Surname		Other Names	
Centre Number			Candidate Number									
Candidate Signature												

For Examiner's Use

General Certificate of Education
January 2008
Advanced Level Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

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

Wednesday 23 January 2008 9.00 am to 10.30 am

For this paper you must have:
- 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.
- 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.
- 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.

For Examiner's Use			
Question	Mark	Question	Mark
1		9	
2			
3			
4			
5			
6			
7			
8			
Total (Column 1) →			
Total (Column 2) →			
Quality of Written Communication			
TOTAL			
Examiner's Initials			

SECTION A

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

1 (a) What is a reflex?

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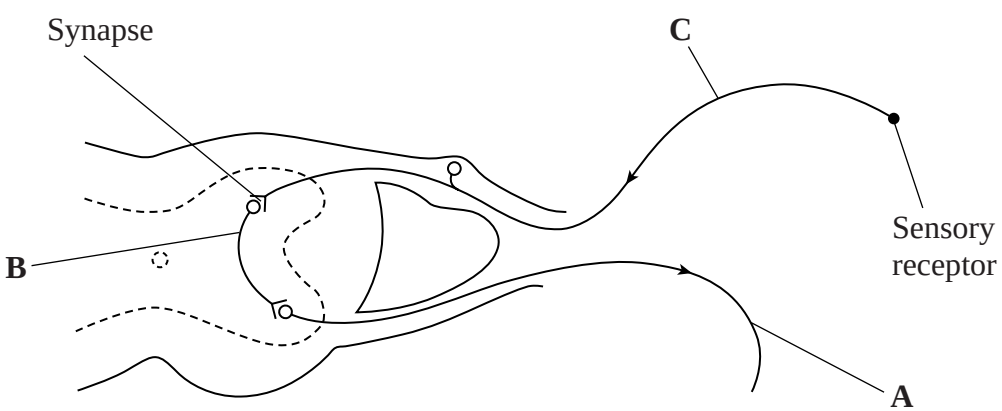
(2 marks)

The diagram shows the neurones in a reflex arc.



(b) Name the types of neurone labelled **A**, **B** and **C**.

A .....

B .....

C .....

(1 mark)

(c) Nervous transmission is delayed at synapses. Explain why.

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(2 marks)

(d) The axon of neurone **A** is myelinated. The axon of neurone **B** is non-myelinated. Explain why impulses travel faster along the axon of neurone **A**.

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(2 marks)

7

Turn over for the next question

2 In the kidney, ultrafiltration and selective reabsorption are two of the processes involved in the formation of urine.

(a) (i) Where does ultrafiltration occur?

.....

(1 mark)

(ii) Give **one** component of the blood which is not normally present in the filtrate.

.....

(1 mark)

(b) The kidneys remove a substance called creatinine from the blood. The rate of creatinine removal is a measure of the rate of filtration of the blood.

In one hour, a person excreted 75 mg of creatinine in his urine. The concentration of creatinine in the blood entering his kidneys was constant at 0.01 mg cm^{-3}.

Calculate the rate at which the blood was filtered in $cm^3\,min^{-1}$. Show your working.

Filtration rate = ... $cm^3\,min^{-1}$

(2 marks)

(c) Reabsorption of glucose takes place in the proximal tubule. Explain how the cells of the proximal tubule are adapted for this function.

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(2 marks)

6

3 (a) The autonomic nervous system controls the size of the pupil in the eye and the emptying of the bladder. The sympathetic and parasympathetic nervous systems control the contraction of different muscles.

Complete the table to show which muscle contracts in each case.

	Muscle that contracts when stimulated by	
	the sympathetic nervous system	**the parasympathetic nervous system**
Control of pupil size		
Control of bladder emptying		Walls of the bladder

(3 marks)

(b) The autonomic nervous system controls responses involving both muscle contraction and secretion from glands.

The size of the pupil is controlled by both components of the autonomic nervous system. Tear production is controlled by only one component of the autonomic nervous system.

Explain this difference in control.

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(2 marks)

5

Turn over for the next question

4 (a) Describe how oxygen is produced in photosynthesis.

