



ADVANCED
General Certificate of Education
2010

Centre Number

71	
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Candidate Number

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Biology

Assessment Unit A2 1

assessing

Physiology and Ecosystems

SPECIMEN PAPER

TIME

2 hours

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.

Write your answers in the spaces provided in this question paper.

Write your answer to Section B on the lined paper at the end of this booklet.

Answer **all eight** questions.

You are provided with **Photograph 4.6** for use with Question 3 in this paper.

Do not write your answers on this photograph.

INFORMATION FOR CANDIDATES

The total mark for this paper is 90.

Section A carries 72 marks.

Section B carries 18 marks.

You should spend approximately **25 minutes** on Section B.

You are expected to answer Section B in continuous prose.

Quality of written communication will be assessed in **Section B**.

Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.

Section A

1 Distinguish between the following pairs of ecological terms.

(a) Community and ecosystem

[2]

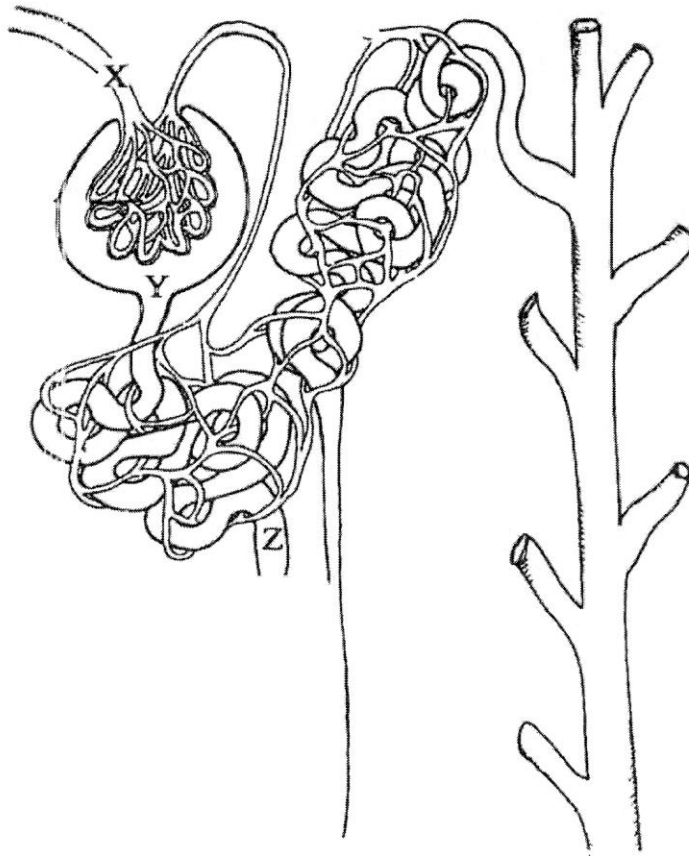
(b) Colonisation and succession

[2]

(c) Biotic and climatic climaxes

[2]

2 The diagram below represents a single kidney nephron:



- (a) Two experiments were carried out to analyse fluid from different regions of the kidney.

In experiment one, samples were taken using a micropipette from the three regions, X, Y and Z. These were then tested using Benedict's (for reducing sugars) and Biuret reagents (for protein). The results are shown in the table below.

Sample	Benedict's	Biuret
Experiment one		
X (blood plasma)	Brick red ppt.	Intense purple
Y (glomerular filtrate)	Brick red ppt.	Very pale purple
Z (start of loop of Henlé)	Blue (unchanged)	Blue (unchanged)
Experiment two – chilled kidney		
Z	Yellow/green ppt.	Purple tinge

- (i) Explain the difference in the Biuret result between samples X and Y (in experiment one).

[2]

- (ii) Account for the difference between the Benedict's result between samples Y and Z (in experiment one).

[1]

- (iii) In experiment two, the kidney was chilled and a sample was taken from region Z using a micropipette. Explain the results of the Benedict's and Biuret tests shown above.

[3]

(b) Describe the effect of ADH on the functioning of the kidney nephron.

[2]

3 **Photograph 4.3** is an electronmicrograph of mammalian voluntary muscle in a **contracted** state.

(a) Identify the structures labelled **A** to **F**.

A _____

B _____

C _____

D _____

E _____

F _____

[6]

(b) State **two** changes that would be apparent if this electronmicrograph showed the same section of muscle in a **relaxed** state.

