Surname		Other Names	
Centre Number			Candidate Number									
Candidate Signature												

For Examiner's Use

General Certificate of Education
June 2007
Advanced Level Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

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

Tuesday 19 June 2007 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

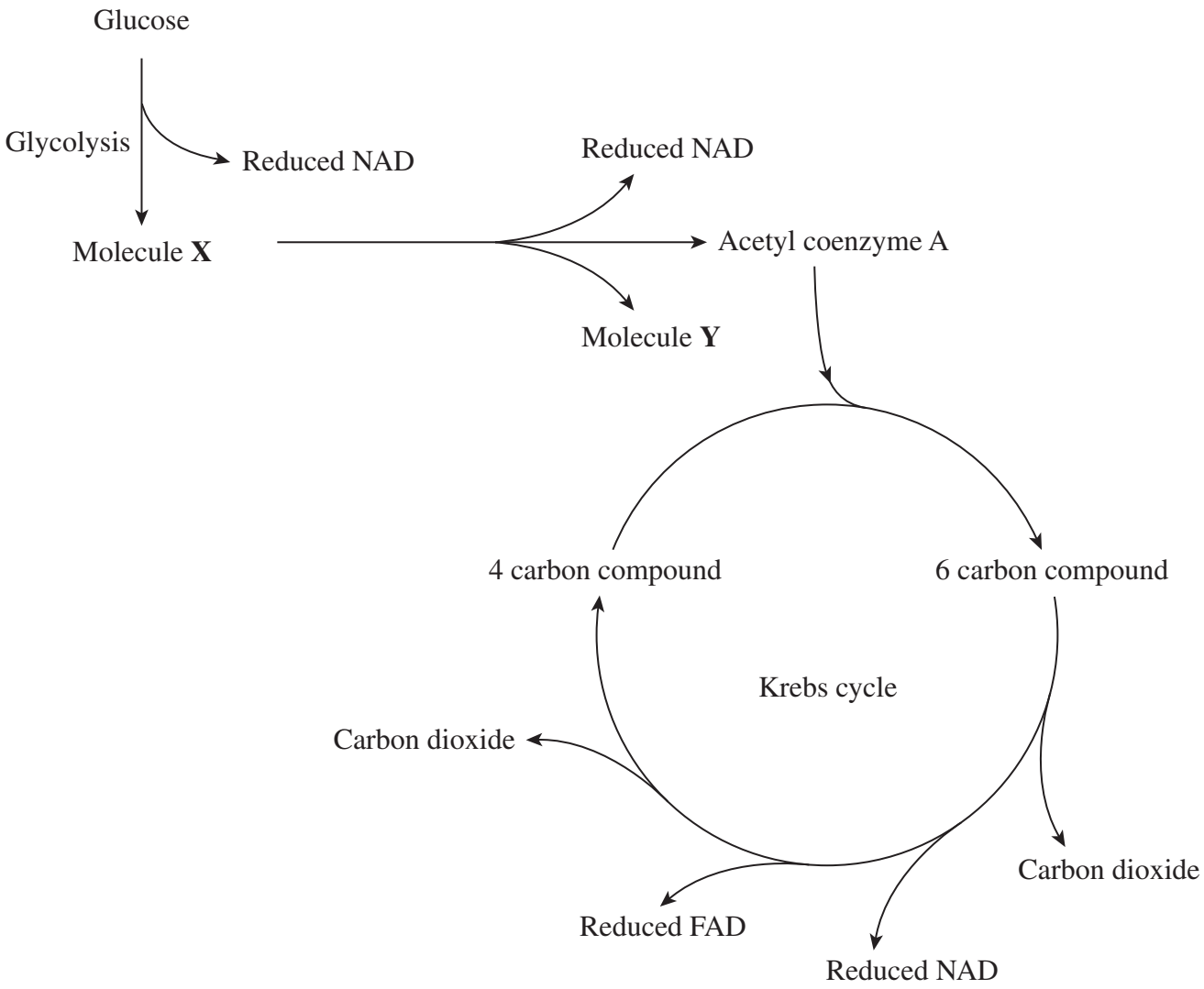
- The maximum mark for this paper is 81.
- The marks for questions are shown in brackets.
- Answers for **Section A** are expected to be short and precise.
- Answer questions in **Section B** in continuous prose where appropriate. Quality of Written Communication will be assessed in these answers.
- 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 The diagram shows glycolysis and the Krebs cycle.



