

Surname					Other Names				
Centre Number					Candidate Number				
Candidate Signature									

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General Certificate of Education
January 2003
Advanced Level Examination



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

BYB4

Thursday 23 January 2003 Morning Session

In addition to this paper you will require:

- a ruler with millimetre measurements.

You may use a calculator.

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

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 degree of legibility of your handwriting and the level of accuracy of your spelling, punctuation and grammar will also be taken into account.

SECTION A

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

- 1** (a) Describe how a resting potential is maintained in an axon.

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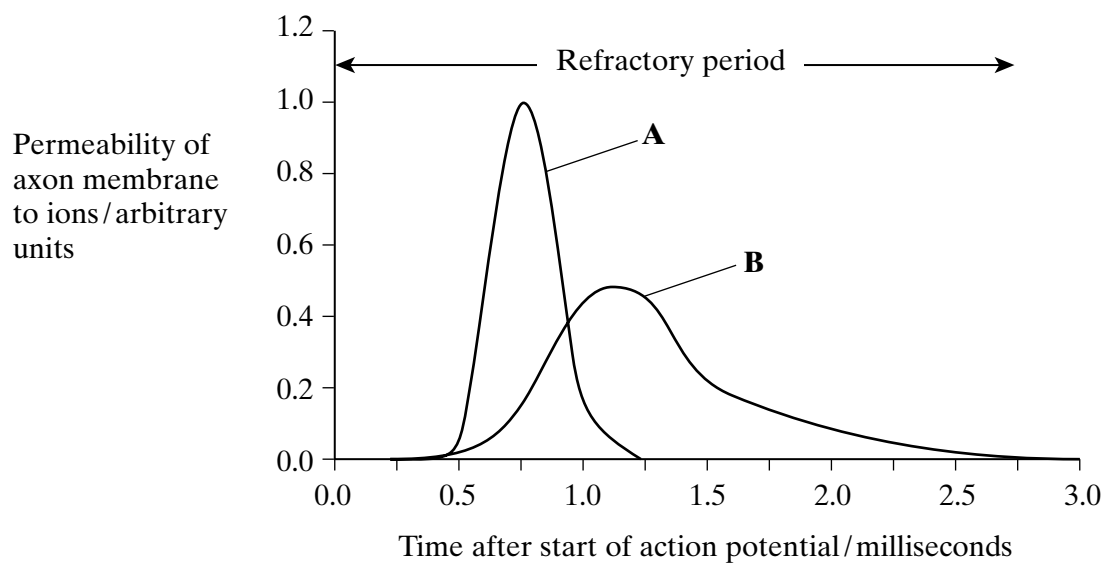
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(2 marks)

- (b) The graph shows the changes in the permeability of a section of axon membrane to two ions involved in producing an action potential.



- (i) Identify ions **A** and **B**.

A

B

(1 mark)

(ii) Explain how movements of these ions are involved in producing the action potential.

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(2 marks)

(iii) What is meant by the *refractory period*?

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(1 mark)

(iv) Use the information in the graph to calculate the maximum frequency of action potentials per second along this axon. Show your working.

Answer action potentials s⁻¹
(2 marks)

8

Turn over ►

2 (a) Two of the products of the light-dependent reaction of photosynthesis are used in the light-independent reaction.

(i) Name these products.

Product 1

Product 2

(2 marks)

(ii) Describe how each product is used in the light-independent reaction.

Product 1

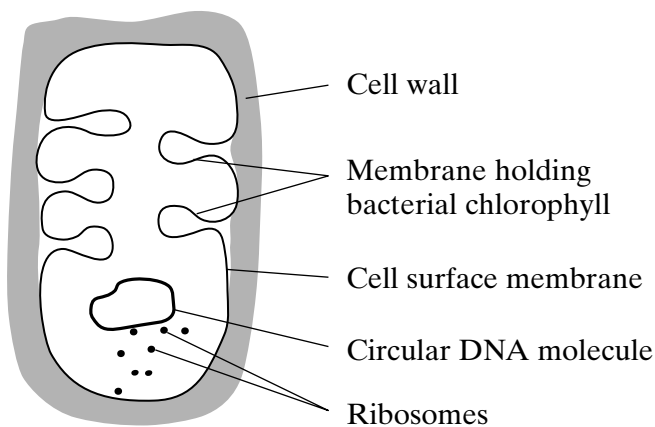
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Product 2

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(2 marks)

(b) The diagram shows the structure of a photosynthetic bacterium.



