



TEST CODE **02207020**

FORM TP 2006179

MAY/JUNE 2006

CARIBBEAN EXAMINATIONS COUNCIL

ADVANCED PROFICIENCY EXAMINATION

BIOLOGY

UNIT 2 – PAPER 02

2 $\frac{1}{4}$ hours

Candidates are advised to use the first 15 minutes for reading through this paper carefully.

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

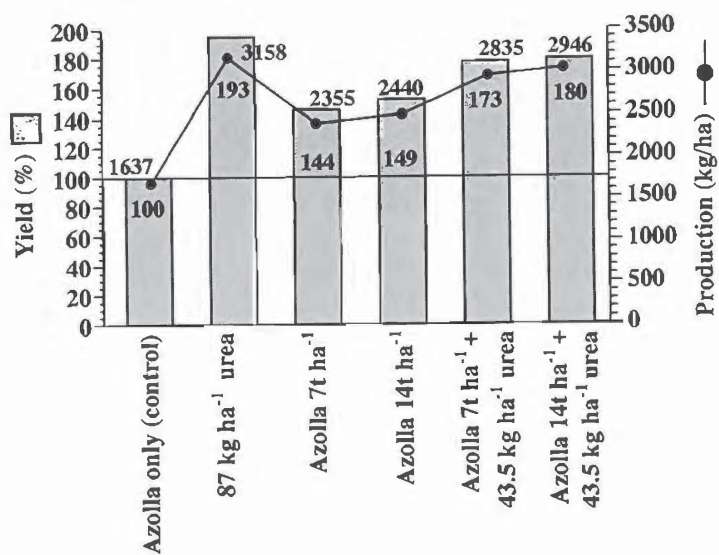
1. This paper consists of NINE questions.
2. Section A consists of THREE questions. Candidates must attempt ALL questions in this section and should spend no more than 30 minutes on this section. Answers to this section MUST be written in this answer booklet.
3. Section B consists of SIX questions. Candidates must attempt THREE questions in this section, ONE question from EACH module. Answers to this section MUST be written in the answer booklet provided.
4. The use of silent non-programmable calculators is allowed.

SECTION A

You must attempt ALL THREE questions in this section. You should NOT spend more than 30 minutes on this section.

1. Azolla is an aquatic fern that lives in an association with bacteria that help it to fix nitrogen. It is used as a green manure for fertilizing rice fields in Africa. Experiments were carried out using Azolla plus the chemical fertilizer urea to fertilize the rice fields.

The graph of Figure 1 shows the average production and yield in a rice field.



(kg ha⁻¹) Kilograms per hectare
(t ha⁻¹) Tonnes per hectare

Figure 1. Average production (kg ha⁻¹) and yield of rice (compared to control)

*The above graph has been reproduced from Kannaiyan:
Biotechnology of Biofertilizers.
Copyright 2002 Narosa Publishing House, New Delhi, p 290.*

- (a) With reference to the graph in Figure 1 determine which fertilizer regimen gives the HIGHEST yield of rice.

[1 mark]

- (b) What is the PERCENTAGE increase in yield when the amount of Azolla is doubled from 7 t to 14 t as the sole fertilizer administered.

[1 mark]

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- (c) Determine the difference in rice production, in kg ha^{-1} , between the following fields:

One treated with urea only, at a rate of 87 kg ha^{-1} and the other treated with both urea, at 43.5 kg ha^{-1} and Azolla at 14 t ha^{-1} .

[1 mark]

- (d) Name TWO factors, **other than** availability of nutrients from fertilizer, that would affect rice yield.

[1 mark]

- (e) Name ONE type of plant compound that requires the functionally useful element in urea.

[1 mark]

- (f) Suggest TWO reasons why it is better to use plant or animal manure rather than chemical fertilizers alone for fertilizing crops.

[1 mark]

(g) Figure 2 below shows a transverse section through the leaf blade of *Syringa vulgaris*.