(a) Name

(i) molecule **X**

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(1 mark)

(ii) molecule **Y**.

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(1 mark)

(b) Where, in a cell, does glycolysis occur?

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(1 mark)

(c) High concentrations of ATP inhibit an enzyme involved in glycolysis.

(i) Describe how inhibition of glycolysis will affect the production of ATP by the electron transfer chain.

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(1 mark)

(ii) Explain this effect.

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(3 marks)

7

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

(i) Describe the role of the retina in this reflex.

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(2 marks)

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

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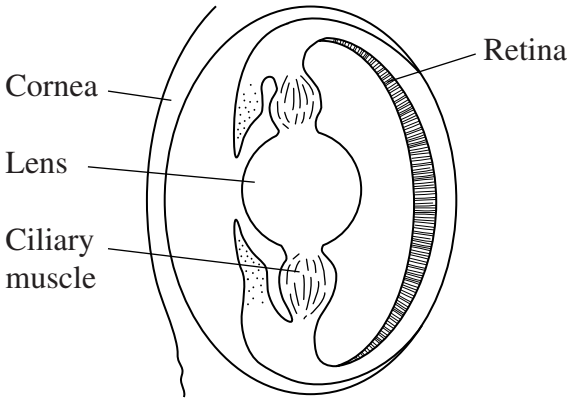
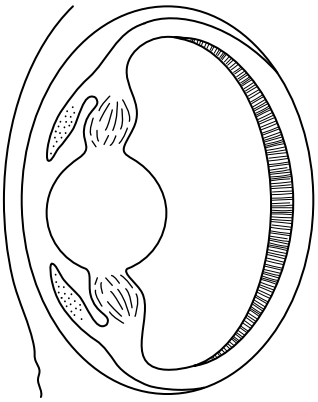
(3 marks)

(b) The diagram shows a section through the eye of an octopus.

Eye focused on distant object



Eye focused on near object



The way an octopus eye changes from focusing on a distant object to focusing on a near object is different from the way a human eye changes. Describe these differences.

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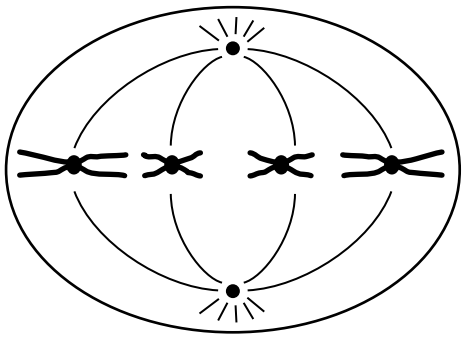
(4 marks)

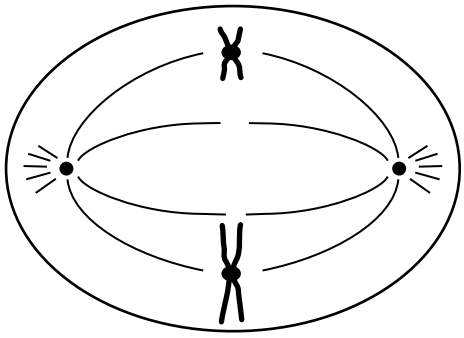
Turn over ►

3 The diagram shows three cells, **A**, **B** and **C** from the same organism. One of the cells is in the first division of meiosis, one is in the second division of meiosis and one is dividing by mitosis.