(i) Describe **two** ways in which the structure of a chloroplast differs from the structure of this bacterial cell.

1

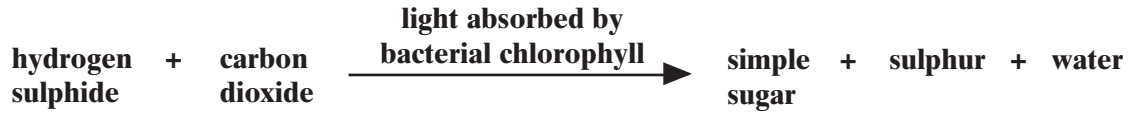
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(2 marks)

- (ii) The process of photosynthesis in this bacterium is not the same as in green plants. The bacterium lives in an environment where there is a lot of hydrogen sulphide, H₂S. A simple equation for photosynthesis in this cell is shown below.



Suggest what the hydrogen sulphide is used for in photosynthesis.

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(2 marks)



- 3 (a) Describe how oxidation takes place in glycolysis and in the Krebs cycle.

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(3 marks)

- (b) Water is a waste product of aerobic respiration. Describe how water is formed at the end of aerobic respiration.

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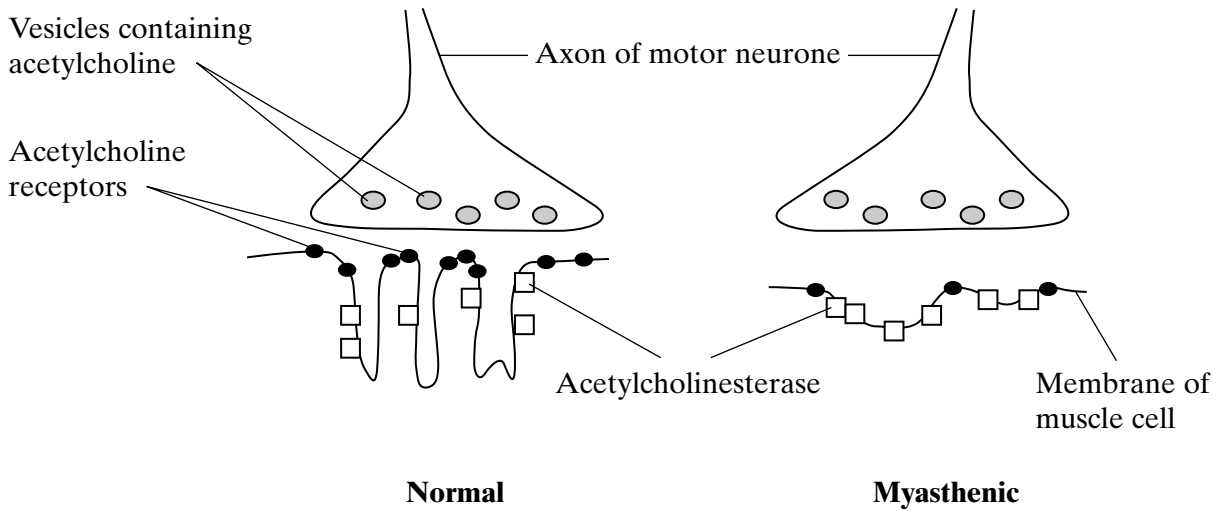
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(2 marks)



Turn over

4 Myasthenia gravis is a disease which causes muscular weakness. It develops because of an attack by the body's own immune system on neuromuscular junctions. The diagram shows a normal neuromuscular junction and one affected by the disease (myasthenic).



