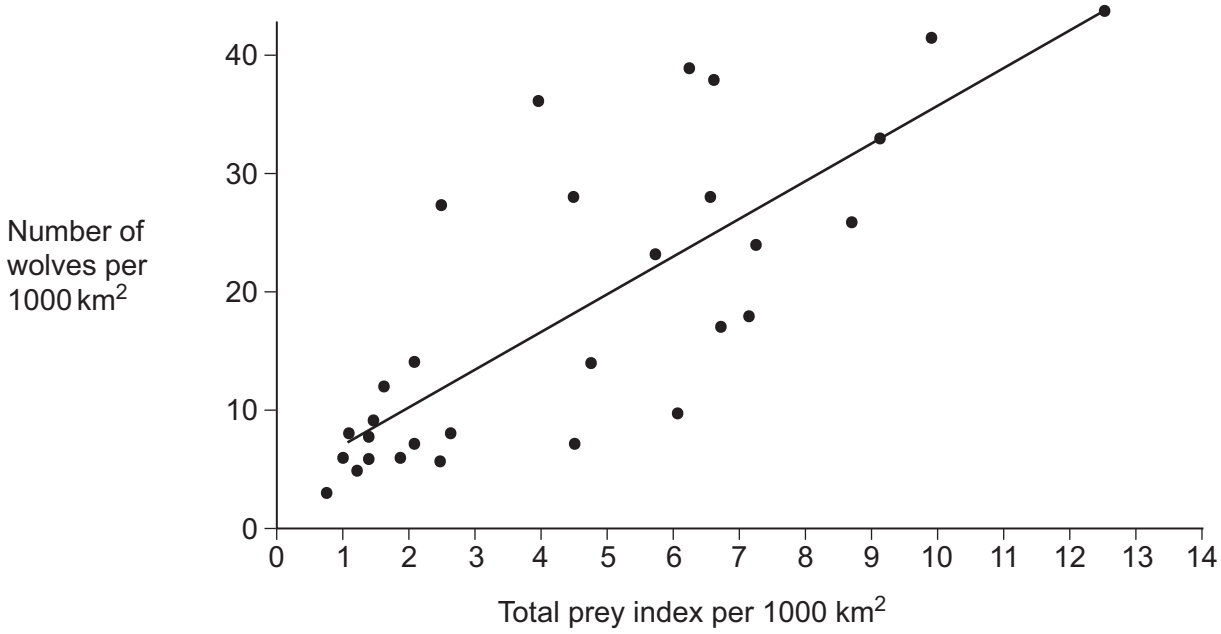
Wolves eat different mammals. An ecologist investigated factors that affect wolf numbers in North America. He collected data from different field studies carried out in different places. The graph shows his results.



9 (e) (i) The wolf numbers are given per unit area. Explain why.

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(2 marks)

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9 (e) (ii) The ecologist calculated the total prey index for each of the places that had been studied. In order to do this, he gave each prey species a value based on how much food was available to wolves from the prey animal concerned. He called this value the prey index.

The ecologist considered that the prey index gave a better idea of the food available than the prey biomass in kg. Suggest why the prey index gives a better idea of food available.

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(2 marks)

9 (f) The ecologist calculated the total prey index by combining the prey indices and the total number of animals of each species present in 1000 km^2. He plotted this information on the graph.
What does the graph suggest about the factors that determine wolf numbers in North America? Explain your answer.

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(2 marks)

15

Turn over for the next question

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ESSAY

You should write your essay in continuous prose.

Your essay will be marked for its scientific accuracy. It will also be marked for your selection of relevant material from different parts of the specification and from the quality of your written communication.

The maximum number of marks that can be awarded is

Scientific content	16
Breadth of knowledge	3
Relevance	3
Quality of written communication	3

10 Write an essay on **one** of the following topics.

EITHER

10 (a) Carbon dioxide may affect organisms directly or indirectly. Describe and explain these effects. *(25 marks)*

OR

10 (b) The causes of disease in humans. *(25 marks)*

If you want to make a plan write it here.

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END OF QUESTIONS

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