| Surname | | Other Names | |
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| Centre Number | | | Candidate Number | | | | | | | | | |
| Candidate Signature | | | | | | | | | | | | |

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General Certificate of Education
January 2005
Advanced Level Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

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

Monday 24 January 2005 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 | | | |
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| Number | Mark | Number | Mark |
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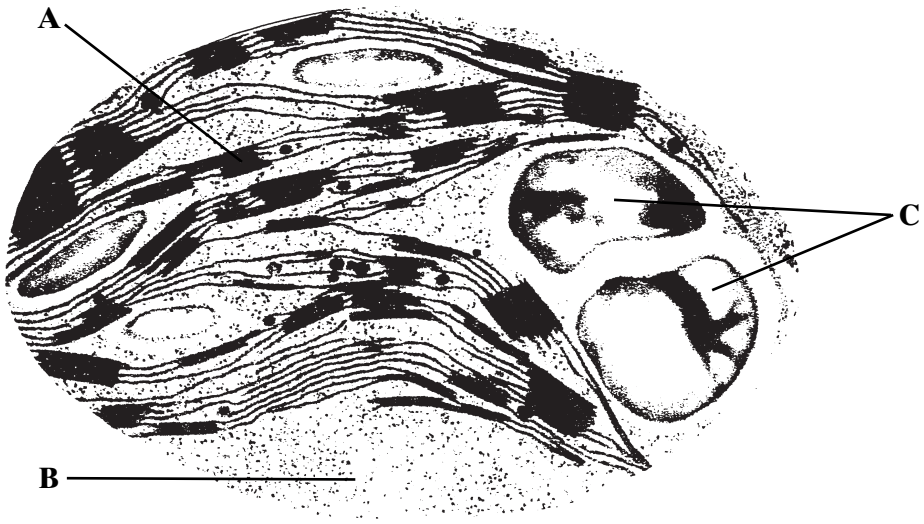
## SECTION A

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

**1** The electron micrograph shows part of a chloroplast.




(a) Name the parts labelled **A** and **B** and, for each, describe **one** role in the process of photosynthesis.

**A** Name .....

Role .....

.....

*(2 marks)*

**B** Name .....

Role .....

.....

*(2 marks)*

(b) (i) Name the main substance present in the part labelled **C**.

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*(1 mark)*

(ii) How is this substance formed?

