Surname		Other Names	
Centre Number			Candidate Number									
Candidate Signature												

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General Certificate of Education
June 2005
Advanced Level Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

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

Tuesday 21 June 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			
Number	Mark	Number	Mark
1			
2			
3			
4			
5			
6			
7			
8			
9			
QWC			
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

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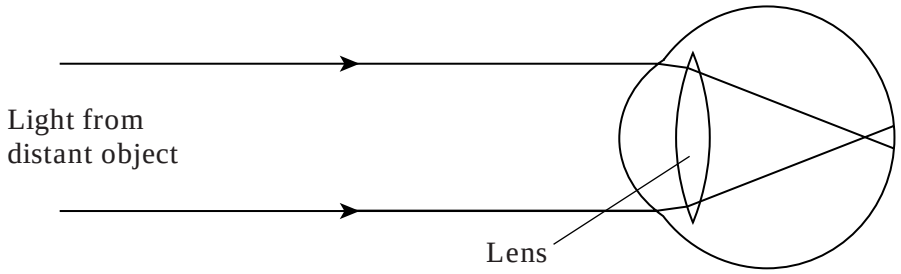
SECTION A

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

1 The diagram shows an eye focused on a distant object.



(a) Which part of the eye produces most of the refraction when light from a distant object is focused on the retina?

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(1 mark)

(b) A girl watching a football match looks down to read the programme she is holding. Describe and explain the changes which occur in her eyes when she focuses on the programme.

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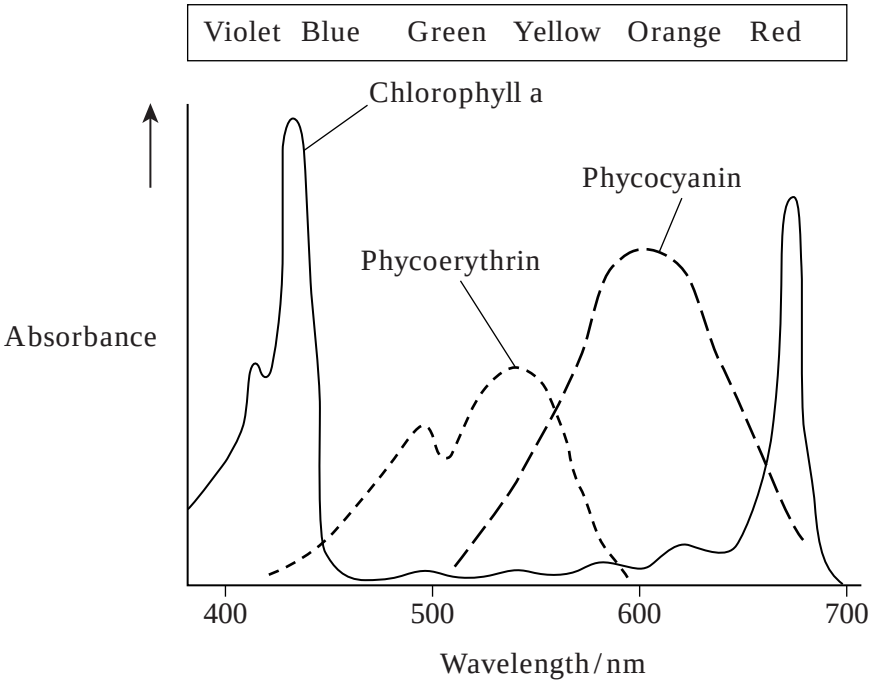
(4 marks)

5

2 The graph shows the absorption of different wavelengths of light by three photosynthetic pigments in a red seaweed.



(a) (i) Describe what the graph shows about the properties of chlorophyll a.

.....

.....

(1 mark)

(ii) Describe the part played by chlorophyll in photosynthesis.

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(3 marks)

(b) The red seaweed lives under water at a depth of 2 metres. Suggest an advantage to the red seaweed of having other pigments in addition to chlorophyll a.

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(2 marks)

6

Turn over ▶

3 Diabetes is a disorder affecting the ability to control blood glucose concentration. One type of diabetes can be due to an abnormality of the insulin receptors in the cell surface membranes of cells in the liver and muscles. A high blood glucose concentration and the presence of glucose in the urine are signs of this type of diabetes.

(a) (i) Suggest **one** way in which the insulin receptors might be abnormal.

.....

.....

(1 mark)

(ii) Explain how the presence of abnormal insulin receptors results in a high blood glucose concentration.

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(2 marks)

(iii) Explain how the kidneys normally prevent glucose appearing in the urine of a non-diabetic person.

