

Surname		Other Names	
Centre Number		Candidate Number	
Candidate Signature			

For Examiner's Use

General Certificate of Education
January 2007
Advanced Level Examination



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

BYB4

Wednesday 24 January 2007 9.00 am to 10.30 am

For this paper you must have:

- a ruler with millimetre measurements.
You may use a calculator.

For Examiner's Use			
Question	Mark	Question	Mark
1		9	
2		10	
3			
4			
5			
6			
7			
8			
Total (Column 1) →			
Total (Column 2) →			
Quality of Written Communication			
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.
- Answer the questions in **Section A** and **Section B** in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want to be marked.

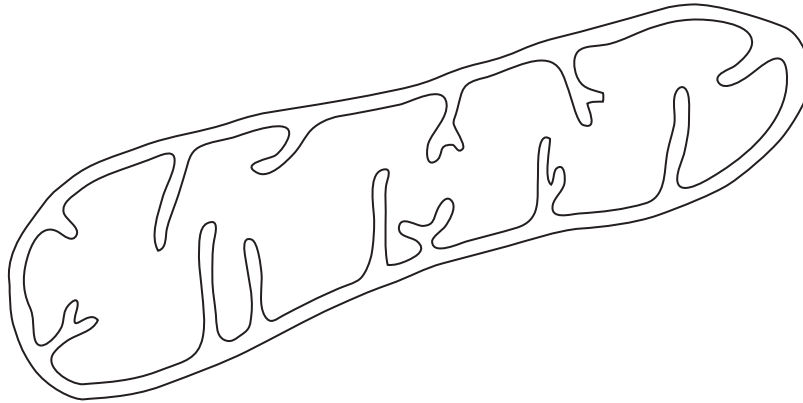
Information

- The maximum mark for this paper is 81.
- The marks for questions are shown in brackets. One mark is awarded for Quality of Written Communication in Section B.
- Answers for **Section A** are expected to be short and precise.
- Answer questions in **Section B** in continuous prose where appropriate. Quality of Written Communication will be assessed in these answers.
- You are reminded of the need for good English and clear presentation in your answers.
- Use accurate scientific terminology in your answers.

SECTION A

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

1 The diagram shows the structure of a mitochondrion.



(a) Give **two** similarities in the structure of a mitochondrion and a chloroplast.

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(2 marks)

(b) On the diagram, use label lines and letters to show

- (i) with **E**, where electron transport chains are found
- (ii) with **K**, where the Krebs cycle occurs.

(2 marks)

(c) Cyanide prevents oxygen acting as the final electron acceptor in the electron transport chain. Explain how cyanide stops ATP production by mitochondria.

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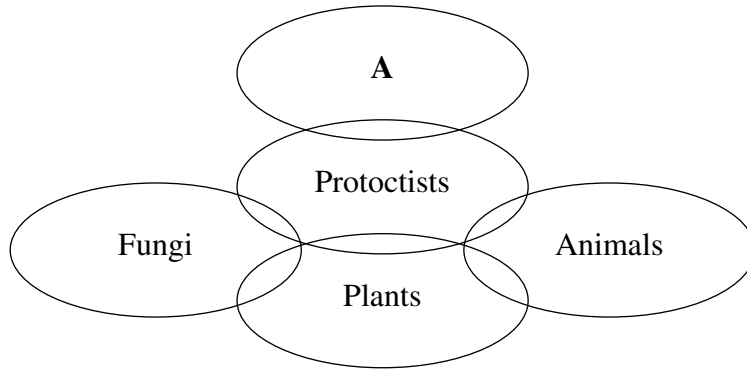
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(2 marks)

2 (a) In the spaces below, write the names of the other five groups in their correct taxonomic sequence.

Kingdom species
(1 mark)

(b) The diagram shows the relationship of the kingdom Protocists to the other four kingdoms. Each oval shape represents the characteristics shown by members of that kingdom.