(a) Describe **two** ways in which a myasthenic neuromuscular junction differs from a normal one and explain how each difference would affect transmissions across the myasthenic neuromuscular junction.

Difference.....

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Effect.....

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Difference.....

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Effect.....

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(4 marks)

(b) The changes in the neuromuscular junctions in myasthenia gravis result in fewer calcium ions entering muscle fibres. Explain how this reduces interactions between actin and myosin filaments and, thus, the strength of muscle contractions.

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(3 marks)



TURN OVER FOR THE NEXT QUESTION

Turn over 

5 (a) Explain what is meant by

(i) a *recessive* allele;

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(ii) *codominant* alleles.

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(2 marks)

(b) Chickens homozygous for black feathers were crossed with chickens homozygous for white feathers. These colours are determined by alleles of a single gene. All the F_1 offspring had blue feathers.

When the blue-feathered F_1 chickens were crossed with each other, there were black-feathered, white-feathered and blue-feathered chickens in the F_2 offspring.

(i) Complete the genetic diagram to explain how the F_1 and F_2 phenotypes were produced.

Parental phenotypes

Black-feathered

White-feathered

Parental genotypes

$F^B F^B$

$F^W F^W$

F_1 genotype

F_1 gametes

F_2 genotypes

F_2 phenotypes

Black-feathered

White-feathered

Blue-feathered

(4 marks)

- (ii) The number of black-feathered, white-feathered and blue-feathered chickens in the F₂ offspring was counted. The observed ratio of black : white : blue was similar to the ratio expected from theory but not the same. Explain why observed ratios are often not the same as the expected ratios.

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(2 marks)



TURN OVER FOR THE NEXT QUESTION

Turn over

- 6 (a) Explain how natural selection produces changes within a species.

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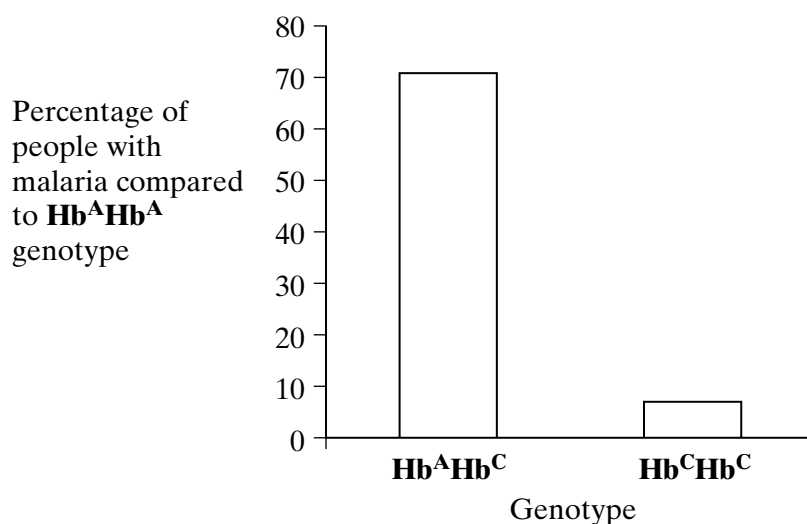
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(4 marks)

- (b) Malaria is caused by a parasite that attacks red blood cells, producing repeated bouts of serious illness and often causing death. The allele for normal haemoglobin in red cells is Hb^{A} . In the West African country of Burkina Faso, twenty percent of people are heterozygous for a different allele, Hb^{C} , which has no effect on their health. People homozygous for Hb^{C} suffer a very mild anaemia. The bar chart shows how the Hb^{C} allele affects the chance of getting malaria.



(i) Use the bar chart to describe how the **Hb^C** allele affects the chance of getting malaria.

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(2 marks)

(ii) Malaria is very common in Burkina Faso. The **Hb^C** allele is increasing in frequency in this part of Africa. Suggest an explanation for this.