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(3 marks)

(b) Twin studies have been used to determine the relative effects of genetic and environmental factors on the development of this type of diabetes. The table shows the concordance (where both twins have the condition) in genetically identical and genetically non-identical twins.

Concordance in genetically identical twins / %	**Concordance in genetically non-identical twins / %**
85	35

(i) What do the data show about the relative effects of environmental and genetic factors on the development of diabetes?

.....

.....

(1 mark)

(ii) Suggest **two** factors which should be taken into account when collecting the data in order to draw valid conclusions.

1 .....

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2 .....

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(2 marks)

9

TURN OVER FOR THE NEXT QUESTION

4 Colour blindness is controlled by a gene on the X chromosome. The allele for colour blindness, $\mathbf{X^b}$, is recessive to the allele for normal colour vision, $\mathbf{X^B}$. The gene controlling the presence of a white streak in the hair is not sex linked, with the allele for the presence of a white streak, **H**, being dominant to the allele for the absence of a white streak, **h**.

(a) Explain why colour blindness is more common in men than in women.

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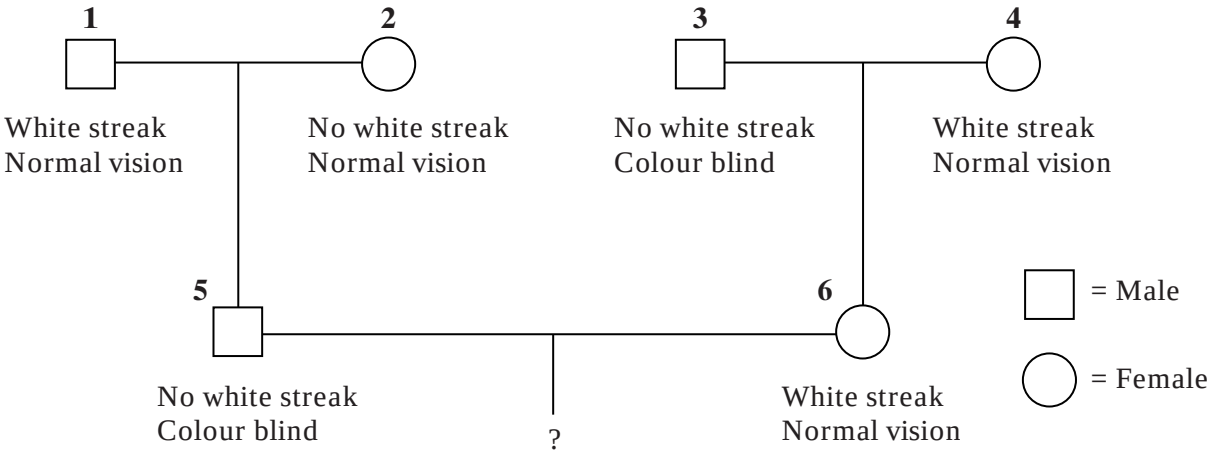
.....

(2 marks)

(b) The diagram shows a family tree in which some of the individuals have colour blindness or have a white streak present in the hair.



(i) What are the genotypes of individuals **5** and **6**?

Individual **5** .....

Individual **6** .....

(2 marks)

(ii) Give the possible genotypes of the gametes produced by

individual **5**; .....

individual **6**. .....

(1 mark)

(iii) What is the probability that the first child of individuals **5** and **6** will be a colour blind boy with a white streak in his hair? Show your working.

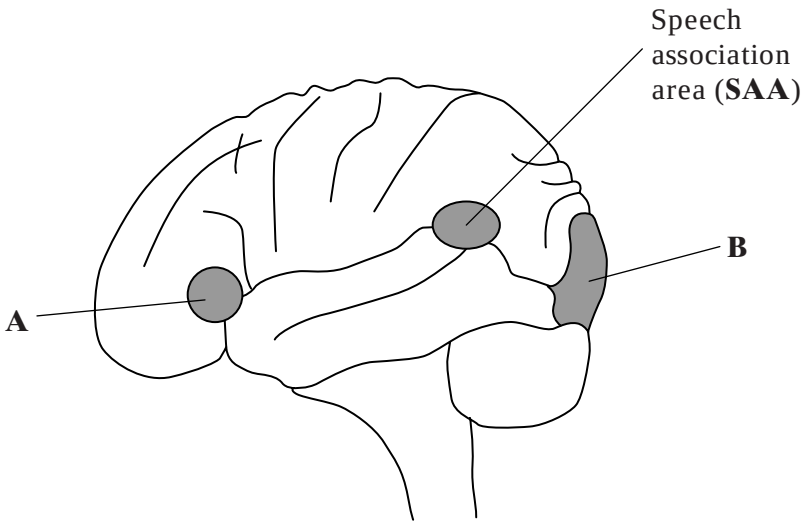
Answer .....