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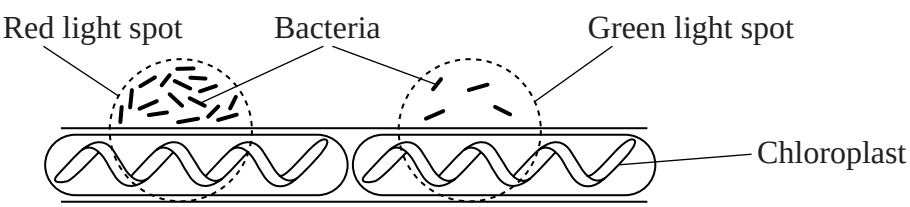
(3 marks)

(b) The green alga *Spirogyra* consists of large cells joined end to end. Each cell has one large, spiral-shaped chloroplast.

A student investigated the effect of red and green light on the rate of photosynthesis. She placed *Spirogyra* on a microscope slide in a drop of water. The water contained many bacteria. The bacteria moved to areas where the oxygen concentration was highest.

The student shone spots of red and green light on to different parts of the *Spirogyra*. The rest of the *Spirogyra* was in the dark. The results are shown in the diagram.



Explain the difference in the numbers of bacteria in the red and green light spots.

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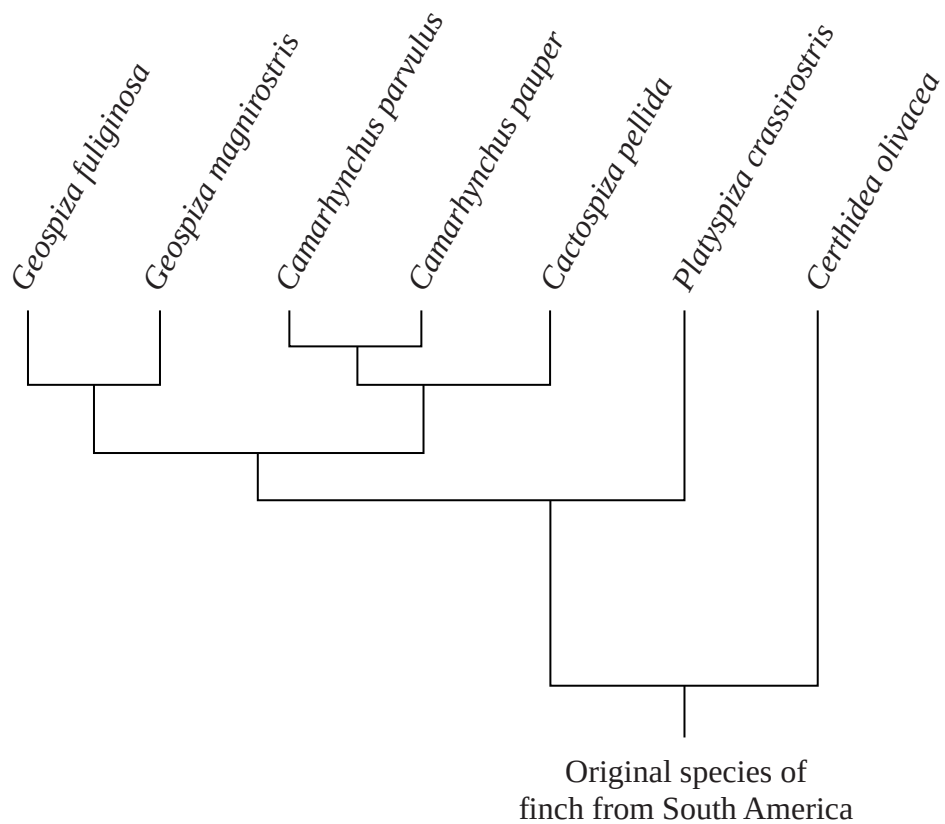
(3 marks)

6

5 The Galapagos are a very isolated group of islands. Species of birds called finches live on these islands. Scientists think that the different species have evolved from a population of one species which managed to reach the islands thousands of years ago from South America.

Scientists used base sequences in the DNA of the finches to work out the evolutionary relationship between the species.

The diagram shows the evolutionary relationship. Larger differences in base sequences are shown by longer vertical lines.



(a) Use the information in the diagram to answer the following questions.

(i) Which present-day species of finch evolved first on the Galapagos islands?