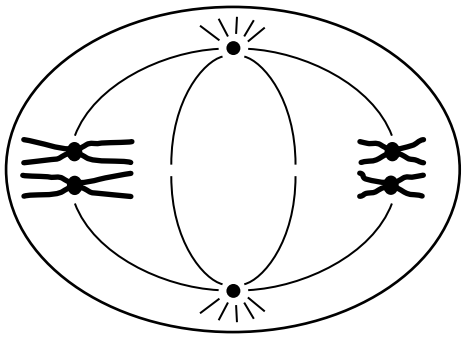
A



B



C



(a) What is the diploid number of chromosomes in the organism from which these cells were taken?

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(1 mark)

(b) Complete the table to show which of the cells, **A**, **B** or **C** is in the first division of meiosis and which is in the second.

Stage of meiosis	Cell
First division	
Second division	

(1 mark)

(c) Explain **two** ways in which meiosis leads to genetic variation in gametes.

1 .....

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2 .....

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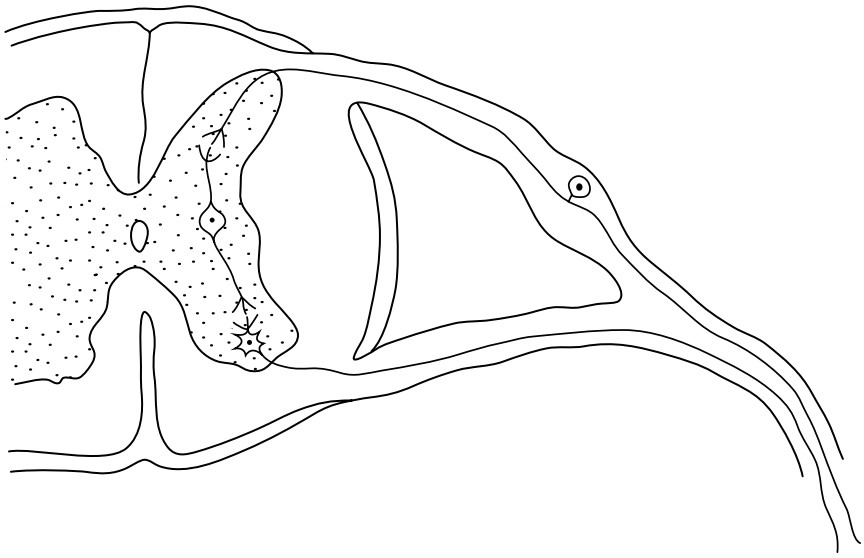
(4 marks)

6

Turn over for the next question

4 Heat receptors in the skin are stimulated when a finger touches a hot object. A reflex causes the finger to be pulled away.

(a) The diagram shows the reflex arc associated with this response.



Draw an arrow on the motor neurone to show the direction in which an impulse travels.

(1 mark)

(b) Pain receptors in the skin are also stimulated when a hot object is touched. These receptors send nerve impulses to the brain. Name the area of the brain receiving these impulses.

.....

(1 mark)

(c) Enkephalins are neurotransmitters released by the brain and spinal cord in response to harmful stimuli. Enkephalin molecules are similar in shape to acetylcholine. Enkephalin molecules act as pain killers by inhibiting synaptic transmission. Explain how this inhibition occurs.

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(4 marks)

6

Turn over for the next question

5 Hair type in dachshund dogs is controlled by two genes which are on different chromosomes.

Dogs with the **H** allele have wiry hair and dogs with the genotype **hh** have non-wiry hair.

The length of wiry hair is always the same. Dogs with non-wiry hair have either long or short hair. The length of non-wiry hair is controlled by another gene. Dogs with the **D** allele have short hair and those with the genotype **dd** have long hair.

(a) Give all the possible genotypes for dachshunds with non-wiry, short hair.

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(1 mark)

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

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(2 marks)

(c) A wiry-haired male with the genotype **HhDd** was mated with a non-wiry, long-haired female with the genotype **hhdd**. Complete the genetic diagram to show the ratio of offspring phenotypes expected in this cross.

Parental phenotypes	Wiry-haired male	Non-wiry, long-haired female
Parental genotypes	**HhDd**	**hhdd**

Gametes

Offspring genotypes

Offspring phenotypes

Ratio of offspring phenotypes

(3 marks)

6

6 (a) What is homeostasis?

