

Surname		Other Names	
Centre Number		Candidate Number	
Candidate Signature			

For Examiner's Use

General Certificate of Education
June 2007
Advanced Level Examination



BIOLOGY (SPECIFICATION A)
Unit 6 Physiology and the Environment

BYA6

Tuesday 19 June 2007 9.00 am to 10.30 am

<p>For this paper you must have:</p> <ul style="list-style-type: none"> a ruler with millimetre measurements. <p>You may use a calculator.</p>
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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 the spaces provided. All working must be shown.
- 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 75.
- The marks for questions are shown in brackets.
- You will be marked on your ability to use good English, to organise information clearly and to use accurate scientific terminology where appropriate.
- You are reminded that this test requires you to use your knowledge of Modules 1, 2, 4 and 5 as well as Module 6 in answering synoptic questions. These questions are indicated by the letter **S**.

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

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

S 1 (a) Name and describe the process by which salivary amylase digests starch into maltose.

Name

Description

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(3 marks)

(b) Salivary amylase does not digest starch in the acid conditions found in the stomach. Explain why.

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(2 marks)

5

Turn over for the next question

Turn over ►

2 (a) What is

a taxis,

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a kinesis?

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(2 marks)

S (b) Woodlice are small animals. They are frequently found under rotting logs where conditions are dark and humid. Some students investigated the response of woodlice to light and humidity. They placed 20 woodlice in a choice chamber with the following conditions in different areas of the chamber.

Dark and moist

Dark and dry

Light and moist

Light and dry

They recorded the number of woodlice present in each of the areas after ten minutes. The results are shown in the table.

Trial	Number of woodlice in each condition after 10 minutes			
	Dark and moist	Dark and dry	Light and moist	Light and dry
1	12	3	4	1
2	11	4	4	1
3	9	3	5	3
4	14	2	4	0
5	14	2	2	2
Total	60	14	19	7
Mean	12.0	2.8	3.8	1.4

The students carried out a χ^2 test on the results. They tested the null hypothesis that there is no significant difference in the distribution of the woodlice.

- (i) Against how many degrees of freedom should they check their value for χ^2 ?

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(1 mark)

- (ii) They found that their value for χ^2 was greater than the critical value for the appropriate number of degrees of freedom for a probability (p) of 0.05. What conclusion should they draw from this?

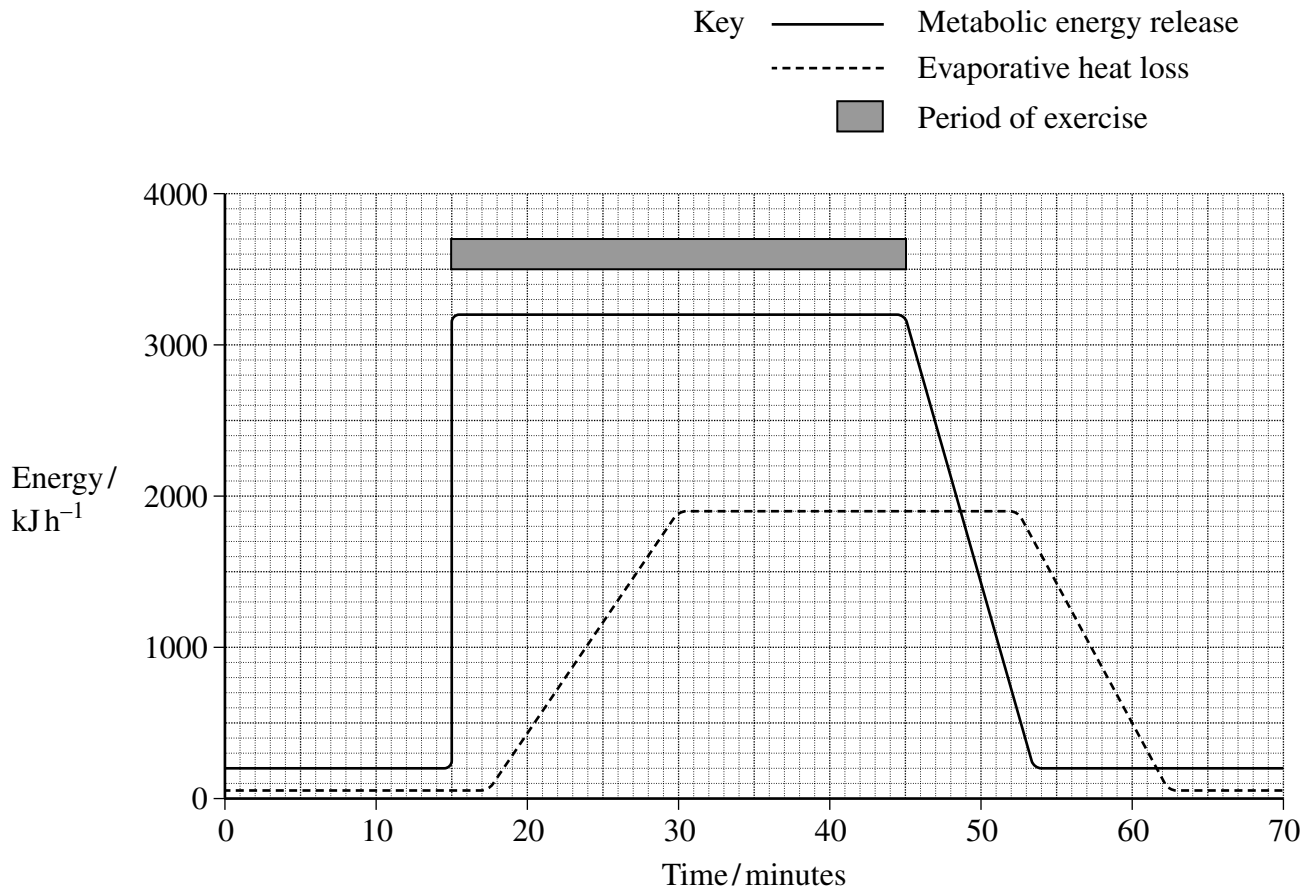
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(2 marks)