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(1 mark)

(ii) How many genera are present?

.....

(1 mark)

(iii) Which two genera are most closely related?

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(1 mark)

(b) Other than DNA base sequences, give **two** types of evidence that can be used to determine evolutionary relationships.

1 .....

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2 .....

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(2 marks)

(c) The beak of each species is adapted for feeding on a particular type of food.

Geospiza fuliginosa evolved as an eater of small seeds. *Geospiza magnirostris* evolved on a different island as an eater of large seeds.

These different species of finch might have evolved from one species. Suggest how.

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(4 marks)

9

6 Camels are large mammals. They live in hot, dry deserts, where the temperature can be more than 50 °C during the day and below freezing during the night. During the day, camels sweat when the environmental temperature rises above 42 °C. Sweating helps them to keep their body temperature below 40 °C.

(a) It is important for the camel to prevent its body temperature rising above 40 °C. Explain why.

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(2 marks)

(b) Evaporation of sweat from the skin is effective in reducing body temperature. Explain why.

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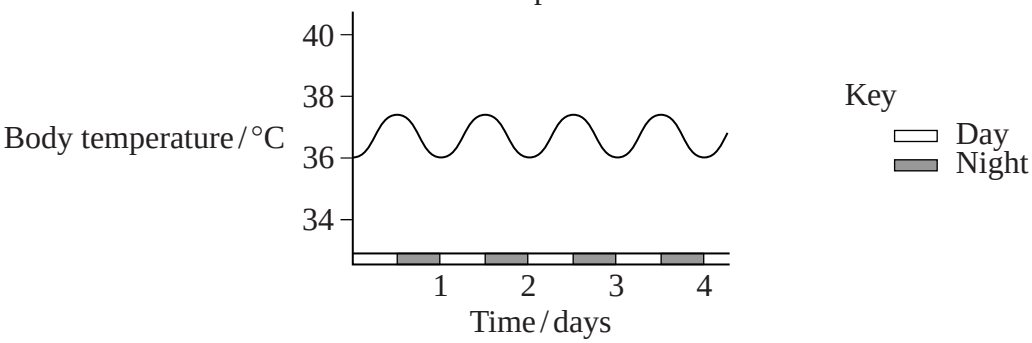
(2 marks)

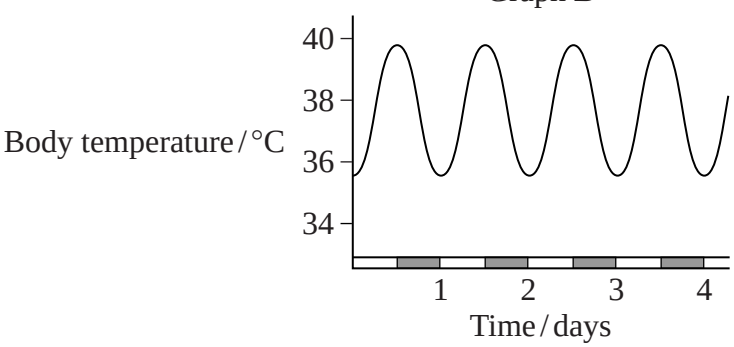
(c) Graph **A** shows the daily variation in body temperature of a camel with a supply of water to drink.

Graph **B** shows the daily variation in body temperature of the same camel when it had not had a drink for several days.

Graph **A**



Graph **B**



(i) Describe the patterns shown in graphs **A** and **B**.

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(2 marks)

(ii) Suggest an explanation for the pattern in body temperature shown in graph **B**.