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*(1 mark)*

6

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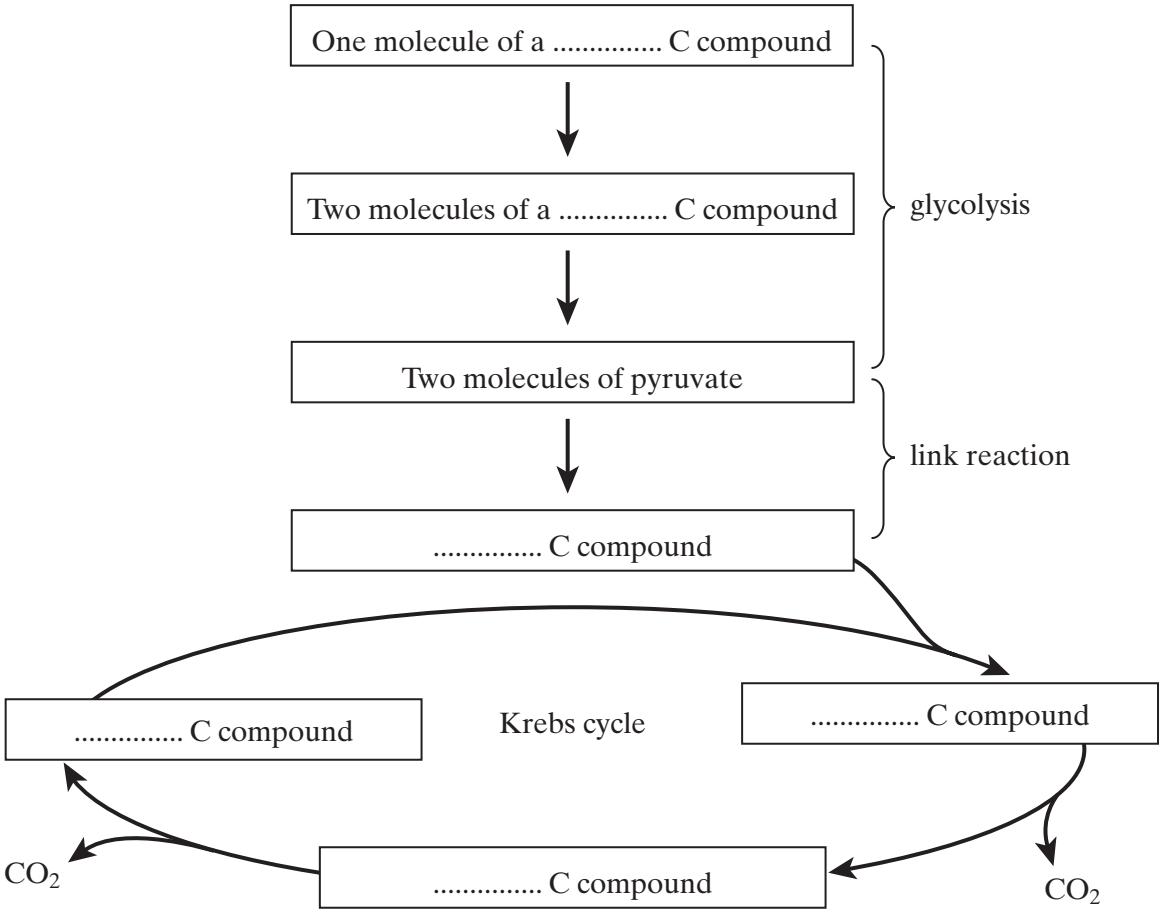
**2** The boxes in the diagram represent substances in glycolysis, the link reaction and the Krebs cycle.




(a) Complete the diagram to show the number of carbon atoms present in **one** molecule of each compound.

*(2 marks)*

(b) Other substances are produced in the Krebs cycle in addition to the carbon compounds shown in the diagram. Name **three** of these other products.

1 .....

2 .....

3 .....

*(3 marks)*

5

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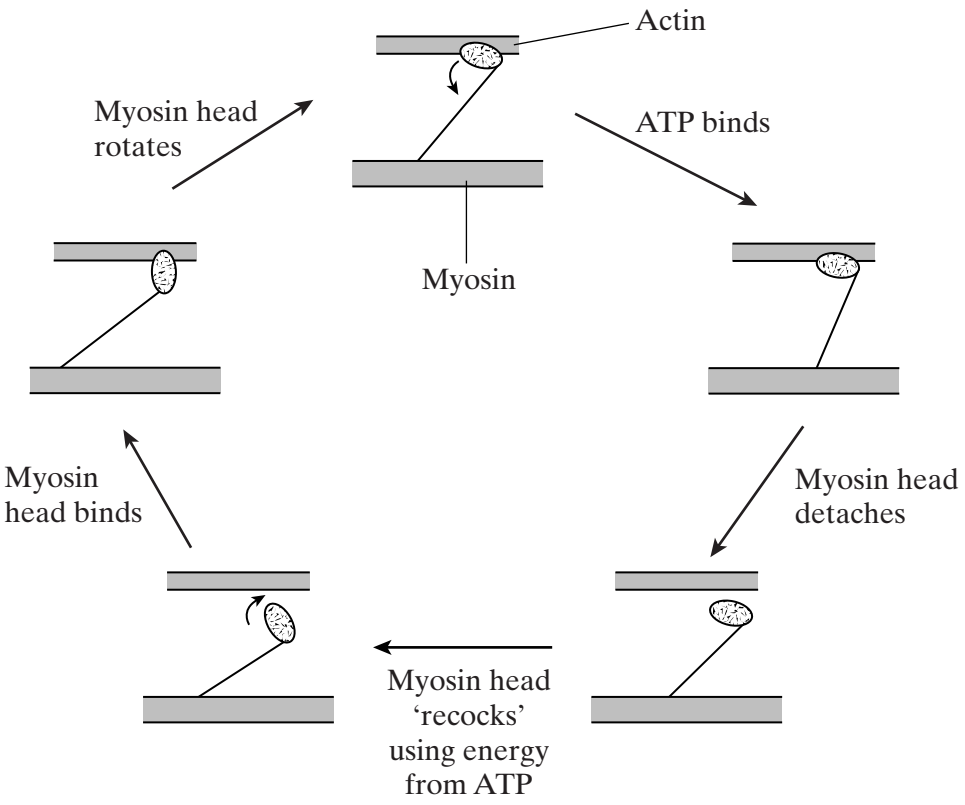
**3** The diagram shows the stages in one cycle that results in movement of an actin filament in a muscle sarcomere.