5

Turn over for the next question

Turn over ►

- 3 The graph shows the changes in metabolic energy release and evaporative heat loss by a person during a period of exercise.



- (a) Calculate the total extra metabolic energy released during the period of exercise. Show your working.

Total extra energy released during exercise kJ (1 mark)

- (b) (i) Explain what caused the change in evaporative heat loss between 17 and 30 minutes.

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(2 marks)

- (ii) Evaporative heat loss decreases only gradually after the period of exercise. Explain why.

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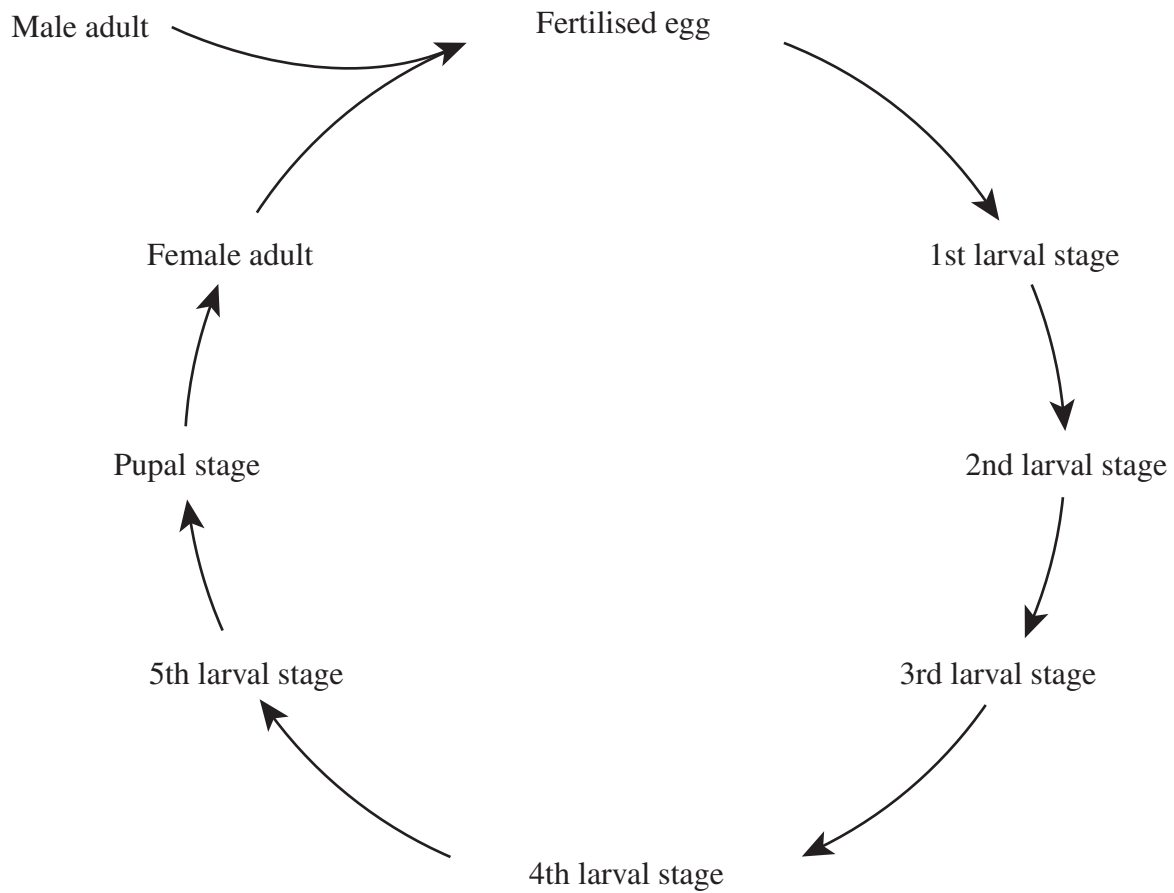
(1 mark)