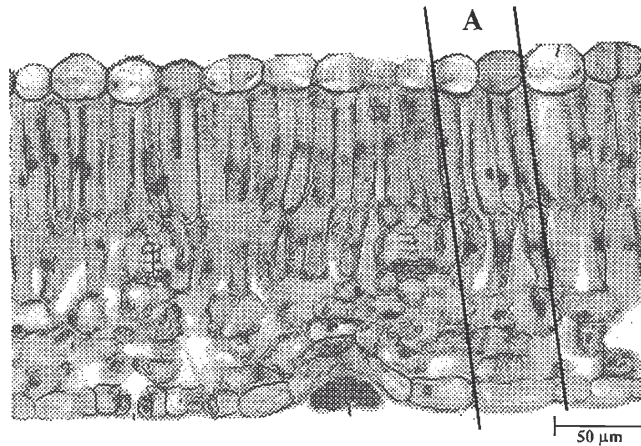


Figure 2. Transverse section through leaf of *Syringa vulgaris*

*P. H. Raven et. al. Biology of Plants 6th Edition
W. H. Freeman and Company-Worth Publishers, 1999, p 290.*

In the box provided below, draw and label the cells in A, between the parallel lines, in Figure 2.



[4 marks]

Total 10 marks

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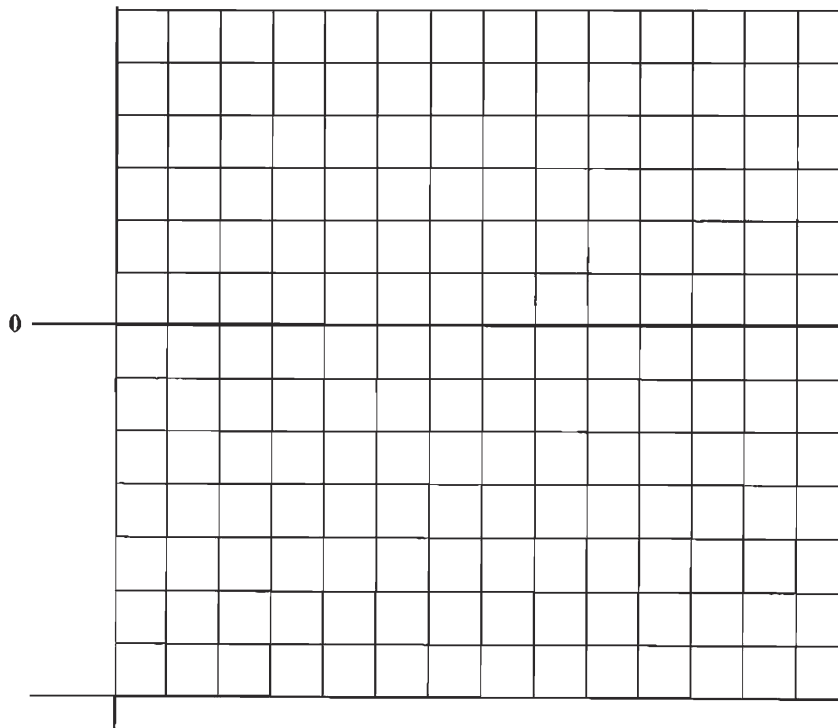
NOTHING HAS BEEN OMITTED.

2. A group of students investigated the effect of sodium ions on the production of action potentials in the large neurons extracted from squids. Since the squid is a marine mollusc, they used a bathing solution of seawater. One neuron was placed in normal strength seawater (A), and the other in seawater diluted 50:50 with distilled water, (B). They stimulated both neurons, and recorded the strength of the action potential in millivolts (mV). The results are set out in Table 1.

TABLE 1. MEMBRANE POTENTIALS IN TWO SOLUTIONS

Time Milliseconds	Membrane Potential mV	
	Normal Seawater A	Normal Seawater: distilled water, 50:50 B
0.0	-50	-50
0.2	-50	-50
0.4	+50	-30
0.6	+20	0
0.8	-60	+15
1.0	-70	-50
1.2	-60	-60
1.4	-50	-50

- (a) (i) Use the grid provided to show these results graphically.