(i) Name kingdom A.

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(1 mark)

(ii) Give **one** structural feature that the cells of protocists share with members of kingdom A.

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(1 mark)

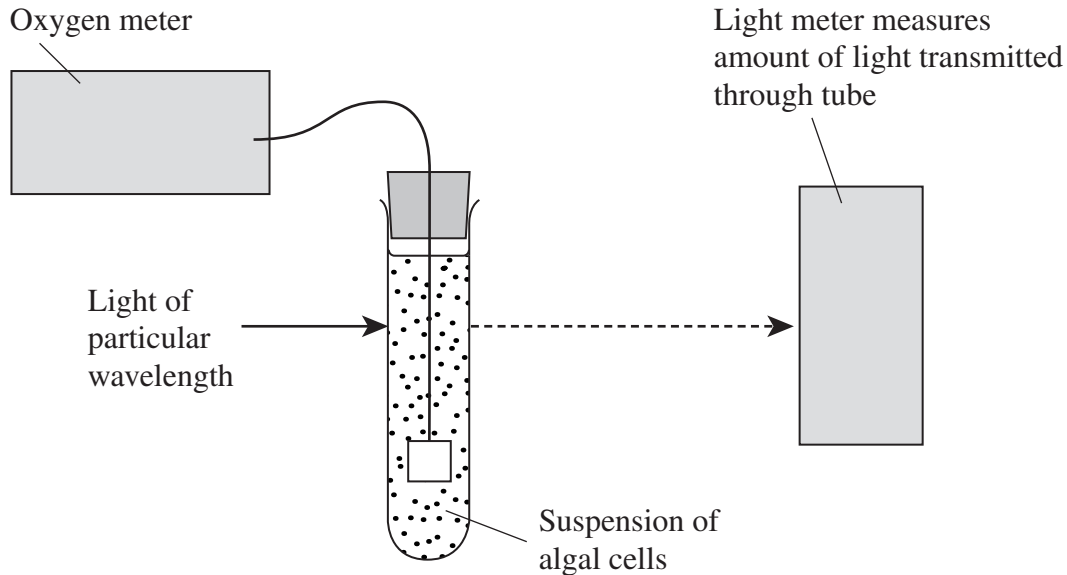
(iii) Give **one** structural feature that the cells of protocists share with animal cells but do **not** share with the members of kingdom A.

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(1 mark)

(c) Give **one** feature of fungi which is absent from all green plants.

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(1 mark)

- 3 Different wavelengths of light are used to illuminate a tube containing a suspension of photosynthetic algal cells. The percentage of light absorbed and the rate of photosynthesis are measured using the apparatus shown.



- (a) (i) The light meter is calibrated to read 100% using a glass tube containing water but no algal cells. Explain how the percentage of light absorbed by the algal cells is calculated.

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 (1 mark)

- (ii) What measurements should be taken to determine the rate of photosynthesis?

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 (1 mark)

- (b) (i) Apart from temperature and pH, give **one** factor that should be kept constant during the investigation.

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(1 mark)

- (ii) A buffer is used to maintain a constant pH. Explain why the pH of the suspension would increase during photosynthesis in the absence of a buffer.

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(1 mark)

- (c) Explain why temperature has little influence on the absorption of light by photosynthetic organisms.

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(2 marks)

6

Turn over for the next question

Turn over ►

- 4 (a) Explain **one** way in which the behaviour of chromosomes during meiosis produces genetic variation in gametes.

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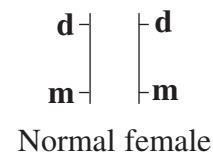
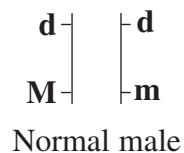
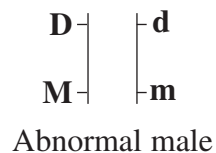
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(2 marks)

- (b) In mosquitoes, the sex of an individual is determined by one gene. Males have the genotype **Mm** and females **mm**.