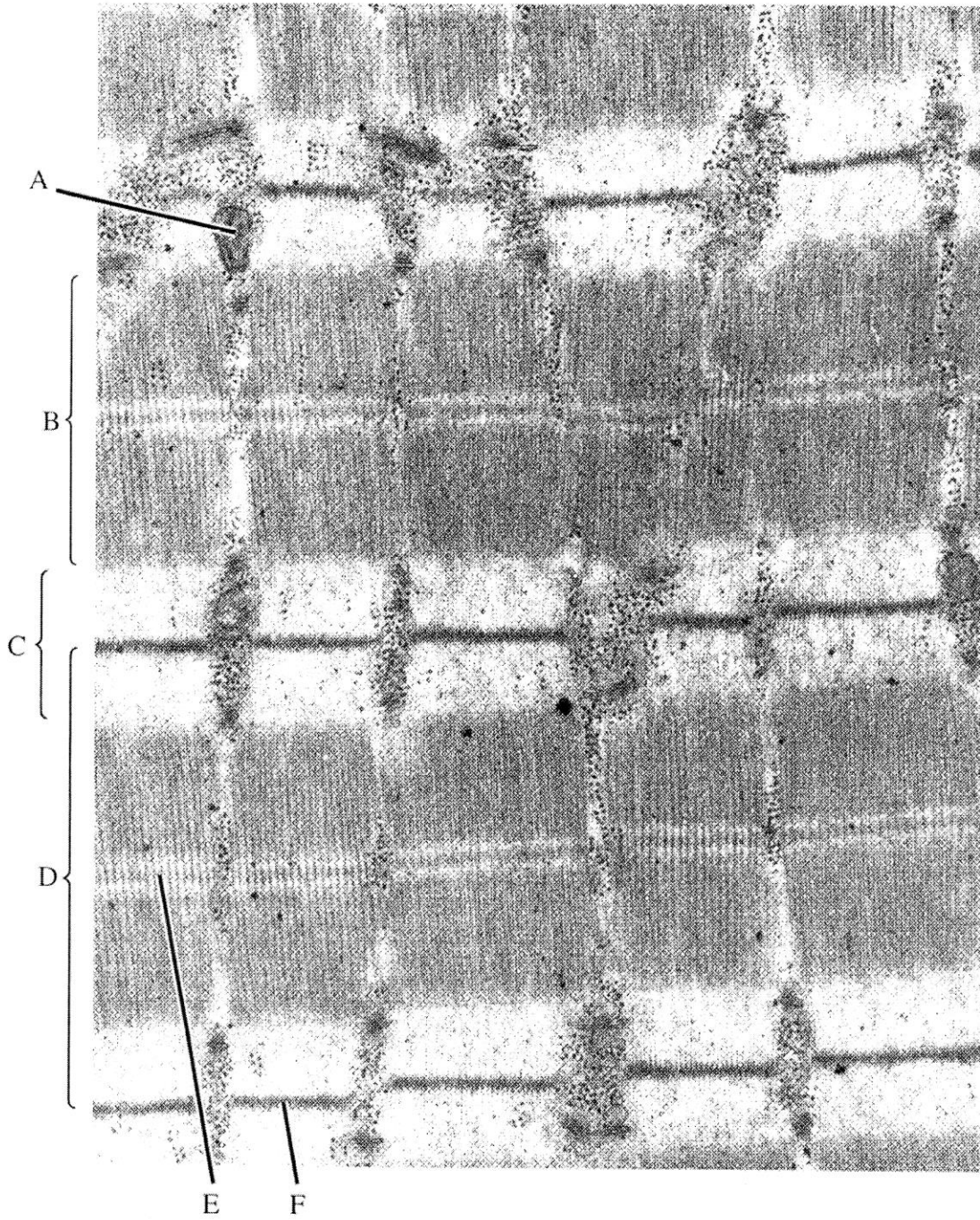
[2]

(c) Three types of muscle are recognised in the body: voluntary (skeletal), smooth and cardiac.

State **one** difference in structure between voluntary (skeletal) and smooth muscle.

