Surname		Other Names	
Centre Number			Candidate Number	
Candidate Signature			

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General Certificate of Education
June 2004
Advanced Level Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

BIOLOGY (SPECIFICATION B) BYB4
Unit 4 Energy, Control and Continuity

Tuesday 22 June 2004 Morning Session

In addition to this paper you will require:
- 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 in **Section A** and **Section B** in the spaces provided. All working must be shown.
- Do all rough work in this book. Cross through any work you do not want marked.

Information
- The maximum mark for this paper is 81.
- Mark allocations are shown in brackets.
- Answers for **Section A** are expected to be short and precise.
- Questions in **Section B** should be answered in continuous prose where appropriate. Quality of Written Communication will be assessed in these answers.
- In addition to the mark allocations indicated within **Section B**, you will be awarded up to 1 mark for your ability to use an appropriate form and style of writing, to organise relevant information clearly and coherently, and to use specialist vocabulary, where appropriate. The legibility of your handwriting and the accuracy of your spelling, punctuation and grammar will also be taken into account.

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

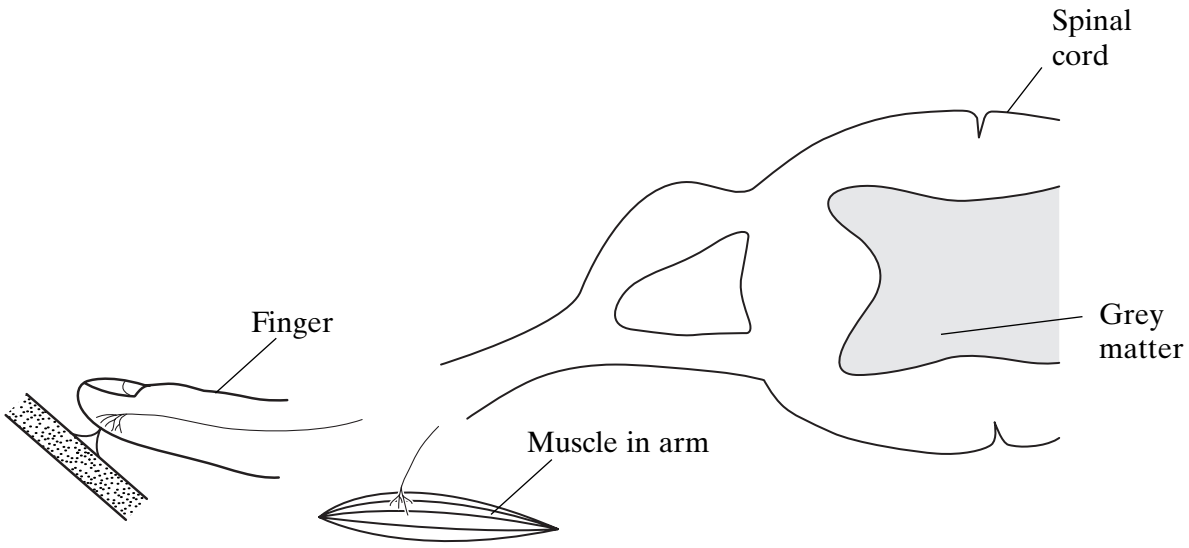
NO QUESTIONS APPEAR ON THIS PAGE

SECTION A

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

1 A gardener accidentally pricks a finger on a thorn. She quickly pulls the finger away. This reaction results from a simple reflex arc involving three neurones.

(a) The diagram shows part of the pathway involved in this reaction.



(i) Complete the diagram to show the rest of the simple reflex arc. *(1 mark)*

On your diagram

(ii) name and label the **three** neurones;

(iii) label the effector.

(2 marks)

(b) As well as pulling the finger away, the gardener also feels pain caused by the thorn. Explain how she becomes aware of the pain.