4

Turn over for the next question

Turn over ►

4 The diagram shows the life cycle of a red admiral butterfly.



S (a) What type of cell division occurs during the larval stages?
Explain your answer.

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(1 mark)

- (b) In one study, the lengths of seven individuals of the first and fifth larval stages were measured. The results are shown in the table.

Lengths of individuals/mm	
1 st larval stage	5 th larval stage
5.2	46.3
7.6	47.5
7.8	48.0
9.0	49.5
10.2	50.2
10.3	50.9
11.2	52.0

Calculate the percentage increase in median length from the first to the fifth larval stage.

Show your working.

Percentage increase in median length = (2 marks)

- (c) The larvae feed on the leaves of nettles. The adult butterflies feed on nectar. Nectar is rich in sugars but contains little protein. Explain the importance of the difference in diet of the larvae and the adults.

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(2 marks)

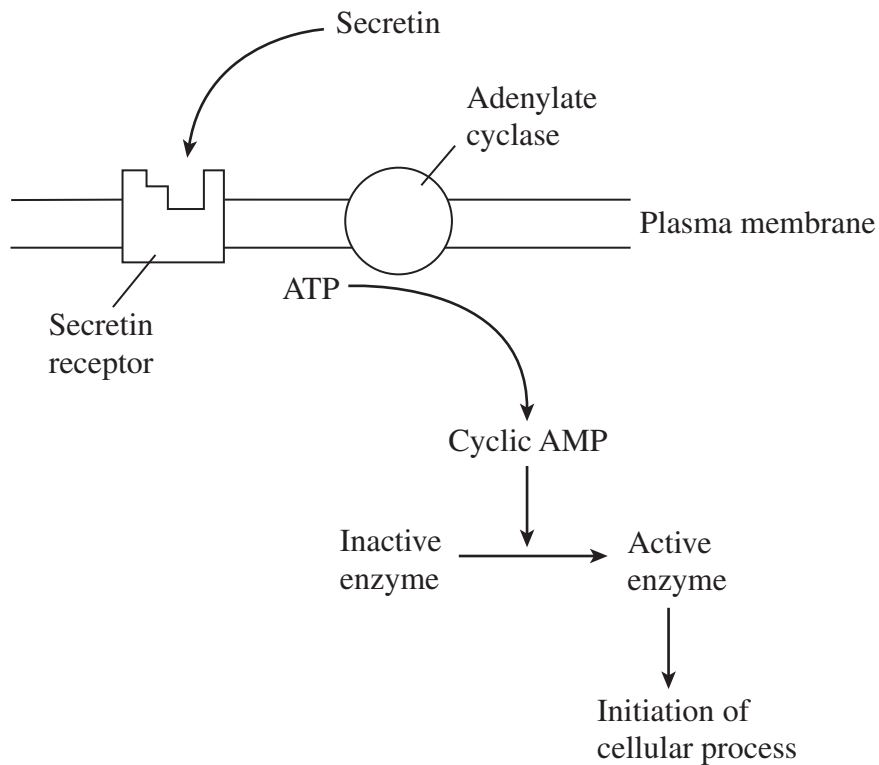
5 Secretin is one of the hormones that controls the secretion of digestive juices.

(a) Give **one** effect of the increased secretion of secretin.

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(1 mark)

S (b) The diagram shows the way in which secretin operates.



(i) Secretin targets only certain cells in the body. Explain why.

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(2 marks)

(ii) In the absence of cyclic AMP, the enzyme is inactivated by a non-competitive inhibitor. Explain how a non-competitive inhibitor makes an enzyme inactive.

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(2 marks)

- 6 (a) In fish gills, water and blood flow in opposite directions. Explain how this counter-current helps in the efficient exchange of respiratory gases.

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(1 mark)

- (b) Lungfish live in freshwater lakes in South Africa. They excrete nitrogenous waste through their kidneys and their gills.