Another gene is carried on the same chromosome. Normal males and females are homozygous **dd** for this gene. Abnormal males have a dominant **D** allele.

The possible genotypes are shown below. The vertical lines represent homologous chromosomes.



During meiosis, allele **D** causes the homologous chromosome carrying the **m** allele to disintegrate. Cells lacking this chromosome do not develop further.

Complete the genetic diagram to show how allele **D** is transmitted from an abnormal male to his offspring.

Parental phenotypes

Abnormal male

Normal female

Parental genotypes

D | **d**
M | **m**

d | **d**
m | **m**

Gametes

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Offspring genotype(s)

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Offspring phenotype(s)

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(3 marks)

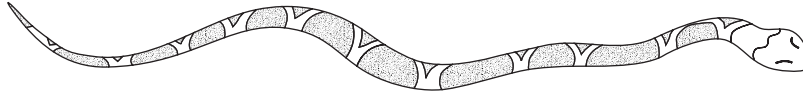
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Turn over for the next question

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- 5 A species of snake breeds on the shore of a very large lake and on the shore of an isolated island in the lake. There are two forms, a banded form (**B**) and an unbanded form (**U**). These are shown in the drawing.

Banded form (**B**)



Unbanded form (**U**)



- (a) Name the type of variation shown. Explain your answer.

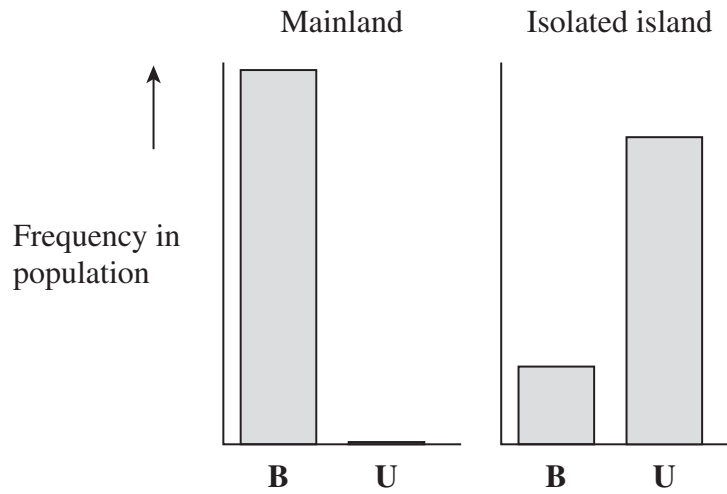
Type of variation

Explanation

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(2 marks)

(b) The frequency of the phenotypes was investigated in the two areas. The results are shown in the bar charts.



(i) The snakes are preyed upon by birds. Explain how natural selection may have produced the differences in frequency shown in the bar charts.

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(4 marks)

(ii) On the island, banded snakes have remained at approximately the same frequency for many generations. Suggest **two** explanations.

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(2 marks)

Turn over ►

- 6 (a) An allele is one form of a gene. Explain what is meant by a recessive allele.

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(2 marks)

- (b) The Chinese primrose has a gene that controls a coloured spot on the flower. There are three alleles: S^1 for white spot, S^2 for small yellow spot and S^3 for large yellow spot. Crosses were carried out using homozygous parents as shown in the table.

Cross	Parental phenotypes	Offspring phenotypes
1	white spot \times small yellow spot	all white spot
2	white spot \times large yellow spot	all white spot
3	small yellow spot \times large yellow spot	all small yellow spot

The offspring from cross **1** were crossed with the offspring from cross **2**. Complete the genetic diagram to show the genotypes and phenotypes expected in the offspring.