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(2 marks)

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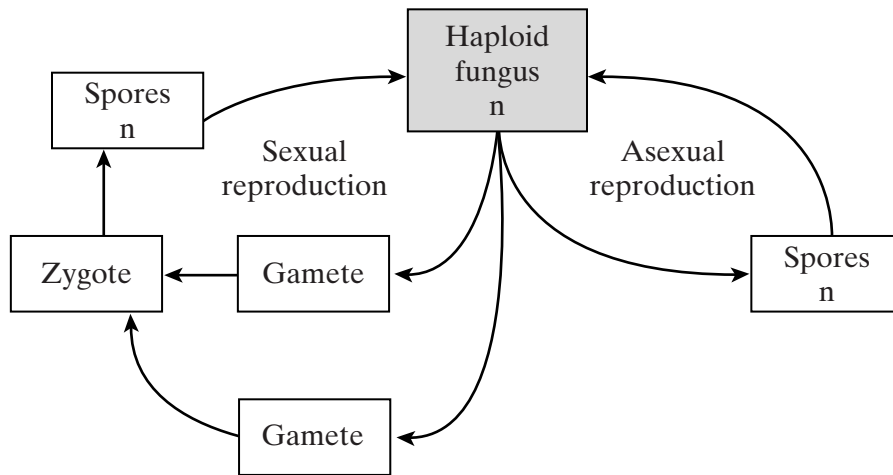
TURN OVER FOR THE NEXT QUESTION

Turn over 

7 (a) Fungi are eukaryotic organisms. Most consist of a mycelium made up of hyphae and reproduce by spores. Give **two** other characteristics of fungi.

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- 2
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- (2 marks)

(b) The diagram shows the life cycle of a fungus. In favourable environmental conditions the fungus reproduces asexually but, when conditions worsen, sexual reproduction occurs. The advantage of sexual reproduction is that it introduces variation.



(i) On the diagram, mark with an **X** where meiosis occurs. (1 mark)

(ii) Give **two** ways in which meiosis produces variation.

- 1
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- 2
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- (2 marks)

(iii) Suggest **one** advantage of sexual reproduction being stimulated by worsening environmental conditions.

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- (1 mark)

Turn over ►

SECTION B

Answer **all** 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) Describe and explain the differences between rod and cone cells in their sensitivity and acuity.

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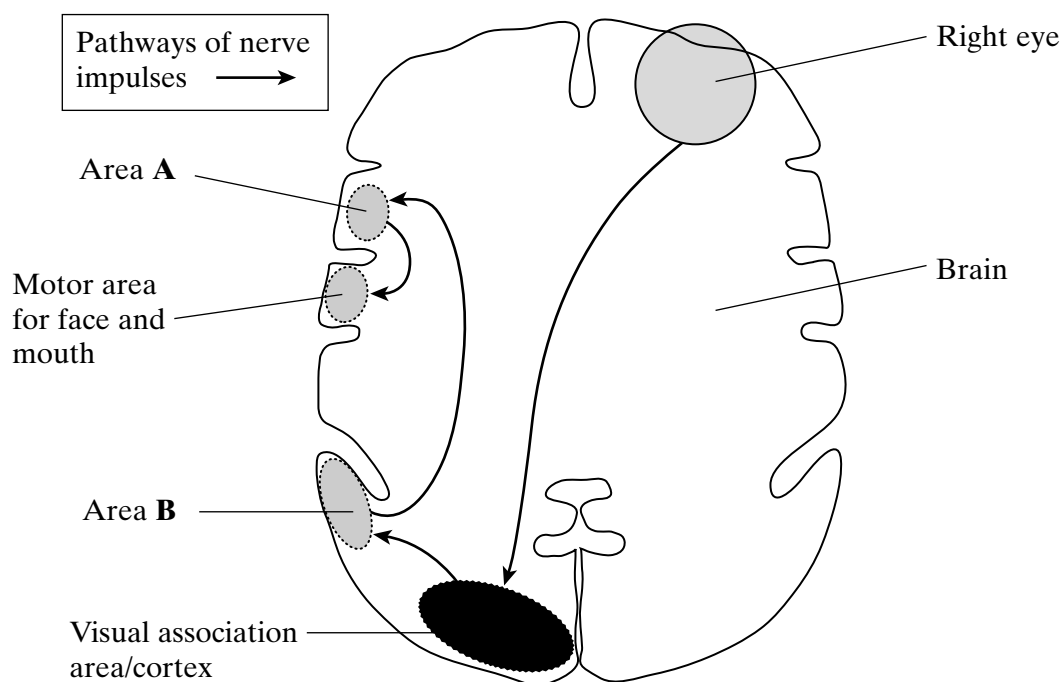
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(4 marks)