[6 marks]

GO ON TO THE NEXT PAGE

(ii) State TWO differences between the peaks in A and B.

1. _____

2. _____

[2 marks]

(iii) State ONE cause of the differences between the membrane potentials reached in A and B.

[1 mark]

(b) Figure 3 shows a specialized type of cell.

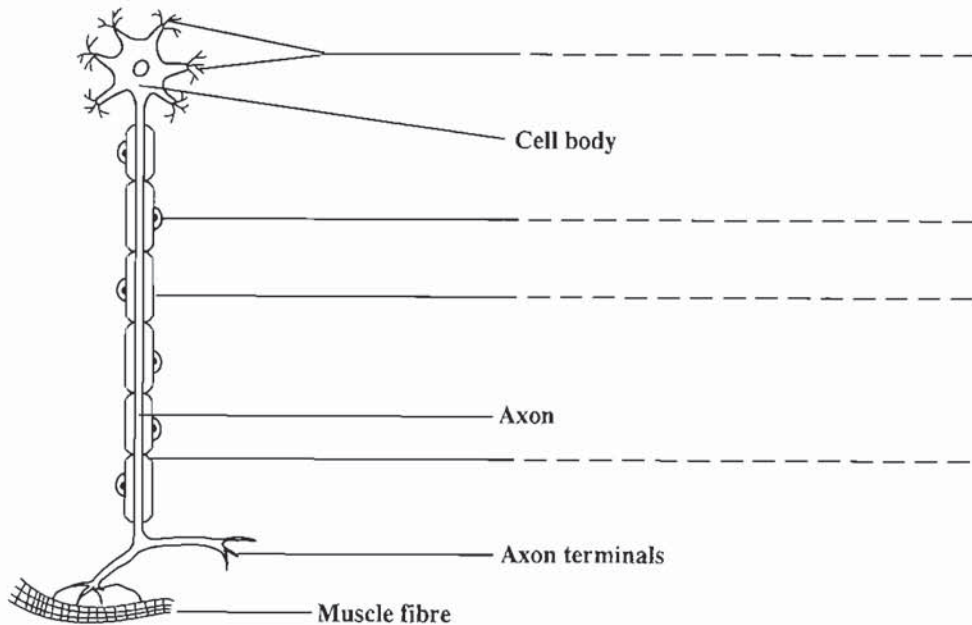


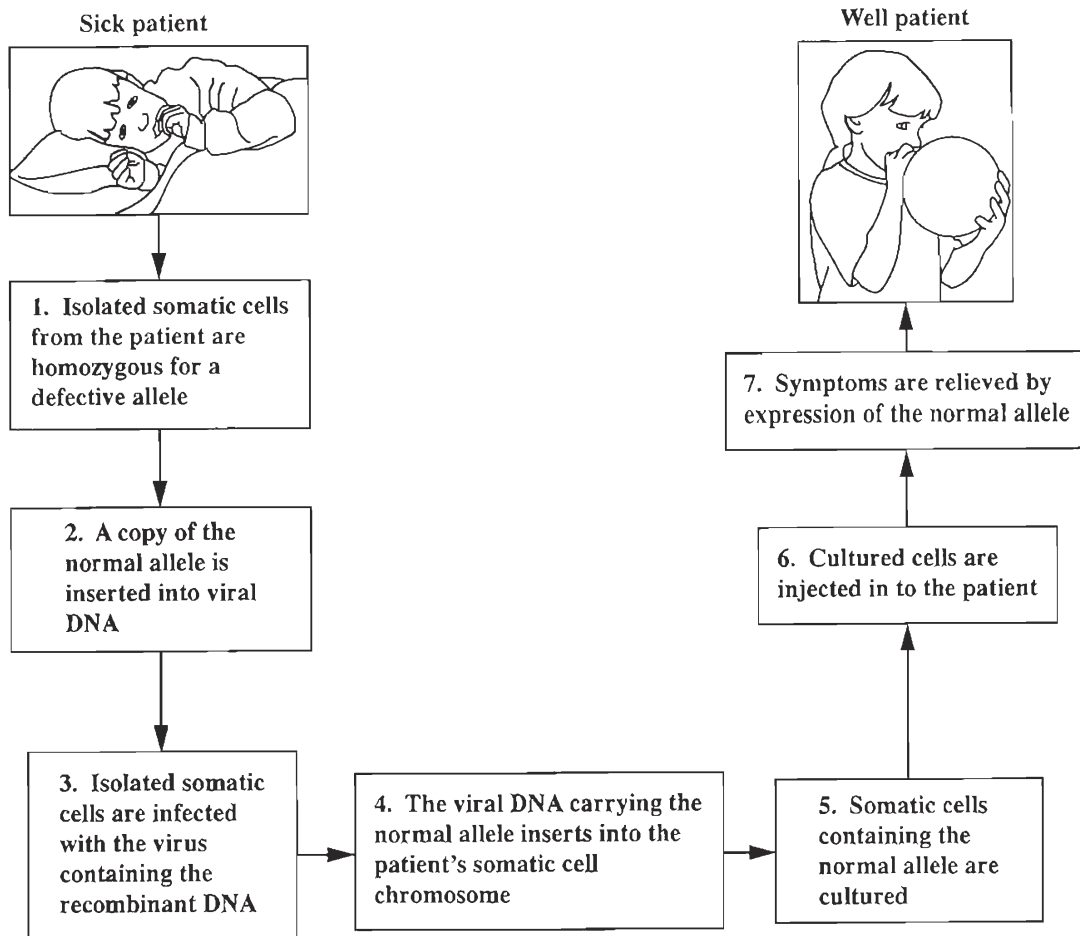
Figure 3. A nerve cell

On the diagram in Figure 3, complete the labelling of the nerve cell.

[1 mark]

Total 10 marks

3. Figure 4 below shows the stages in the therapy which a sick child undergoes.



W. Purves et al. Source: Life The Science of Biology 6th Ed. W. H. Freeman and Company, 2001, p 348.

Figure 4. Stages in the therapy of a sick child

(a) Name the type of therapy that the child is undergoing.

[1 mark]

(b) Identify the type of enzymes used to remove the normal allele from the genome of the donor whose genes are being used in the treatment.

[1 mark]

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- (c) Suggest ONE benefit and ONE hazard of the technique in Figure 4.

Benefit: _____

Hazard: _____

[2 marks]

- (d) Can the change in the genome be passed on to the individual's offspring? Give ONE reason for your answer.

[2 marks]

- (e) The bacterium *Escherichia coli* has a plasmid, A, in its cytoplasm. Plasmid A carries genes for resistance to two antibiotics, tetracycline and kanamycin. The gene for tetracycline resistance has a site for restriction enzyme A to cut and disrupt it.

The genome for corn has two sites for restriction enzyme A on either side of the gene for corn protein. Restriction enzyme A cuts out an entire functional gene for corn protein.

Restriction enzyme, A, plasmid A DNA and corn genome DNA are mixed together and recombinant DNA is formed. The recombinant DNA is mixed with a new *E. coli* strain that does not have any plasmid A. This *E. coli* takes up the recombinant DNA.

Briefly outline a method of detection and what you would observe if

- (i) *E. coli* has taken up no DNA

[2 marks]

- (ii) *E. coli* has taken up recombinant DNA.

[2 marks]

Total 10 marks

SECTION B

You must answer **THREE** questions in this section. Answer **ONE** question **EACH** from Modules 1, 2 and 3. You **MUST** write your answers in the answer booklet provided.

MODULE 1

Answer **EITHER** Question 4 **OR** Question 5.