(a) Describe how stimulation of a muscle by a nerve impulse starts the cycle shown in the diagram.

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*(3 marks)*

LEAVE MARGIN BLANK

(b) Each cycle requires hydrolysis of one molecule of ATP and moves one actin filament 40 nm. During contraction of a muscle sarcomere, a single actin filament moves 0.6 μm. Calculate how many molecules of ATP are required to produce this movement.

Answer .....

*(2 marks)*

(c) After death, cross bridges between actin and myosin remain firmly bound resulting in rigor mortis. Using information in the diagram, explain what causes the cross bridges to remain firmly bound.

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*(2 marks)*

7

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**4** Organisms are classified into five kingdoms – prokaryotes, protoctists, fungi, plants and animals.

(a) Give **one** characteristic feature of fungi which is not found in other kingdoms.

.....

*(1 mark)*

(b) Complete the table with a tick (✓) if the statement is true and a cross (✗) if the statement is not true.

| | **Prokaryotes** | **Protoctists** | **Fungi** | **Plants** | **Animals** |
|---|---|---|---|---|---|
| Includes organisms which photosynthesise | | | | | |
| Includes organisms which have cell walls | | | | | |
| Includes organisms with mitochondria in their cells | | | | | |

*(3 marks)*

4

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**5** Coat colour in mice is controlled by two genes, each with two alleles. The genes are on different chromosomes.

One gene controls the pigment colour. The presence of allele **A** results in a yellow and black banding pattern on individual hairs, producing an overall grey appearance called agouti. Mice with the genotype **aa** do not make the yellow pigment and are, therefore, black.

The other gene determines whether any pigment is produced. The allele **D** is required for development of coat colour. Mice with the genotype **dd** produce no pigment and are called albino.

(a) What type of gene interaction is occurring between the two genes? Explain your answer.

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*(2 marks)*

(b) Give all the possible genotypes for a black mouse.

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*(1 mark)*

(c) An agouti mouse of unknown genotype was crossed with an albino mouse of unknown genotype. Their offspring included albino, agouti and black mice.

(i) What was the genotype of the agouti parent?

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*(1 mark)*

(ii) Give **two** possible genotypes for the albino parent.

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*(1 mark)*

(iii) Suggest how the actual genotype of the albino parent could be determined.

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*(2 marks)*

7

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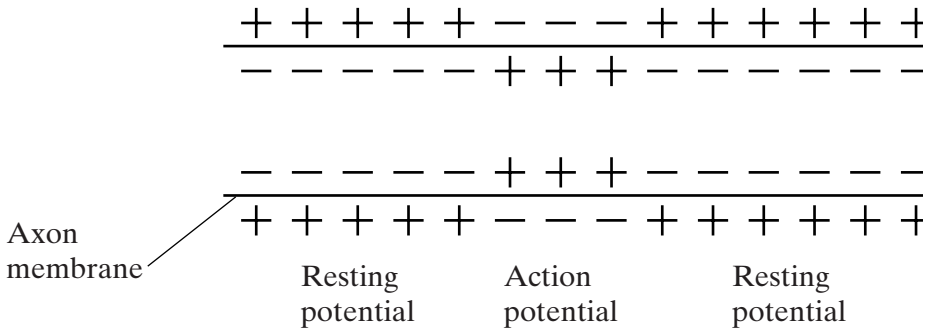
**6** The diagram shows the change in the charge across the surface membrane of a non-myelinated axon when an action potential is produced.