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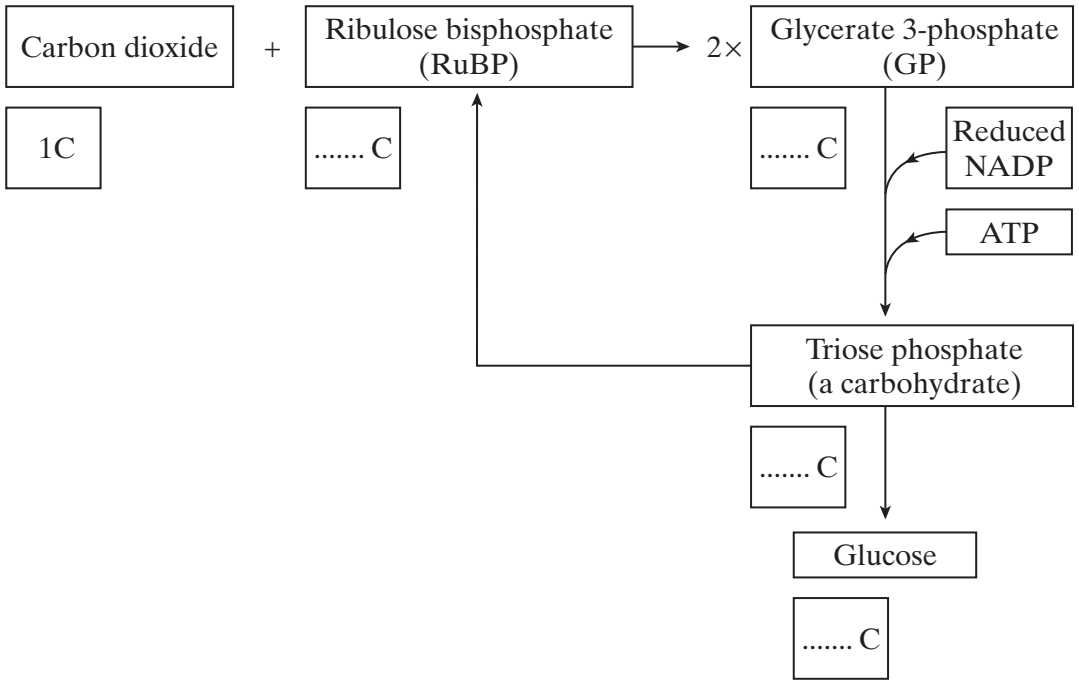
(3 marks)

6

2 The diagram shows a summary of the light-independent reaction of photosynthesis.



(a) (i) Complete the boxes to show the number of carbon atoms in the molecules.
(2 marks)

(ii) In which part of a chloroplast does the light-independent reaction occur?

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(1 mark)

(iii) Which process is the source of the ATP used in the conversion of glycerate 3-phosphate (GP) to triose phosphate?

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(1 mark)

(iv) What proportion of triose phosphate molecules is converted to ribulose bisphosphate (RuBP)?

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(1 mark)

(b) Lowering the temperature has very little effect on the light-dependent reaction, but it slows down the light-independent reaction. Explain why the light-independent reaction slows down at low temperatures.

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(2 marks)

3 (a) One effect of getting into a cold shower is a reduction in the amount of blood flowing through the capillaries near the surface of the skin. Explain how the cold water causes this response.

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(4 marks)

(b) (i) When exercising at 30 °C, the body is more likely to overheat in humid conditions than in dry conditions. Explain why.

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(2 marks)

(ii) Strenuous exercise leads to exhaustion more quickly in hot conditions than in cool conditions. One reason for this is a reduced blood supply to the muscles, which means that they receive less oxygen.

Suggest an explanation for the reduced blood supply to the muscles.

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(2 marks)

8

4 (a) The mammals form a class called the Mammalia within the animal kingdom. The grey wolf is a species of mammal. **Figure 1** shows the groups within the Mammalia to which the wolf (labelled **W**) belongs.