4. (a) Clarify the **actions** and **purposes** of the oxidative and decarboxylative reactions which occur in the mitochondria during the following events:
- (i) Entry and processing of pyruvic acid [4 marks]
 - (ii) Rotation of the Krebs's cycle [6 marks]
- (b) With the aid of a diagram, give an account of the process of oxidative phosphorylation (the electron transport chain), to show the roles of hydrogen and electron carriers, phosphate compounds and oxygen in the production of ATP. [10 marks]

Total 20 marks

5. (a) Define the following terms:
- (i) Ecosystem [1 mark]
 - (ii) Habitat [1 mark]
 - (iii) Ecological niche [1 mark]
 - (iv) Food chain [1 mark]
- (b) Discuss how the components in an ecosystem function to achieve and maintain ecological balance. [4 marks]
- (c) (i) Explain why the flow of energy through ecosystems is linear and **NOT** cyclical. [3 marks]
- (ii) Explain why food chains are generally limited to three or four links. [3 marks]
- (d) In a forest there is a large tree that supports 500 caterpillars and 200 snails. There are five sparrows that live in the tree feeding on the caterpillars while one large hawk feeds on the sparrows. Consider this tree and its associated organisms as an ecosystem.
- Describe the tree ecosystem in terms of: a pyramid of biomass, a pyramid of numbers and a pyramid of energy. [6 marks]

Total 20 marks

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MODULE 2

Answer EITHER Question 6 OR Question 7.

- 6.** (a) Define the following terms and exemplify EACH one with reference to the glucose concentration of the blood **and** the endocrine-related actions of the pancreas and/or the liver:
- (i) Homeostasis [2 marks]
 - (ii) Set point [2 marks]
 - (iii) Detectors [3 marks]
 - (iv) Regulators [3 marks]
- (b) What reactions does the liver perform on protein material to process it to the body's advantage? [10 marks]

Total 20 marks

- 7.** (a) Describe the ascent of water in plants from outside the root to the intercellular spaces of the leaf. Include the role of root pressure, capillarity, cohesion, adhesion, transpiration pull and stomata. [10 marks]
- (b) Relate the structure of xylem vessels to their function. [4 marks]
- (c) Plant 1 is placed in a pot with its roots immersed in a dilute solution of potassium cyanide and an atmosphere of 20 per cent humidity.
- Plant 2 is placed in a pot with its roots in distilled water and an atmosphere of 100 per cent humidity.
- Discuss the effects these conditions would have on water uptake, mineral ion transport and transpiration. [6 marks]

Total 20 marks

MODULE 3

Answer EITHER Question 8 OR Question 9.

8. (a) Describe the mode of action of:
- (i) Phagocytes [2 marks]
 - (ii) Plasma cells [2 marks]
- (b) Distinguish between B and T lymphocytes in relation to their origin and maturation process. [6 marks]
- (c) Chloe gets a positive pregnancy test on a kit that she has used at home. The box label says it contains monoclonal antibodies. Her husband doesn't know whether to trust it. Chloe, who has studied Biology, persuades him that it is based on sound technology and is accurate.
- What convincing points could she make? [4 marks]
- (d) Active artificial immunity and passive artificial immunity are two methods of controlling disease, in cases where recipients do not have the necessary antibodies.
- Compare TWO situations in which EACH of these methods is used to BEST advantage. Give examples to support your comparison. [6 marks]

Total 20 marks

9. (a) Using appropriate examples, recommend the appropriate diet for the following individuals:
- (i) A lactating mother [2 marks]
 - (ii) Sedentary grandparents [2 marks]
 - (iii) An agricultural labourer [2 marks]
- (b) For the TWO diseases, HIV/AIDS and diabetes
- (i) state the disease categories under which EACH falls [4 marks]
 - (ii) discuss reasons for their global distribution. [5 marks]
- (c) Betty, aged 38, eats mainly rice, potato chips, sweet potatoes, macaroni and cheese, cake and carbonated beverages. Betty is unwell and goes to the doctor who tells her that she is obese, and has developed diabetes. The doctor also tells Betty that she is malnourished but she indignantly responds that she eats plenty of good food.
- With reference to the meaning of the term 'healthy', explain why the doctor considers Betty to be malnourished. [5 marks]

Total 20 marks

END OF TEST

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