- (b) A person was shown an object and asked to say what it was. The diagram shows the stages in processing information supplied by receptors in the eye and then saying the name of the object.



(i) Name areas **A** and **B**.

A

B

(2 marks)

(ii) Using the diagram, explain how an image on the retina of the right eye results in an object being identified and its name spoken.

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(6 marks)

(c) A person received an injury to the head. When a doctor shone a bright light into each eye, the person's right pupil did not contract. Suggest an explanation for the failure of the right pupil to contract.

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(3 marks)

Turn over ▶

9 (a) Describe the role of insulin in the control of blood glucose concentration.

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(4 marks)

Figure 1 shows the pathway by which glycogen is broken down in liver and muscle cells.

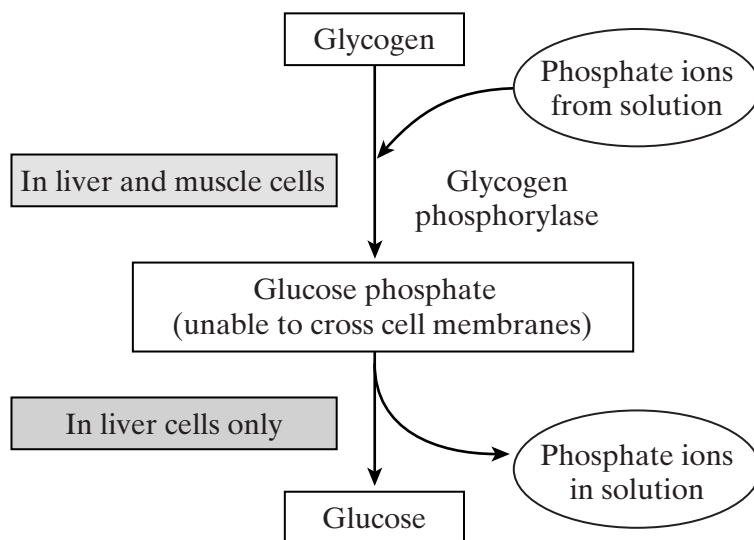


Figure 1

(b) Suggest why it is important that muscle cells do **not** convert glucose phosphate to glucose.

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(2 marks)

- (c) The production of glycogen phosphorylase from an inactive form of the enzyme is triggered by the hormones glucagon and adrenaline, and by calcium ions. Adrenaline is a hormone released when an animal senses danger. This is controlled by the sympathetic nervous system. **Figure 2** shows the receptors for glucagon and adrenaline on liver and muscle cells.