(a) Describe how the change shown in the diagram occurs when an action potential is produced.

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*(2 marks)*

(b) Explain what causes the conduction of impulses along a non-myelinated axon to be slower than along a myelinated axon.

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*(3 marks)*

5

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**7** In an investigation, the tolerance to copper ions of the grass *Agrostis tenuis* was determined. Samples were taken of plants growing in waste from a copper mine and from nearby areas just outside the mine. The mean copper tolerance of plants from the mine waste was found to be four times higher than that of plants in the surrounding area.

(a) Explain how natural selection could produce a copper-tolerant population in the mine waste.

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*(4 marks)*

(b) Copper-tolerant *Agrostis tenuis* plants flower at a different time from those which are not copper-tolerant. Explain how this might eventually lead to the production of a new species of *Agrostis*.

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*(4 marks)*

8

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**8** Two pairs of alleles **A** and **a**, and **B** and **b** are found on one pair of homologous chromosomes. A person has the genotype **AaBb**. **Figure 1** shows the chromosomes at an early stage of meiosis. The position of two of the alleles is shown.

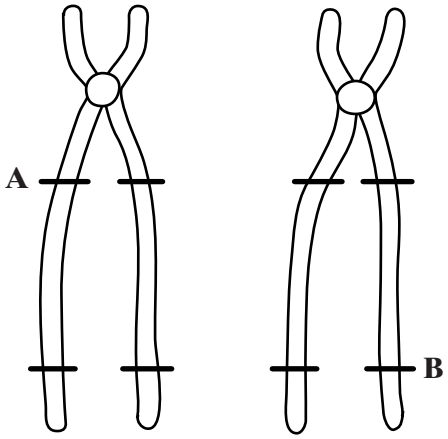


**Figure 1**

(a) Complete **Figure 1** to show the alleles present at the other marked positions.

*(1 mark)*

Crossing over occurs as shown in **Figure 2**.

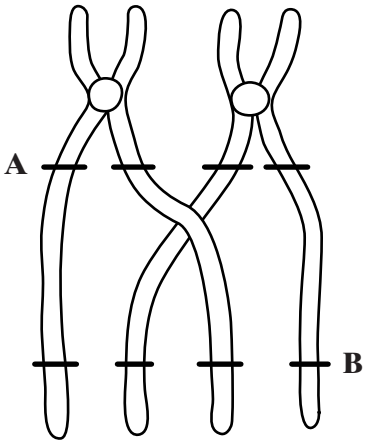


**Figure 2**

(b) What term is used to describe the pair of homologous chromosomes shown in **Figure 2**?

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*(1 mark)*

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(c) From **Figure 2**, give the genotypes of the gametes produced containing the chromatids

(i) that have **not** crossed over;

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(ii) that have crossed over.

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*(2 marks)*

(d) Give **two** processes, other than crossing over, which result in genetic variation. Explain how each process contributes to genetic variation.

Process .....

Explanation .....

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*(2 marks)*

Process .....

Explanation .....

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*(2 marks)*

8

**TURN OVER FOR THE NEXT QUESTION**

**NO QUESTIONS APPEAR ON THIS PAGE**

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## SECTION B

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

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

**9** (a) The amount of light entering the eye is controlled by a reflex involving the iris.

(i) Where are the receptors for this reflex?

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*(1 mark)*

(ii) Explain the role of the autonomic nervous system in the control of this reflex.

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*(2 marks)*

(b) The human retina contains rods and cones. Describe the similarities and differences between the pigments in the rods and cones and the ways in which these pigments respond to light.