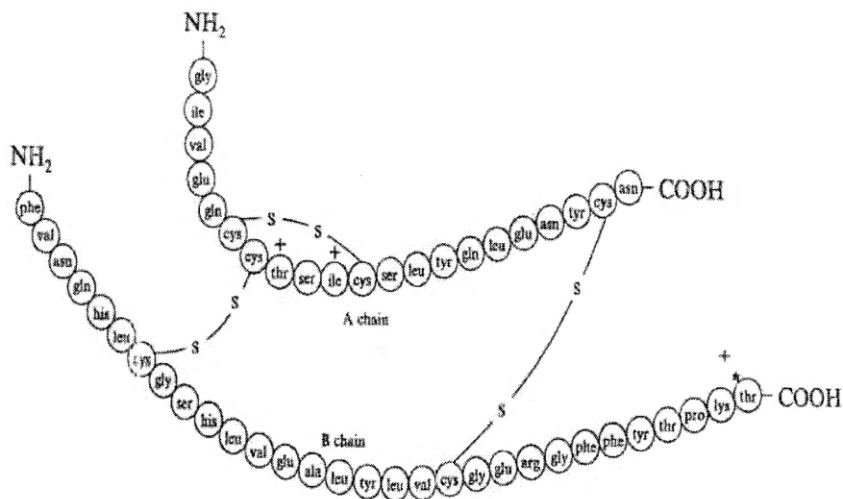
[1]

Photograph 4.3
(for use with Question 3)



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- 4 The figure below illustrates the amino acid sequence or primary structure of the human hormone insulin – a relatively small protein of 51 amino acids. Differences in the primary structure between human insulin and pig insulin (*), and human insulin and cow insulin (+) are also shown.



- (a) (i) How many nucleotides on a mRNA molecule would code for this insulin molecule?

_____ [1]

- (ii) Describe the quaternary structure of the insulin molecule.

 _____ [2]

- (b) Patients suffering from diabetes mellitus inject insulin directly into the bloodstream rather than taking it orally. Explain.

 _____ [2]

Both cow and pig insulin are recognised as 'human' by the patient's cells and can function, but eventually lead to an antibody-mediated immune response which then renders them useless.

(c) (i) Why are both cow and pig insulin recognised as 'human' by human cells?

_____ [1]

(ii) Suggest why cow insulin eventually leads to a more adverse immune reaction than pig insulin.

_____ [1]

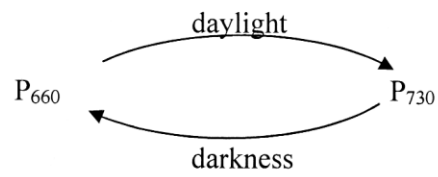
(iii) Which cells in the immune system produce antibodies?

_____ [1]

(iv) Antibodies produced eventually lead to the foreign insulin being destroyed by the body's phagocytic cells. Describe the sequence of events from antibody production in response to the foreign insulin to destruction by the phagocytes.

_____ [3]

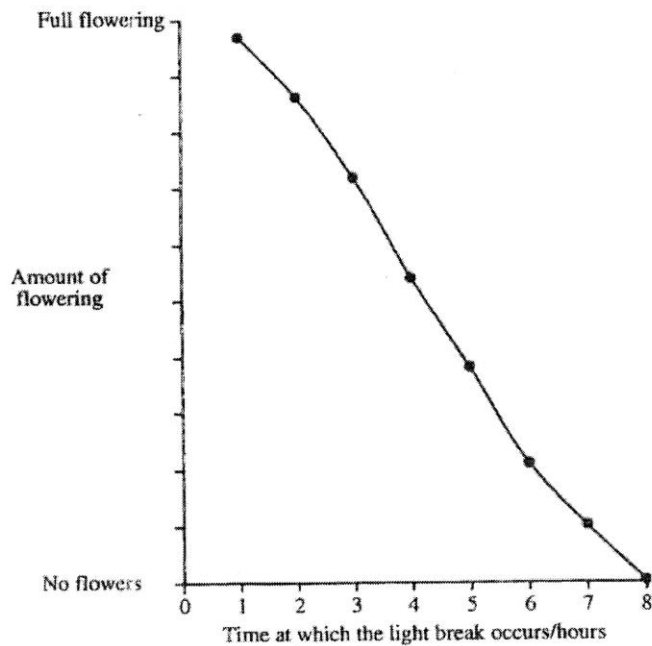
- 5 Many plants contain a light-sensitive pigment, phytochrome, which exists in two interchangeable forms, as shown below:



- (a) Using the information above, and your own understanding, explain precisely how flowering is controlled in short-day plants.