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(1 mark)

(b) Describe the role of the hormone glucagon in the control of blood sugar concentration.

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(4 marks)

(c) The kidney removes various substances from the blood plasma. The clearance value for a substance is the volume of blood cleared of that substance by the kidney in one minute. This clearance value can be calculated using the equation.

$$C = \frac{U \times V}{P}$$

where the concentration of a substance in the blood is $P\ g\ cm^{-3}$
the concentration of a substance in the urine is $U\ g\ cm^{-3}$
the volume of urine produced is $V\ cm^3$ per minute

(i) Use the equation to work out the clearance value of glucose.

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(1 mark)

(ii) Explain how the activity of the kidney results in this clearance value for glucose.

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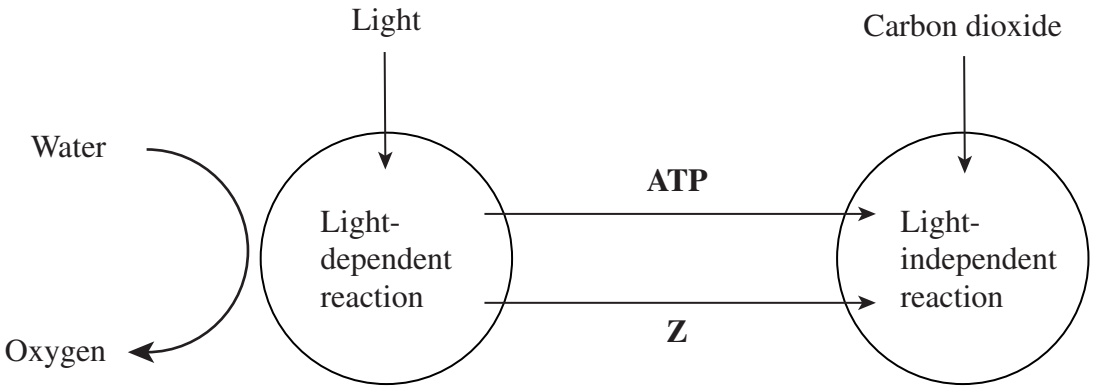
(3 marks)

Turn over ►

9

7 (a) The diagram summarises the pathways involved in photosynthesis.



Name molecule **Z**.

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(1 mark)

(b) Under some conditions oxygen reacts with ribulose bisphosphate to give glycerate 3-phosphate and phosphoglycolate. This reaction is summarised in the equation

RuBP + oxygen ⟶ glycerate 3-phosphate + phosphoglycolate

Phosphoglycolate takes no part in the light-independent reaction.

(i) Give the number of carbon atoms in one molecule of phosphoglycolate.

..... *(1 mark)*

(ii) The production of phosphoglycolate could lead to a reduction in the rate of photosynthesis. Explain how.