Parental phenotypes

White spot

White spot

Parental genotypes

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Gametes

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Offspring genotypes

Offspring phenotypes

Phenotypic ratio

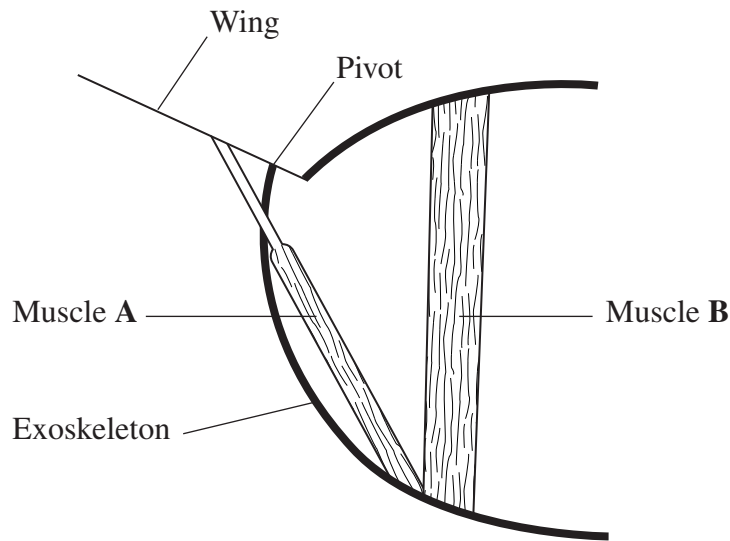
(4 marks)

6

Turn over for the next question

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- 7 Insects do not have bones; instead their hard outer covering acts as an exoskeleton to which muscles are attached. The diagram shows two of the main flight muscles of an insect.



- (a) Use your knowledge of antagonistic muscle action to explain how muscles **A** and **B** bring about movement of the wing.

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(2 marks)

- (b) Choline is a chemical needed to synthesise the neurotransmitter acetylcholine. Hemicholinium blocks the absorption of choline into the presynaptic neurone at a neuromuscular junction. Describe and explain how exposure to hemicholinium will affect the muscle action of an insect.

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(3 marks)

(c) Describe the function of calcium ions in muscle contraction.

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(3 marks)

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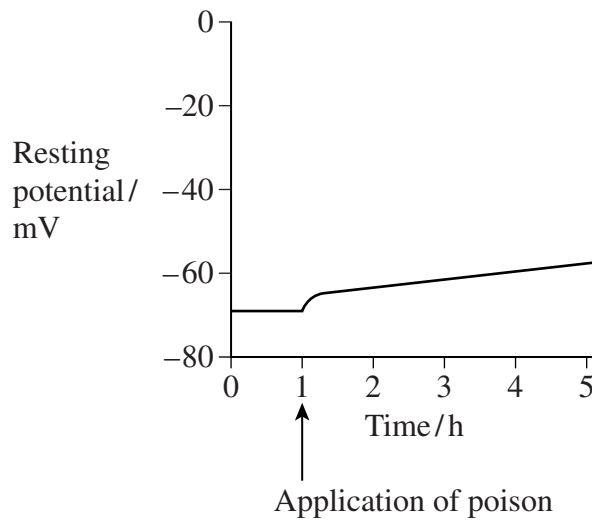
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8 (a) Describe how the resting potential of a neurone is maintained.

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(2 marks)

(b) The resting potential of a neurone is maintained at -70 mV . A metabolic poison was applied to a neurone and the change in the resting potential was measured over several hours. The results are shown in the graph.



Explain the change in resting potential that takes place after the application of the metabolic poison.

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(4 marks)

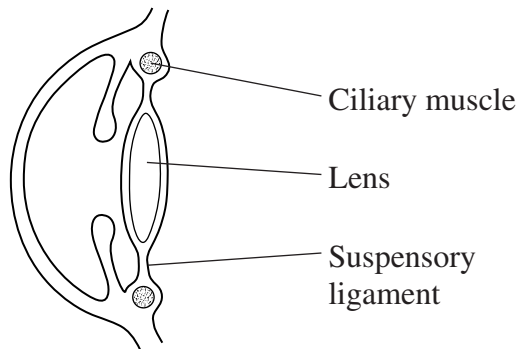
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SECTION B

Answer **all** questions.