[4]

- (b) In a particular short-day plant, flowering is induced by exposure to a photoperiod consisting of eight hours of daylight and sixteen hours of darkness. In an experiment, plants were exposed to a photoperiod in which the sixteen hour period of darkness was interrupted with a break of ten minutes of bright light. Light breaks were given at hourly intervals throughout the sixteen hour period but to a different group of plants each time: one group received the light break after one hour, another after two hours and so on. The results are shown below.



- (i) What can be deduced from the above results?

[2]

- (ii) With respect to the action of phytochrome, explain the effect of ten minutes of light applied:

- following the first hour of a sixteen-hour period of darkness

- following the eighth hour of a sixteen hour period of darkness

[4]

(c) Suggest an advantage of the photoperiodic control of flowering for:

- plants growing naturally

- commercial flower growers

[2]

- 6 (b) A large number of chemicals interfere with the proper functioning of the synapse. The table below summarises the effect of three such chemicals on synaptic transmission. Use the information in the table to help you answer the questions that follow.

Chemical	Effect on synapse
Opiates	Block receptor sites on post-synaptic membrane
Nicotine	Has similar effect to acetylcholine on the post-synaptic membrane
DIPFP nerve gas	Inhibits the action of cholinesterase enzyme

- (i) Which of the three chemicals described could be used as a pain killer? Explain your answer.

Chemical

Explanation

[3]

- (ii) Which of the three chemicals described would produce a prolonged response in the post-synaptic nerve cell? Explain your answer.

Chemical

Explanation

[3]

- (c) At a synapse, transmitter substances must diffuse across a cleft which is 20 nm wide. If the diffusion rate of the transmitter substance is $40 \mu\text{m s}^{-1}$, calculate the time delay caused by its movement across the synaptic cleft.

Answer _____ [2]

7 Read the following passage on the use of insecticides and use it to help you answer the questions that follow.

1 A wide range of chemical insecticides is now available to combat parasitic insects in the fields of horticulture, agriculture and public health.

Many insecticides act by disrupting the functioning of the insect nervous system.

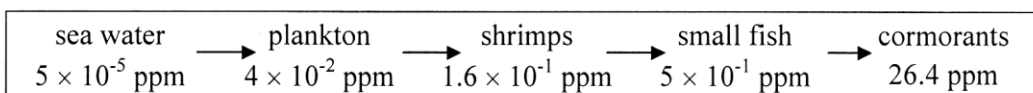
DDT, for example, prevents the normal transmission of the nerve impulse along the axon of the neurone. Concentrations of DDT which are effective against insects are harmless to birds and mammals. DDT persists unchanged, however, both in the environment and in animal tissues. Pyrethrum, a naturally occurring insecticide, has a mode of action similar to that of DDT. It is, however, subject to photoinactivation and rapid hydrolysis by enzymes.

11 Organophosphorus insecticides such as malathion act by interfering with the control of synaptic transmission. They inhibit the action of the hydrolytic enzyme, acetylcholinesterase.

(a) What do you understand by the term “parasitic”? (line 1)

[2]

(b) Following the use of DDT, lethal concentrations have been detected in the tissues of tertiary consumers such as birds. The figure below illustrates the accumulation of DDT which has occurred in a marine ecosystem in the 1970s. (The figures are given in parts per million, ppm).



(i) How many times more concentrated is DDT in the cormorants than in the original sea water?

[1]

(ii) Why is more DDT found in organisms at the top of food chains?

[3]

(iii) Why has this problem not arisen with the insecticide pyrethrum?

[1]

(c) In the space below, with the aid of a diagram explain the terms 'axon' (line 5), 'neurone' (line 5) and 'synaptic' (line 11).

[4]

(d) Describe the mechanism by which malathion might interfere with the control of the synaptic transmission in mammals. Suggest the consequences of this interference for post-synaptic neurones and effectors.

[3]

Section B

In this section you are expected to answer in continuous prose, supported, where appropriate, by diagrams. You are reminded that up to two marks in this question are awarded for quality of written communication.

[2]

8 Give an account of the adverse impact of human activity on the environment, to include:

- Impact of intensive farming
- Eutrophication
- Atmospheric pollution

[16]