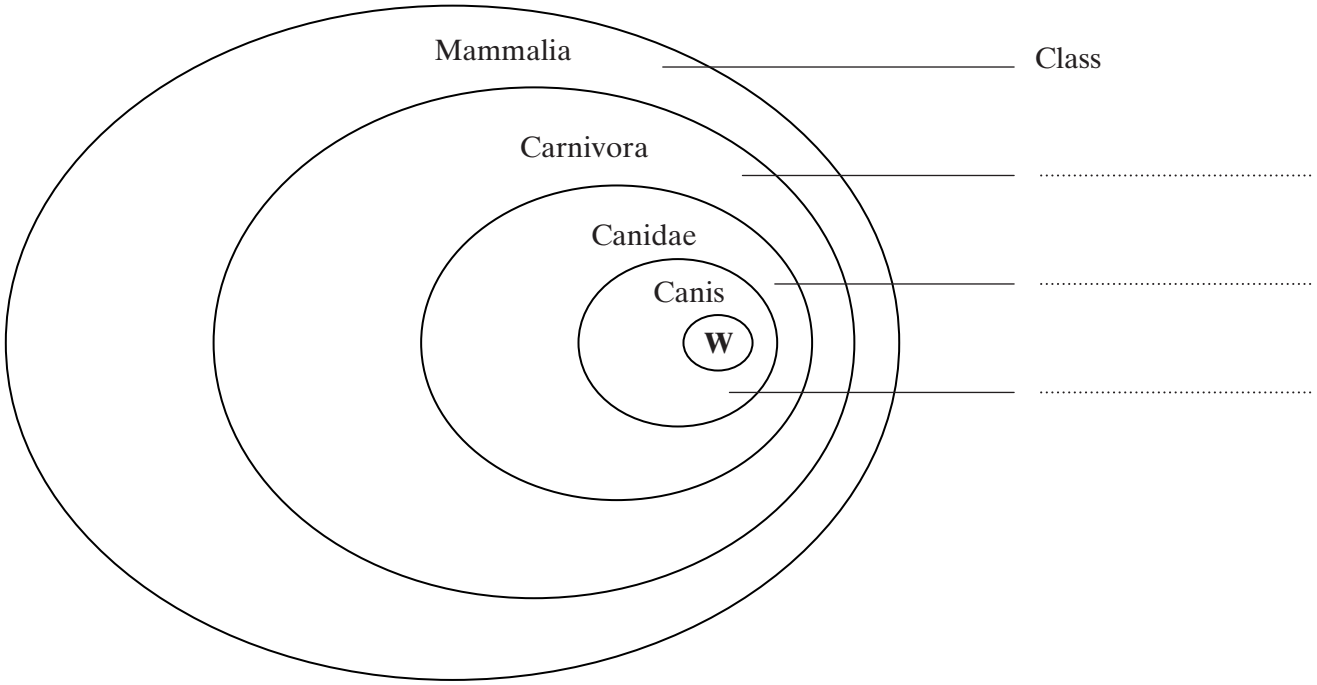

Figure 1

(i) Label **Figure 1** to show the names of the groups. *(2 marks)*

(ii) The lion, *Panthera leo*, belongs to another group in the Carnivora, called the Felidae. Add this information to **Figure 1**, using the letter L to represent the lion species. *(1 mark)*

(b) The diagrams show two systems of classification of mammals. **Figure 2** shows a simple hierarchy. **Figure 3** shows a phylogenetic system.

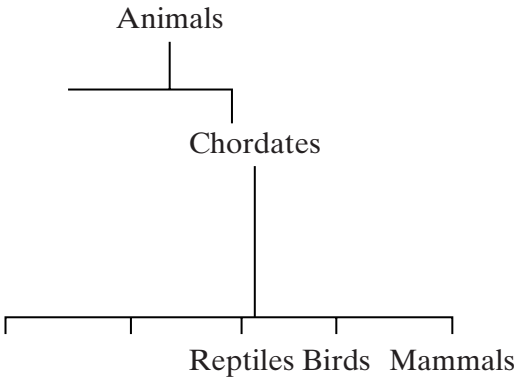

Figure 2

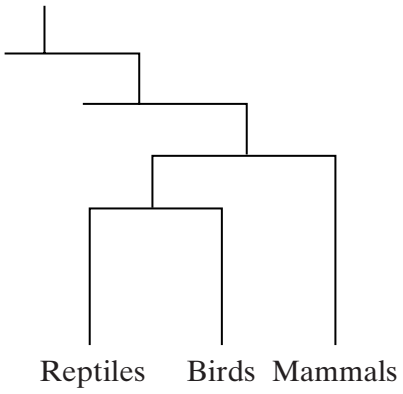

Figure 3

(i) What is meant by a hierarchy?