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

- 9 (a) The diagram shows a section through the front of a human eye that is focused on a distant object.



- (i) Describe how the image of a near object would be focused on the retina.

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(4 marks)

- (ii) Refraction (bending of light) occurs when light passes from one medium to another medium with a different density. The refractive index is a measure of this refraction. The greater the refractive index, the greater the refraction. The table shows the refractive index as light passes from one medium to another.

Path of light	Refractive index
Air to air	1.00
Air to water	1.33
Air to cornea	1.37

When swimming under water, swimmers experience blurred vision. Use information in the table to suggest what causes this.

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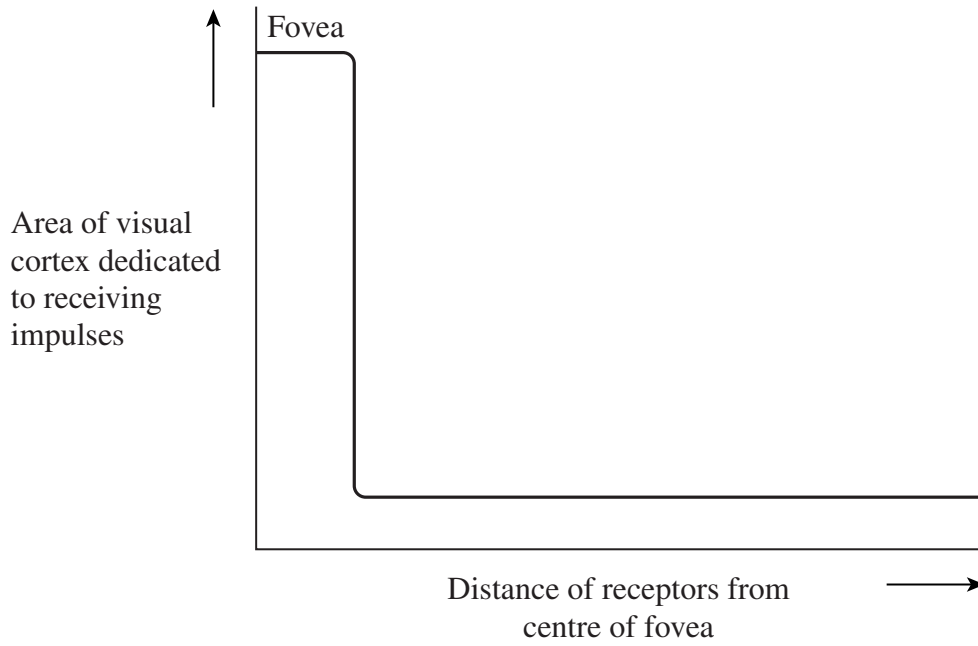
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(2 marks)

Question 9 continues on the next page

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(b) The graph shows the area of the visual cortex in the brain that is dedicated to receiving impulses from receptors in different parts of the retina.



Explain the shape of the curve.

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(4 marks)

- (c) The human eye has a visual acuity of 1. This means it can see two points as separate when light from both points hits the eye with an angle of at least 1 minute ($1/60^{\text{th}}$ of a degree) between them. The table compares the acuity of other animal eyes with that of the human eye.

Minimum angle/minutes	Acuity
2.00	0.50
1.00	1.00
0.75	1.33
0.25	4.00

Use the table to suggest and explain how the distribution of cones in the fovea affects the acuity of the eye.

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(2 marks)

- (d) Tears protect the surface of the eye. Describe the nervous control of tear production.