(2 marks)

7

NO QUESTIONS APPEAR ON THIS PAGE

5 The diagram shows three areas of the brain associated with reading and speech.



(a) Name the part of the brain in which areas **A** and **B** occur.

.....

(1 mark)

(b) A person reads a book aloud.

(i) Describe the role of each of the following areas of the brain when a person is reading aloud.

Speech association area (**SAA**) .....

.....

(1 mark)

Area **A** .....

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.....

.....

(2 marks)

Area **B** .....

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(2 marks)

(ii) In which order will impulses pass between the three areas shown?

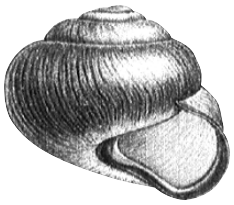
..... → ..... → .....

(1 mark)

7

Turn over ▶

6 The land snail, *Cepaea nemoralis*, is found in a number of different habitats. It is prey to birds such as thrushes. The shells of the snail show variation in colour and in the number of dark bands around them. They may be brown, pink or yellow, and they may have one, three or five bands or none at all.



Shell with no bands

Shell with five bands

(a) What type of variation is shown by the banding of the shells? Explain your answer.

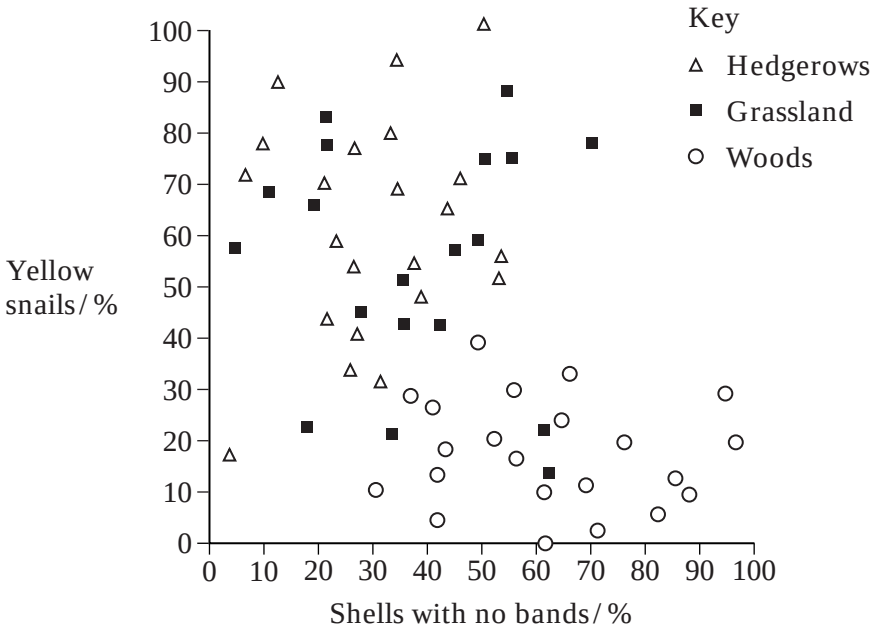
Type of variation .....

Explanation .....

.....

(1 mark)

(b) The graph shows the frequency of yellow, unbanded snails in three habitats. The frequencies were found to be consistent over a period of time.



(i) Describe what the graph shows about the relationship between the habitats and the phenotypes of the snails.

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(2 marks)

(ii) Suggest an explanation for this relationship.

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(4 marks)

7

TURN OVER FOR THE NEXT QUESTION

7 The production of pigment in rabbit fur is controlled by two genes.

One gene controls whether any pigment is made. This gene has three alleles. Allele **A** codes for the production of one form of the enzyme tyrosinase, which converts tyrosine into a black pigment. Allele $\mathbf{a^h}$ codes for the production of a second form of the enzyme, which becomes inactive at temperatures close to a rabbit's core body temperature, so only the face, ears, legs and tail are pigmented. A third allele, **a**, fails to code for a functional tyrosinase.

The other gene controls the density of pigment in the fur. This gene has two alleles. Allele **B** is dominant and results in the production of large amounts of pigment, making the fur black. Allele **b** results in less pigment, so the fur appears brown.