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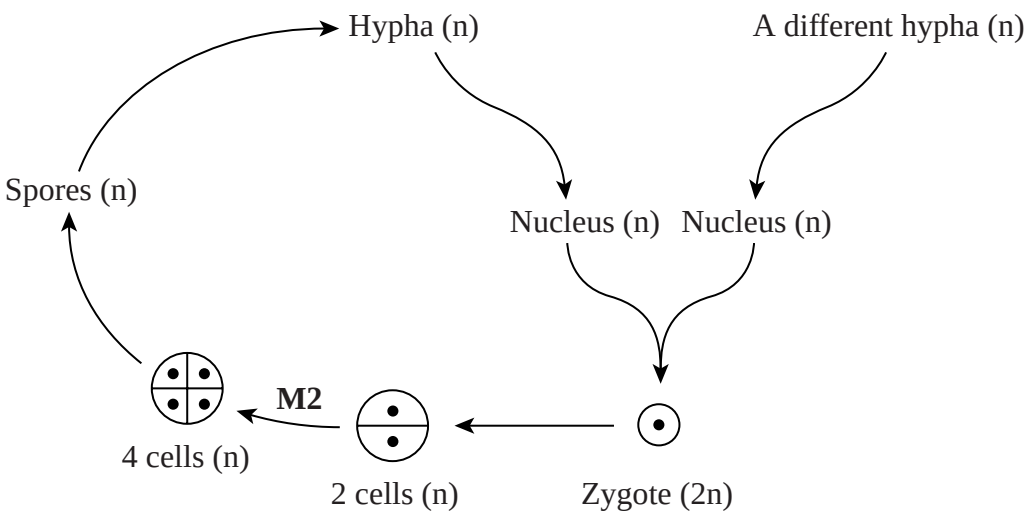
(3 marks)

7 The diagram shows the life cycle of a fungus that reproduces sexually.



(a) Only fungi have hyphae. Give **one** other feature found only in fungi.

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(1 mark)

(b) Explain why the arrow labelled **M2** represents the second division of meiosis.

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(2 marks)

(c) The spores vary genetically. Describe **two** ways by which this variation is produced.

1 .....

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2 .....

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(2 marks)

(d) A gene in this species has two alleles, **A** and **a**. Another gene also has two alleles, **B** and **b**.

A zygote with the genotype **AaBb** produces spores with the genotypes shown in the table.

Genotype	Percentage of spores
AB	4
Ab	46
aB	46
ab	4

Explain how each of the following conclusions can be made.

(i) The two genes are on the same chromosome.

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(1 mark)

(ii) Alleles **A** and **b** are on one homologous chromosome and alleles **a** and **B** are on the other homologous chromosome.

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(1 mark)

(iii) The two genes are close together on the chromosome.

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(1 mark)

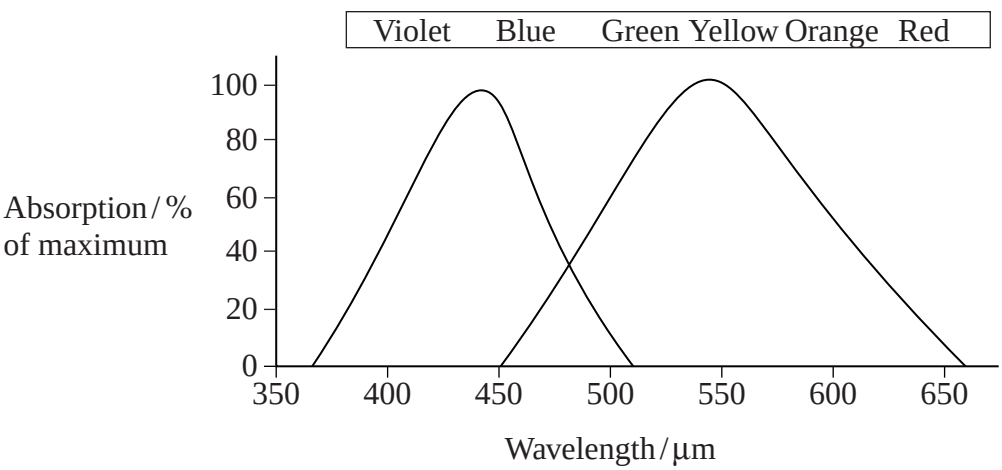
8

SECTION B

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

Answer questions in continuous prose, where appropriate.
Quality of Written Communication will be assessed in these answers.

8 Some people have red-green colour blindness. This may be caused by a mutant allele that results in the failure to produce a light-sensitive pigment in one type of cone cell. The graph shows the absorption spectra of the pigments from the cone cells of a person with this form of colour blindness.



(a) A person with red-green colour blindness finds it difficult to distinguish between orange and green, but can distinguish between blue and green.

Use the graph to explain why.

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(2 marks)

(b) Some people are completely colour blind. This is because they have no cone cells. People with complete colour blindness have difficulty in seeing detail in bright daylight. Suggest why.