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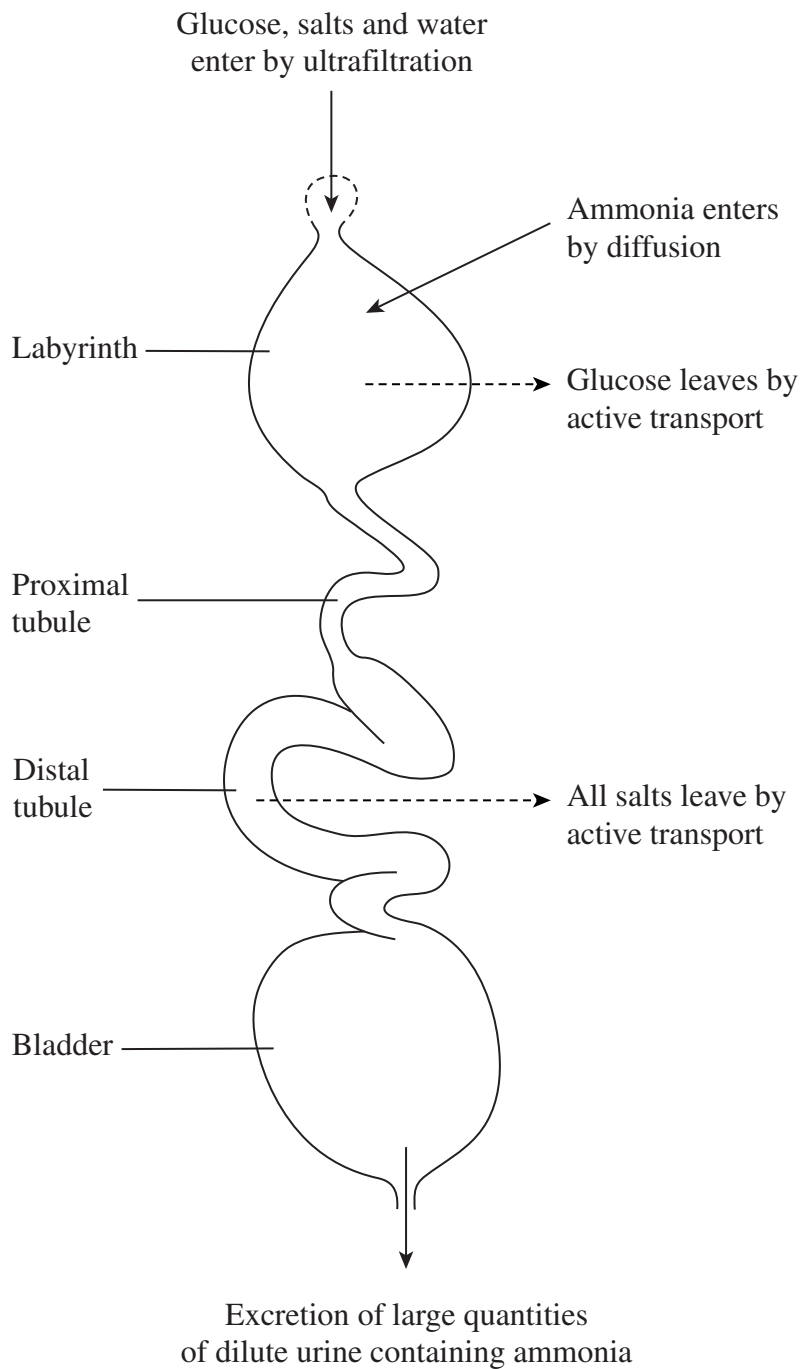
(3 marks)

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- (b) A species of crayfish lives in fresh water. This crayfish does not have kidneys but it does have an organ which excretes nitrogenous waste and controls the amount of water in its body. The diagram shows this excretory organ.



(i) Describe how excretion in this organ differs from excretion in a human nephron.

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(3 marks)

(ii) Suggest how the production of large amounts of dilute urine enables the crayfish to survive in fresh water.

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(2 marks)

END OF QUESTIONS

15

QWC

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