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*(5 marks)*

**QUESTION 9 CONTINUES ON THE NEXT PAGE**

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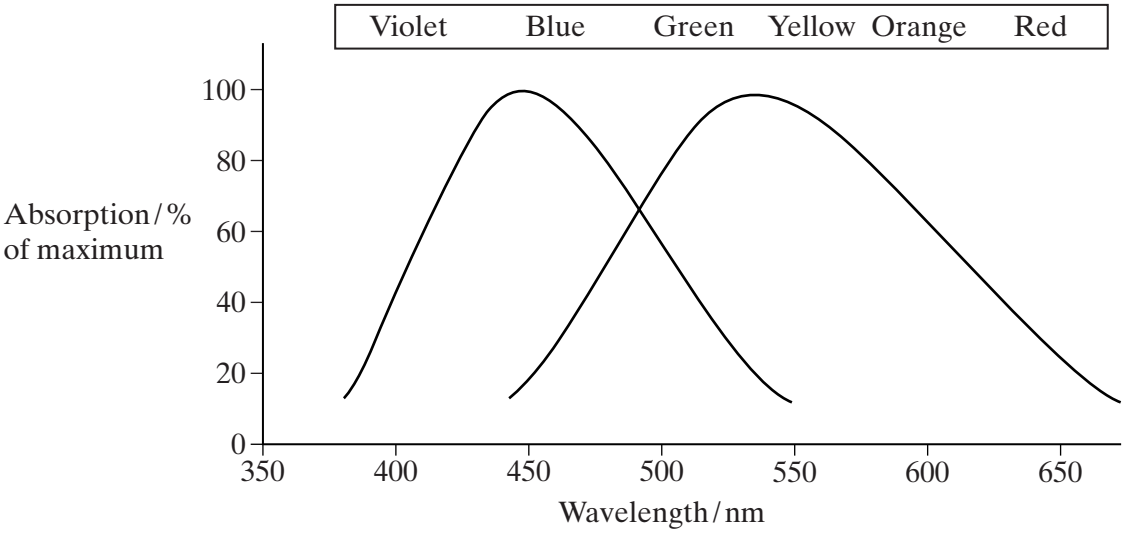
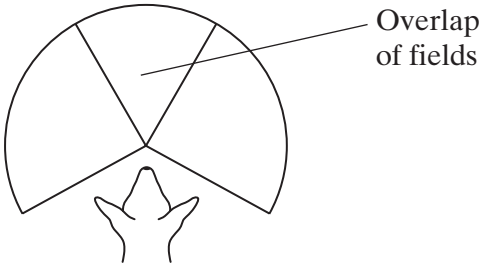
(c) In dogs, 10-20% of the photoreceptors in the central region of the retina are cones. Two types of cone are present. The graph shows their absorption spectra.




A dog's eyes are on the sides of its head. This gives the dog a visual field of about 240 degrees, with an overlap of the fields from each eye of about 60 degrees.



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(i) Apart from the number of types of cone, give **one** way in which the retina of a dog differs from that of a human.

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*(1 mark)*

(ii) Using the information given, suggest and explain how a dog's vision differs from human vision.

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*(6 marks)*

15

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**10** **Figure 3** shows a seal which lives in the Arctic ocean. It is a mammal with a core body temperature of 37 °C. It has a layer of fat (blubber) under the skin which is 50 mm thick and which insulates it from the cold.