(a) How do multiple alleles of a gene arise?

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(2 marks)

(b) The table shows some genotypes and phenotypes.

Genotype	Phenotype
A–B–	all fur black
aaB–	all fur white (albino)
$\mathbf{a^h abb}$	white body fur with brown face, ears, legs and tail (Himalayan)

(i) What do the dashes represent in the genotype of the black rabbit?

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(1 mark)

(ii) Give all the possible genotypes for a Himalayan rabbit with black face, ears, legs and tail.

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(2 marks)

(iii) Suggest an explanation for the pigment being present only in the tail, ears, face and legs of a Himalayan rabbit.

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(2 marks)

(c) Using the information given, explain why the phenotypes of rabbits with **AABB** and **Aa^{h}BB** genotypes are the same.

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(2 marks)

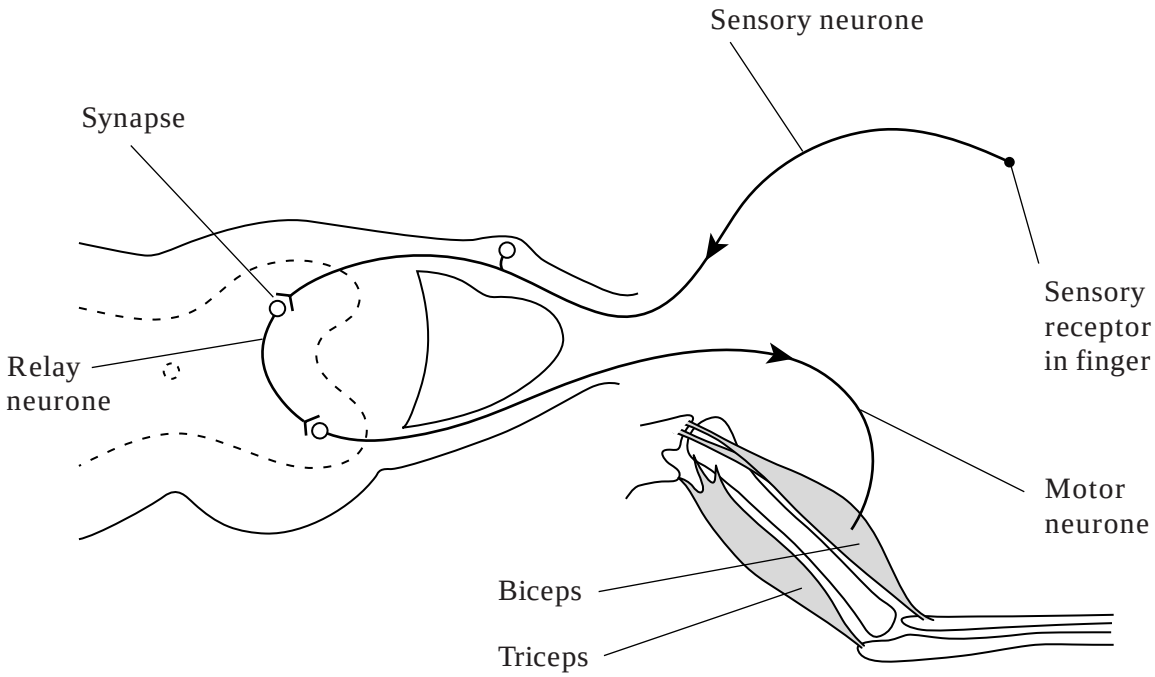
9

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 When a finger accidentally touches a hot object, a reflex action occurs. The biceps muscle contracts, causing the arm to be flexed and the finger is pulled away. The diagram shows the arrangement of the bones in the arm, the muscles used for flexing and straightening the arm and the nervous pathways associated with the contraction of these muscles.



(a) Explain the importance of reflex actions.

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(3 marks)

(b) (i) Describe the sequence of events which allows information to pass from one neurone to the next neurone across a cholinergic synapse.

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(6 marks)

(ii) Give **two** differences between a cholinergic synapse and a neuromuscular junction.

1 .....

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2 .....

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(2 marks)

(c) After the reflex action, the arm is straightened by a voluntary action. Describe how the arm is straightened after the reflex action has occurred.

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(4 marks)

15

Turn over ▶

NO QUESTIONS APPEAR ON THIS PAGE

9 (a) Explain the principles which biologists use to classify organisms into groups.