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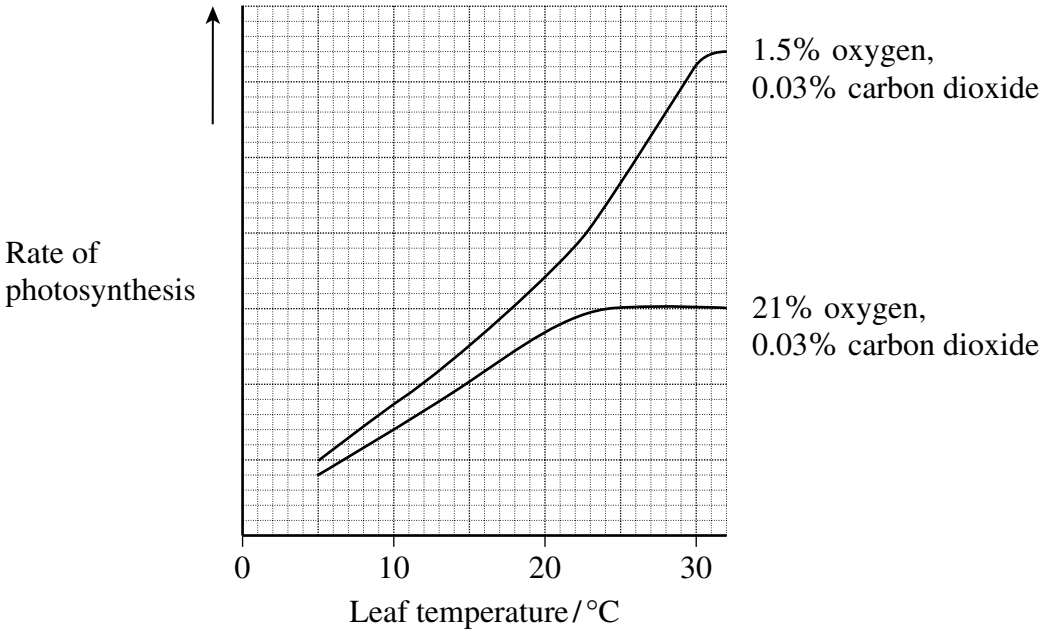
(3 marks)

(iii) An investigation was carried out on the effect of temperature and oxygen concentration on the rate of photosynthesis in leaves. The results are shown in the graph.



Describe and explain the effect of oxygen concentration on the rate of photosynthesis.

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(2 marks)