**Figure 3**

**Figure 4** shows the temperature gradient in the surface tissues of the seal when it is in water at 0 °C.

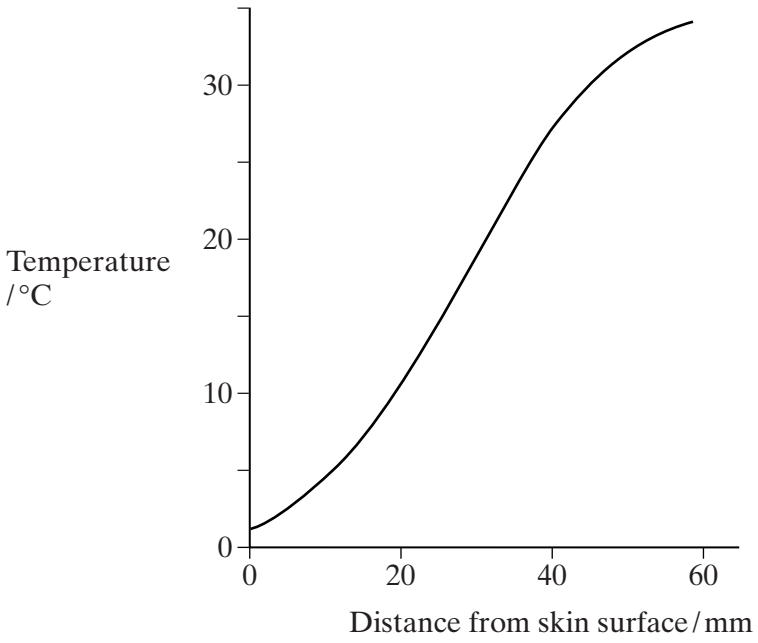


**Figure 4**

(a) Describe the evidence from **Figure 4** that blubber is an effective insulator.

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*(2 marks)*

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(b) **Figure 5** shows the arrangement of the blood vessels in the surface tissues of the seal.

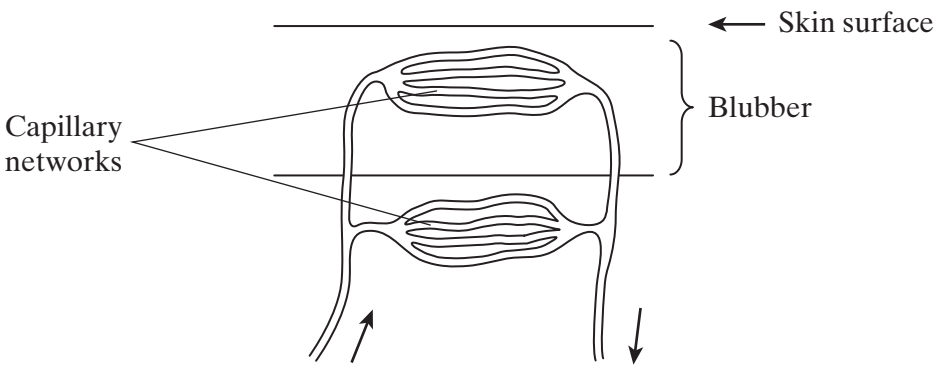


**Figure 5**

Explain how this arrangement of the blood vessels helps the seal to maintain a constant body temperature.

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*(4 marks)*

**QUESTION 10 CONTINUES ON THE NEXT PAGE**

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(c) The seal has no blubber in the flippers. Each artery carrying blood to the flipper is surrounded by veins from the flipper, as shown in **Figure 6**.

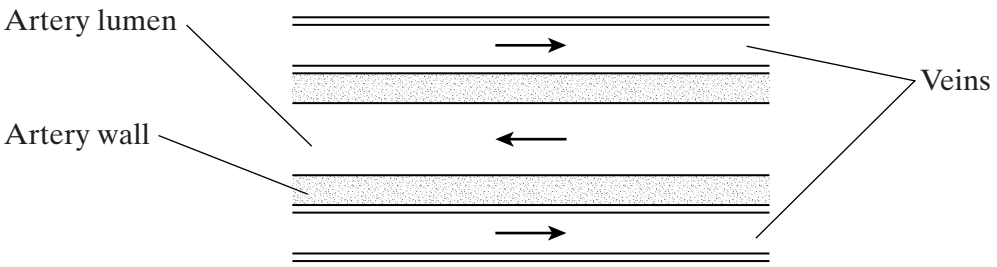


**Figure 6**

Explain how this arrangement of blood vessels prevents excessive heat loss.

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*(3 marks)*

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(d) Like other mammals, seals produce urine which is more concentrated than their blood plasma. Explain the role of the loop of Henle in producing concentrated urine.

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*(6 marks)*

15

**END OF QUESTIONS**

**QWC**

1

**THERE ARE NO QUESTIONS PRINTED ON THIS PAGE**

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Question 1: N Green, G Stout and D Taylor, Editor R Soper *Biological Science* Vol 1 Chapter 9 Cambridge University Press, 1984.

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