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(1 mark)

(ii) By reference to **Figures 2** and **3**, explain how a phylogenetic system differs from a simple hierarchy.

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(3 marks)

7

5 (a) A protein found on red blood cells, called antigen G, is coded for by a dominant allele of a gene found on the X chromosome. There is no corresponding gene on the Y chromosome.

The members of one family were tested for the presence of antigen G in the blood. The antigen was found in the daughter, her father and her father's mother, as shown in the genetic diagram below. No other members had the antigen.

	Grandmother (has antigen G)	Grandfather	Grandmother	Grandfather
Genotypes	..... or	.....	.....	.....
Gamete genotypes	..... or	.....	.....	.....

	Father (has antigen G)	Mother
Genotypes	.....	.....
Gamete genotypes	.....	.....

	Daughter (has antigen G)
Genotype	.....

(i) One of the grandmothers has two possible genotypes. Write these on the genetic diagram, using the symbol $\mathbf{X^G}$ to show the presence of the allele for antigen G on the X chromosome, and $\mathbf{X^g}$ for its absence. *(1 mark)*

(ii) Complete the rest of the diagram. *(3 marks)*

(iii) The mother and father have a son. What is the probability of this son inheriting antigen G? Explain your answer.

Probability .....

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(2 marks)

(b) During meiosis, when the X and Y chromosomes pair up, they do not form a typical bivalent as do other chromosomes. Explain why.

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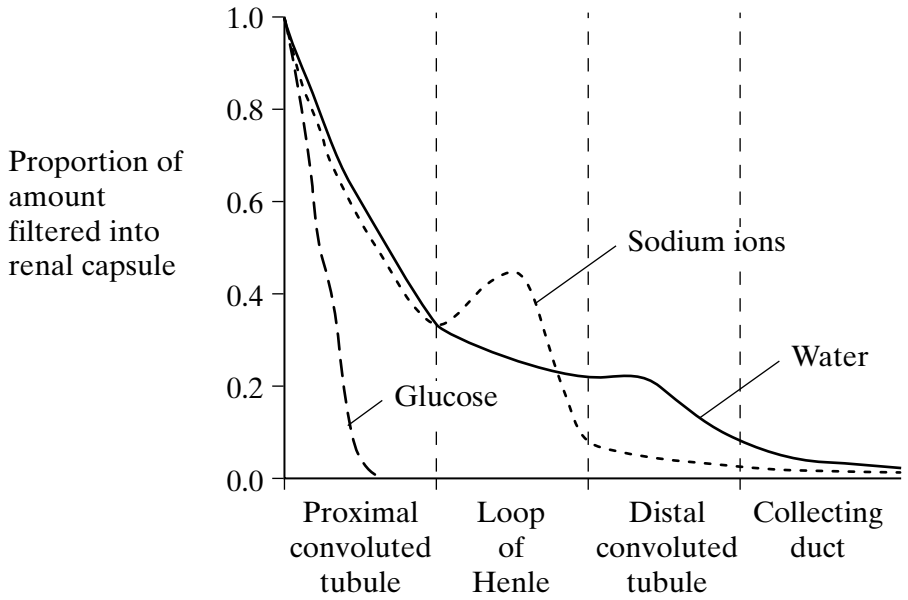
(2 marks)

8

TURN OVER FOR THE NEXT QUESTION

6 The graph shows changes in the amounts of water, glucose and sodium ions as fluid passes along a kidney tubule from the renal capsule to the collecting duct.



(a) Which hormone causes the decrease in the water content in the distal convoluted tubule?

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(1 mark)

(b) Explain the change in the amount of glucose.