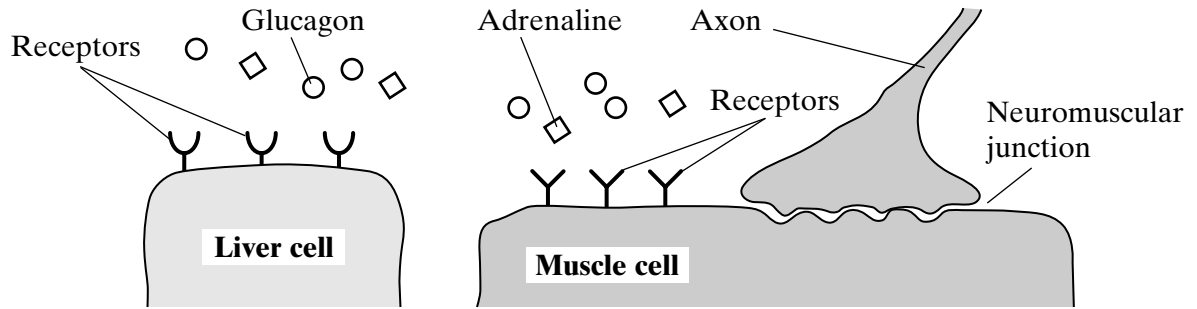


Figure 2

Use the information in **Figures 1** and **2** to suggest how glycogen breakdown in liver and muscle cells is increased when an animal runs away from a predator.

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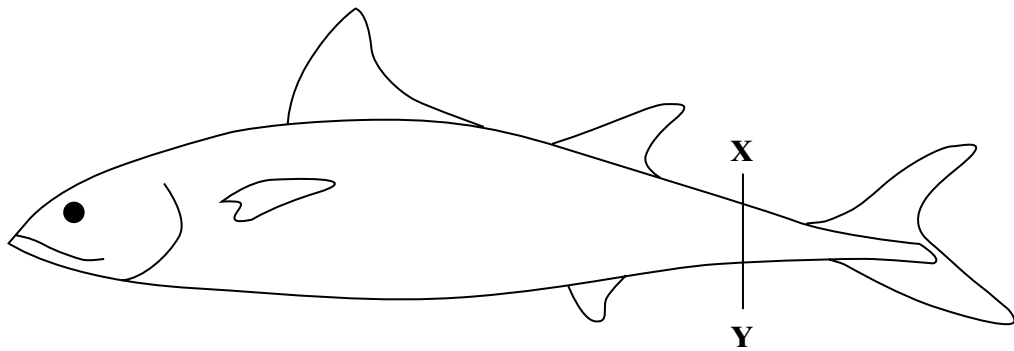
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(6 marks)

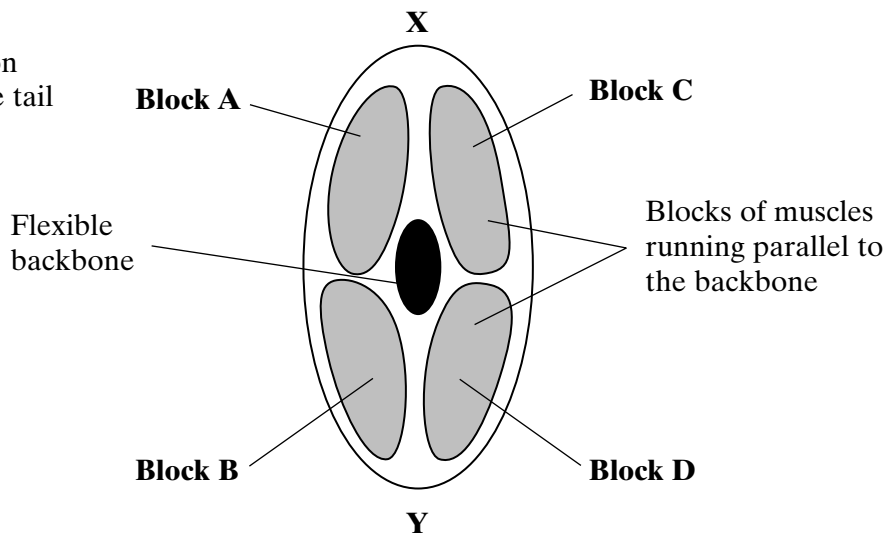
QUESTION 9 CONTINUES ON THE NEXT PAGE

Turn over ►

- (d) This fish swims away from danger using powerful side-to-side movements of its tail fin to push against the water.



Enlarged cross-section through the tail of the fish



Use the information in the diagrams to explain how the blocks of muscles produce the side-to-side swimming movements of the tail.

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(3 marks)

END OF QUESTIONS

QWC

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