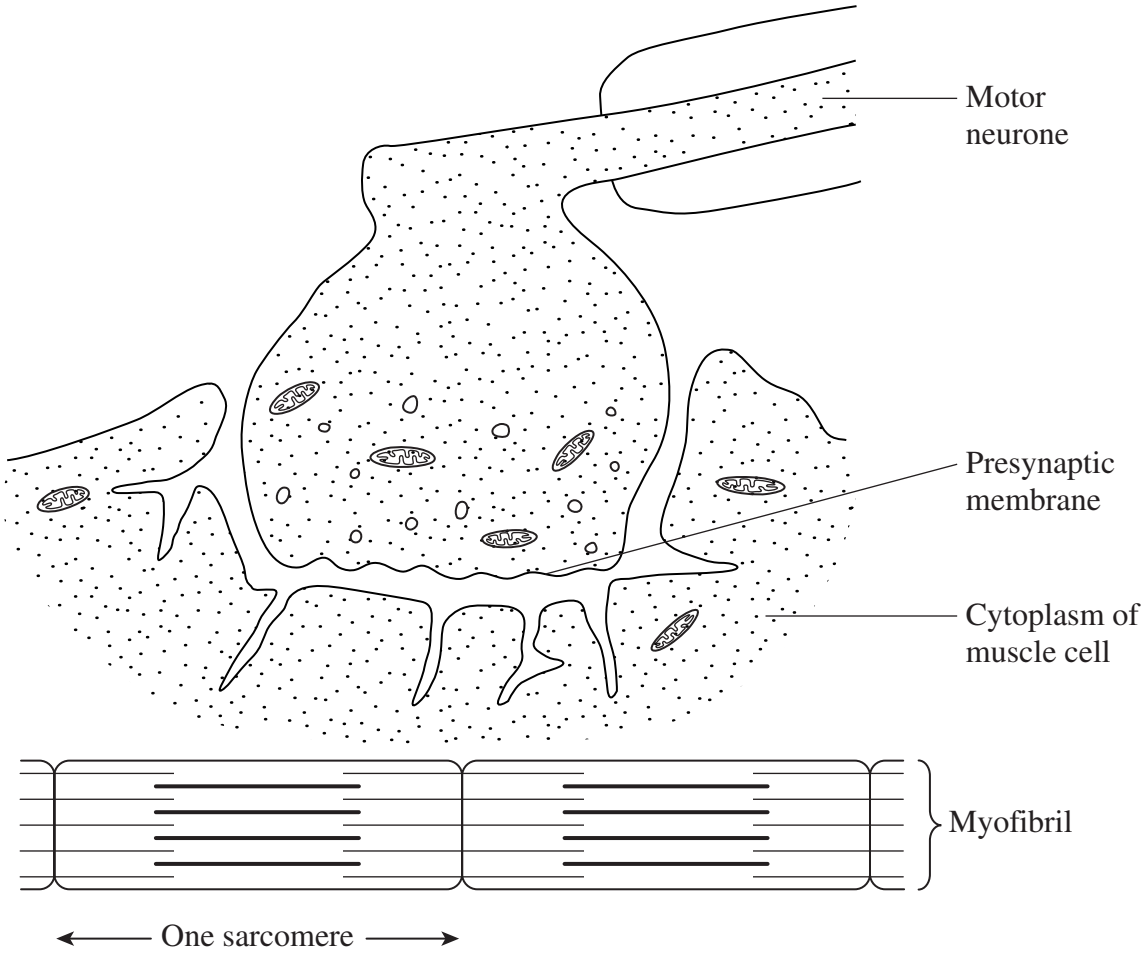
7

SECTION B

Answer **all** questions.

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

8 The diagram shows a neuromuscular junction.



(a) (i) On the diagram, label the myelin sheath. *(1 mark)*

(ii) The myelin sheath is not formed in new-born babies. Explain how this leads to slower reflexes in babies.

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(2 marks)

(b) Nerve impulses arriving at the presynaptic membrane at the neuromuscular junction result in shortening of sarcomeres. Describe how.

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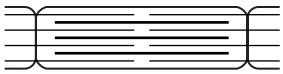
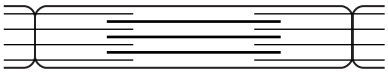
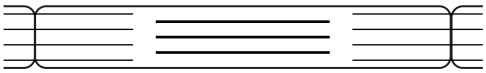
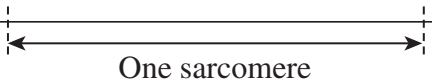
(7 marks)

Question 8 continues on the next page

(c) Myofibrils are made up of many sarcomeres. The sarcomeres in a myofibril are always the same length as each other. However this length changes with the state of contraction of the muscle. The table shows the force produced by a myofibril in relation to the length of its sarcomeres.

Sarcomere length/μm	Force produced as percentage of maximum	Degree of overlap between filaments
1.3	0	
2.3	100	
3.7	0	



(i) Give the sarcomere length at which the H zone will be at its minimum length. Explain your answer.

Sarcomere length .....

Explanation .....

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(1 mark)

(ii) Explain why no force is generated when the sarcomere length is 3.7 μm.

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(2 marks)

(iii) Explain why the maximum force is produced when the sarcomere length is 2.3 μm.

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(2 marks)

9 (a) Describe the principles which scientists use to classify organisms into taxonomic groups.

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(3 marks)

(b) The table gives the taxonomic groups to which the fruitfly *Drosophila melanogaster* belongs.

Taxonomic group	Name	Sequence
Kingdom	Animalia	
Genus		
Species		
Phylum	Arthropoda	
	Insecta	
Order	Diptera	
Family	Drosophilidae	

(i) Complete the first two columns of the table. *(1 mark)*

(ii) Write the numbers 1 to 7 in column three to show the sequence of taxonomic groups. Write the number 1 to show the group with the most organisms and the number 7 the least. *(1 mark)*

Question 9 continues on the next page

The Hawaiian Islands are 3000 km from the nearest continent. The islands were formed relatively recently by volcanic activity. They have patches of forest separated by wide lava flows. Due to high mountains, the climate varies greatly over short distances. Five hundred species of fruitfly are found in Hawaii.

(c) Explain how the large number of fruitfly species might have evolved in Hawaii.

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(6 marks)

(d) There are 21 833 species of insects in Britain but only 6500 in Hawaii. Britain however, has 32 species of *Drosophila* but Hawaii has 500. Suggest an evolutionary explanation for the difference in the number of species of *Drosophila*.

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(4 marks)

15

END OF QUESTIONS

QWC

1

There are no questions printed on this page