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(2 marks)

(c) Explain the shape of the curve for sodium ions in the loop of Henle.

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(3 marks)

6

7 (a) Mitochondria in muscle cells have more cristae than mitochondria in skin cells. Explain the advantage of mitochondria in muscle cells having more cristae.

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(2 marks)

(b) Substance **X** enters the mitochondrion from the cytoplasm. Each molecule of substance **X** has three carbon atoms.

(i) Name substance **X**.

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(1 mark)

(ii) In the link reaction substance **X** is converted to a substance with molecules effectively containing only two carbon atoms. Describe what happens in this process.

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(2 marks)

(c) The Krebs cycle, which takes place in the matrix, releases hydrogen ions. These hydrogen ions provide a source of energy for the synthesis of ATP, using coenzymes and carrier proteins in the inner membrane of the mitochondrion.

Describe the roles of the coenzymes and carrier proteins in the synthesis of ATP.

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(3 marks)

8

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SECTION B

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

Answers should be written in continuous prose, where appropriate.
Quality of Written Communication will be assessed in these answers.

8 (a) The iris of the eye contains antagonistic muscles which control the diameter of the pupil.

(i) Use your knowledge of the iris muscles to explain what is meant by *antagonistic muscle action*.

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(3 marks)

(ii) The diameter of the pupil is reduced in bright light. Describe the part played by the autonomic nervous system in reducing the diameter.

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(3 marks)

(b) When focusing, the shape of the lens in the eye changes. In an investigation, the maximum convexity of the lens was measured in people of different ages. **Figure 4** shows the results.

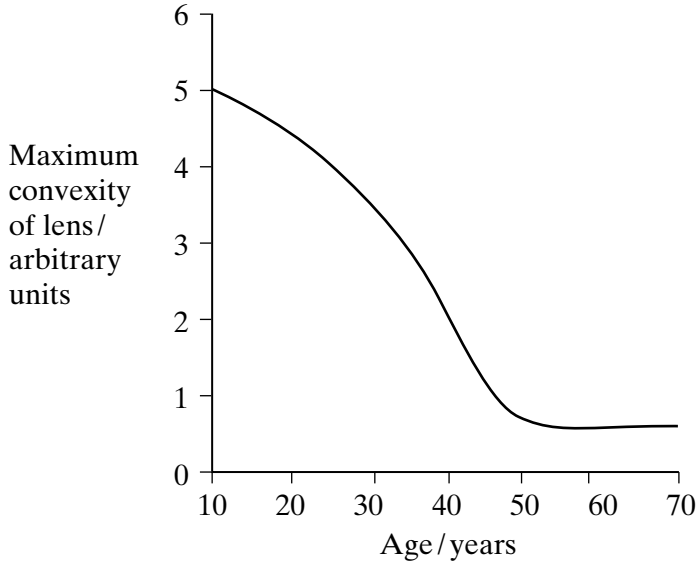

Figure 4

Using information from **Figure 4**, explain how the change in the ability of the lens to become more convex affects the ability to focus clearly as people get older.

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(4 marks)

QUESTION 8 CONTINUES ON THE NEXT PAGE

(c) After moving from bright light into darkness, it takes several minutes for the rod cells to recover their sensitivity. Researchers measured the ability of the rod cells to detect small spots of light of different colours and intensity after a person moved into darkness. The results are shown in **Figure 5**.
Figure 6 shows the amount of light of different wavelengths that rhodopsin absorbs.