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(4 marks)

Question 8 continues on the next page

Red-green colour blindness is controlled by a gene on the X chromosome. The allele for colour blindness, $\mathbf{X^g}$, is recessive to the allele for normal colour vision, $\mathbf{X^G}$.
Complete colour blindness is controlled by a different gene which is not on the X chromosome. The allele for the development of normal cones, **B**, is dominant to the allele for no cone development, **b**.

(c) (i) Give **all** the possible genotypes of the gametes produced by

a man with the genotype **Bb $\mathbf{X^GY}$**

.....

a woman with the genotype **Bb $\mathbf{X^GX^g}$**.

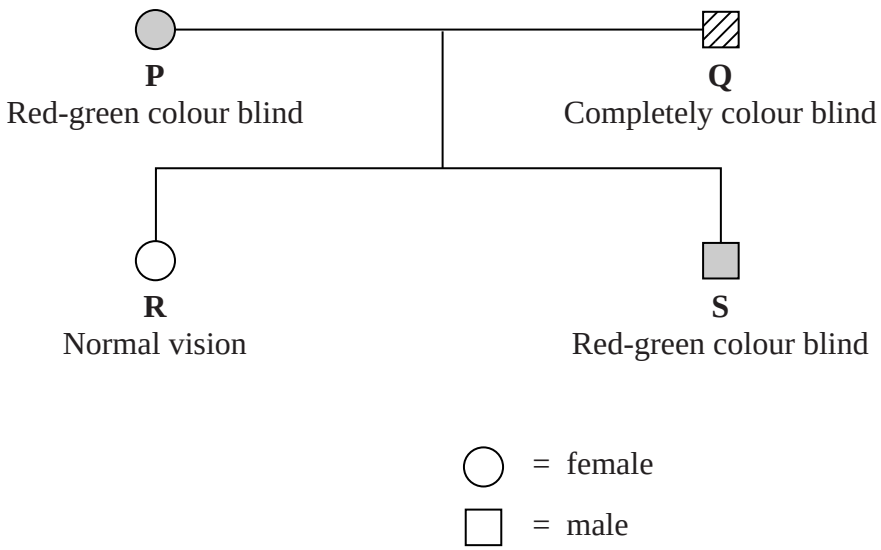
.....

(1 mark)

(ii) A man with the genotype **Bb $\mathbf{X^GY}$** and a woman with the genotype **Bb $\mathbf{X^GX^g}$** are expecting a child. What is the probability that the child will be a boy with red-green colour blindness? Show your working.

Answer ..... *(2 marks)*

(d) The diagram shows the phenotypes of members of a different family in which both types of colour blindness occur.



Give **all** the possible genotypes of

(i) individual **P** .....

(ii) individual **Q** .....

(iii) individual **S** .....

(4 marks)

(e) Complete colour blindness occurs in the same frequency in males and females, but red-green colour blindness occurs more frequently in males. Explain why.

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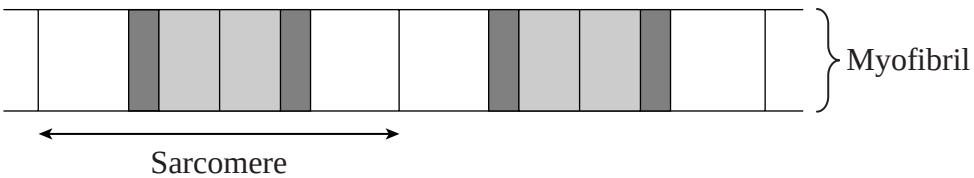
(2 marks)

15

9 (a) The diagrams show the banding patterns in a relaxed and a contracted myofibril as seen under the electron microscope.

Relaxed myofibril



Contracted myofibril

(i) Explain the banding pattern in the relaxed myofibril.

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(3 marks)

(ii) Explain why the banding pattern changes when the myofibril contracts.

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(1 mark)

(b) The contraction of muscle involves tropomyosin, calcium ions and ATP. Describe how each is involved in contraction.

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(5 marks)

(c) Describe how ATP is made during aerobic respiration.

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(6 marks)

15

END OF QUESTIONS

QWC

1

There are no questions printed on this page