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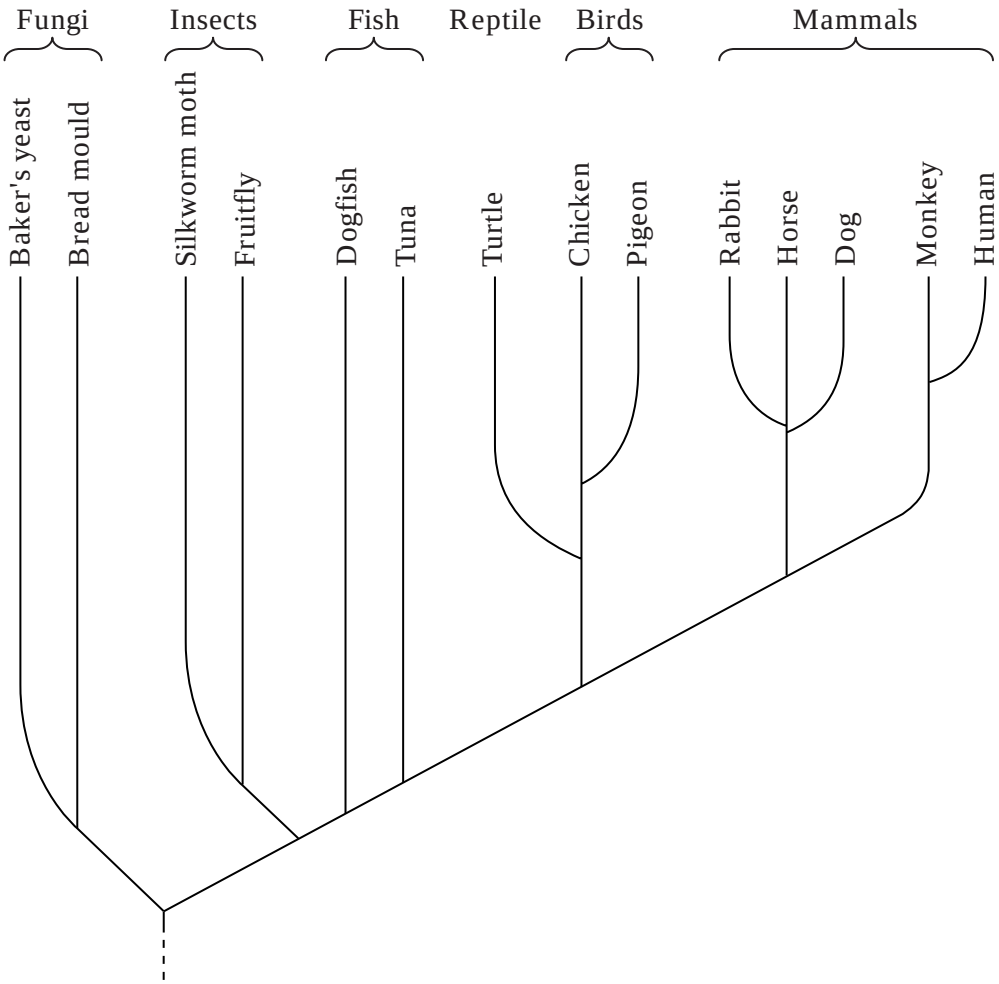
(3 marks)

QUESTION 9 CONTINUES ON THE NEXT PAGE

Cytochrome c is a protein with about 100 amino acids and is present in all eukaryotic organisms. It has the same three-dimensional shape in all species, but only 30 of the amino acids are the same in all species. The amino acid sequence of cytochrome c has been used to construct the phylogenetic tree shown below.



(b) Name the kingdoms represented in this phylogenetic tree.

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(1 mark)

(c) What does the phylogenetic tree show about the evolutionary relationship between fungi and insects?

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(2 marks)

(d) Suggest how information on amino acid sequences is used to construct a phylogenetic tree.

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(2 marks)

(e) Suggest **one** advantage and **one** disadvantage of using cytochrome c to construct a phylogenetic tree.

Advantage .....

.....

Disadvantage .....

.....

(2 marks)

(f) Cytochrome c is one of the components of the electron transport chain.

(i) Give the precise location of cytochrome c in the cell.

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(2 marks)

(ii) Describe how ATP is produced by the electron transport chain.

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(3 marks)

15

END OF QUESTIONS

QWC

1

THERE ARE NO QUESTIONS PRINTED ON THIS PAGE

ACKNOWLEDGEMENT OF COPYRIGHT-HOLDERS AND PUBLISHERS

Question 6 Source: M P Kerney and R A D Cameron, *A Field Guide to the Land Snails of Britain and North West Europe,* 1979, Collins.