- (i) The nitrogenous waste of lungfish is converted in the liver to glutamine and transported in the blood plasma in this form. Glutamine is non-toxic, but cannot be excreted. An enzyme catalyses the conversion of glutamine to glutamate and ammonia. Explain the advantage of cells in the gills containing this enzyme.

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(3 marks)

- (ii) During droughts, the lakes in which lungfish live dry up. Lungfish survive enclosed in a layer of mucus and dry mud. During this time, they excrete urea instead of ammonia. Explain the importance of the change in their excretory product.

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(2 marks)

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7 (a) Describe how an action potential is produced in a neurone.

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(4 marks)

(b) Describe how an impulse is transmitted across an excitatory synapse.

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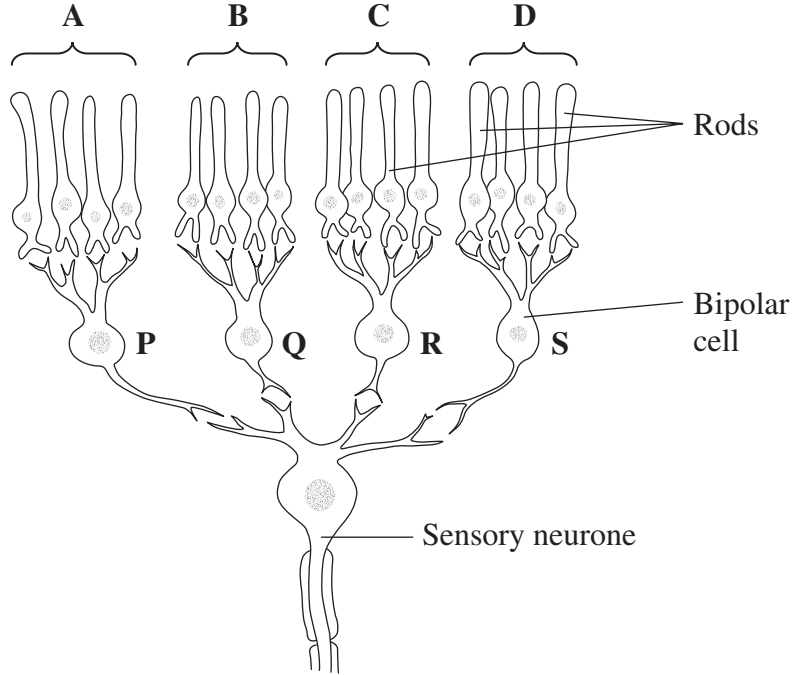
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(3 marks)

The diagram shows connections between cells in the retina.



(c) Explain how the connection of several rods to a single bipolar cell influences

(i) visual acuity,

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(ii) sensitivity.

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(4 marks)

(d) Different groups of rods were illuminated. The impulses produced in the bipolar cells and in the sensory neurone were recorded. The results are shown in the table.

	Experiment 1	Experiment 2	Experiment 3	Experiment 4
Group of rods illuminated	None	A and D	B and C	A, B, C and D
Bipolar cells in which impulses were generated	None	P and S	Q and R	P, Q, R and S
Frequency of impulses in sensory neurone	None	None	Frequent	Infrequent

Use your knowledge of inhibitory and excitatory synapses to explain the results obtained in **Experiment 4**.

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(4 marks)

S (iii) Use your knowledge of Fick’s law to suggest an explanation for the greater rates of water loss by plant **B**.

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(2 marks)

(b) Explain **three** ways in which xerophytic plants minimise water loss due to transpiration.

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(3 marks)

Question 8 continues on the next page

Turn over ►

9 S (a) Describe how amino acids are organised to form a molecule of a protein such as haemoglobin. Do **not** give details of protein synthesis in your answer.

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(5 marks)

(b) Lugworms live in burrows on the seashore where the partial pressure of oxygen is always low. The haemoglobin of lugworms has slightly different properties from human haemoglobin. Describe how you would expect the dissociation curve of oxyhaemoglobin of lugworms to differ from that of human oxyhaemoglobin. Explain how this difference provides an adaptation to living in an environment with a low partial pressure of oxygen.

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(4 marks)

Question 9 continues on the next page

Turn over ►

S (c) As people exercise, their cardiac output increases. Explain how this is brought about.

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(4 marks)

S (d) Some South American people live at high altitudes where the partial pressure of oxygen is less than it is at sea level. Many of these people have high concentrations of nitrous oxide in their blood plasma. Nitrous oxide stimulates the dilation of arterioles. Suggest the advantage of the high concentrations of nitrous oxide in the blood.

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(2 marks)

END OF QUESTIONS

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