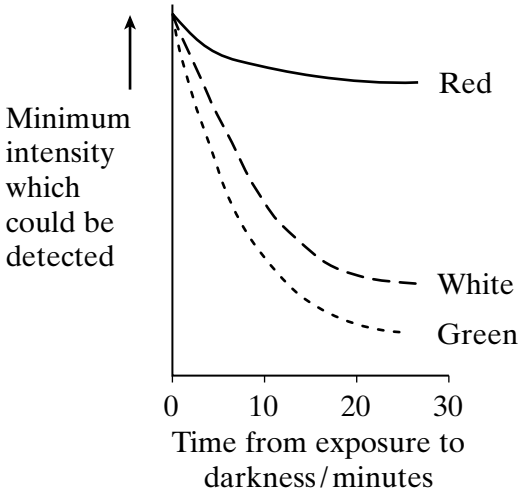

Figure 5

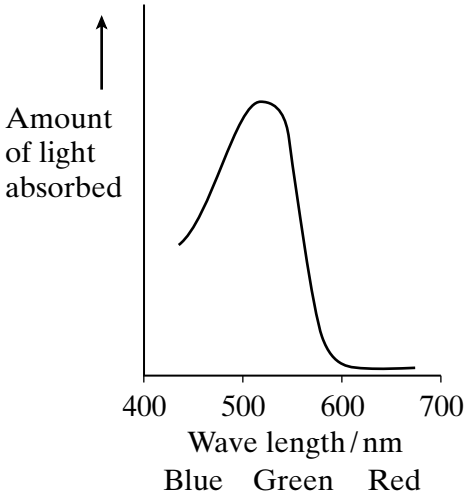

Figure 6

(i) Explain why it takes time for the rod cells to recover their sensitivity to light after moving into darkness.

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(2 marks)

(ii) Use information in **Figures 5** and **6** to explain the differences in sensitivity of rod cells to red and green light.

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(2 marks)

(iii) Suggest an explanation for the difference in sensitivity of rod cells to the white and green spots after 30 minutes.

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(1 mark)

15

TURN OVER FOR THE NEXT QUESTION

9 (a) Explain how crossing over can contribute to genetic variation.

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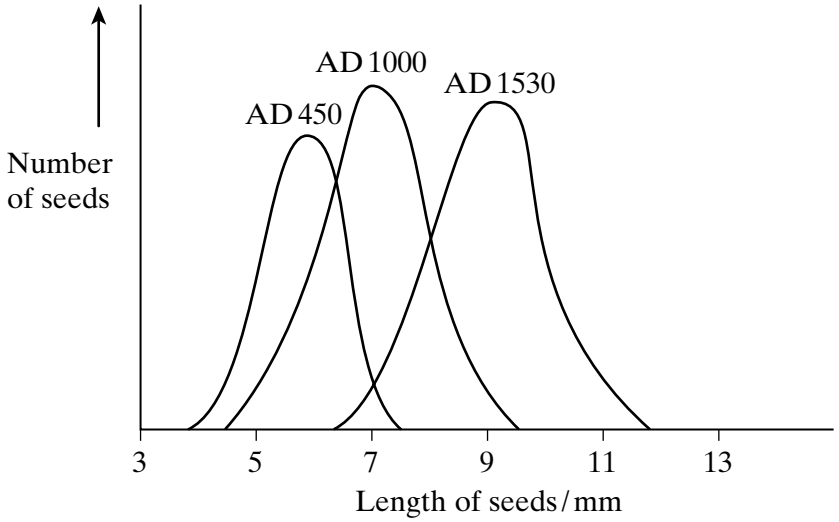
(3 marks)

(b) Maize seeds were an important food crop for the people who lived in Peru. The seeds could be kept for long periods. Each year, some were sown to grow the next crop. Archaeologists have found well-preserved stores. The graph shows the lengths of seeds collected from three stores of different ages.



(i) Within each store the maize seeds showed a range of different lengths. Explain **one** cause of this variation.

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(2 marks)

(ii) Use your knowledge of genetics and selection to explain the changes in the mean length of the seeds between AD 450 and AD 1530.

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(4 marks)

QUESTION 9 CONTINUES ON THE NEXT PAGE

Turn over ▶

(c) The Galapagos Islands are an isolated group about 900 km from South America. Thirteen species of small birds called finches live on the islands. All species are thought to have evolved from a single species which reached the islands from South America. This species fed only on seeds, but the finches on the islands include species which specialise in feeding on buds, nectar and insects, as well as on different sizes of seed.

Explain how evolutionary change could have resulted in this diversity of finch species on the Galapagos Islands.

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(6 marks)

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END OF QUESTIONS

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