



TEST CODE **02107020**

FORM TP 2014141

MAY/JUNE 2014

CARIBBEAN EXAMINATIONS COUNCIL

CARIBBEAN ADVANCED PROFICIENCY EXAMINATION®

BIOLOGY

UNIT 1 – Paper 02

2 hours 30 minutes

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of SIX questions in two sections. Answer ALL questions.
2. For Section A, write your answers in the spaces provided in this booklet.
3. For Section B, write your answers in the spaces provided at the end of each question in this booklet.
4. You may use a silent non-programmable calculator.

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02107020/CAPE/2014

SECTION A

Answer ALL questions.

Write your answers in the spaces provided in this booklet.

1. (a) Using haemoglobin as an example, explain EACH of the following levels of structural organization of proteins:

(i) Primary structure

[1 mark]

(ii) Secondary structure

[2 marks]

(iii) Tertiary structure

[2 marks]

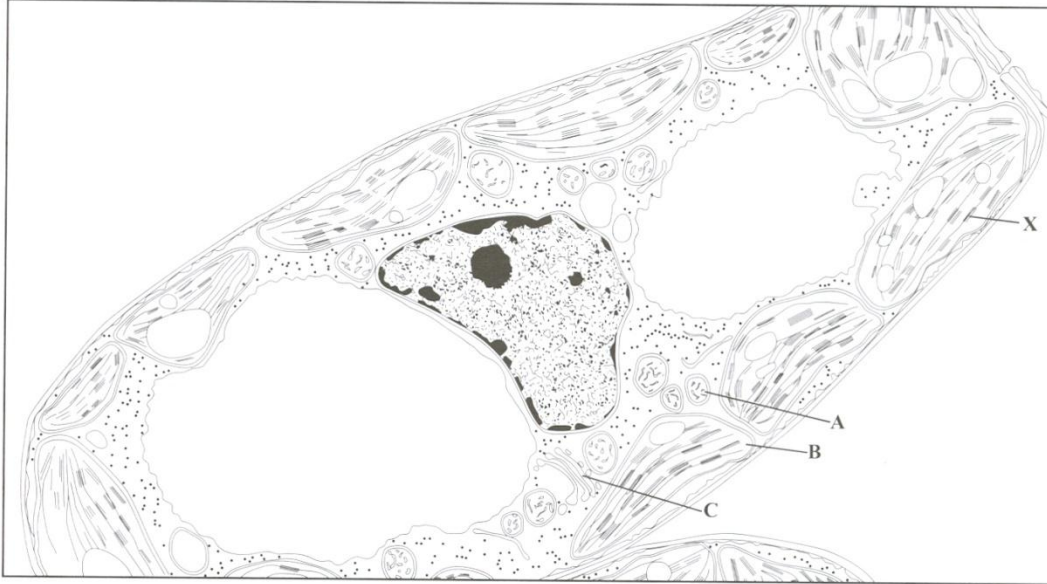
(iv) Quaternary structure

[2 marks]

- (b) With reference to its protein structure, explain how the haemoglobin molecule functions in its essential role.

[3 marks]

(c) Figure 1 is a drawing of an electron micrograph of a plant cell.



Ramesar, Jones and Jones 2011, Fig. 2.15, page 41

Figure 1. Drawing of an electron micrograph of a plant cell ($\times 5600$)

(i) Identify the organelles labelled A, B and C in Figure 1.

A: _____

B: _____

C: _____

[3 marks]

(ii) Calculate the actual maximum length of the organelle labelled X to the nearest micrometre (μm). **Show your working.**

Length: _____

[2 marks]

Total 15 marks

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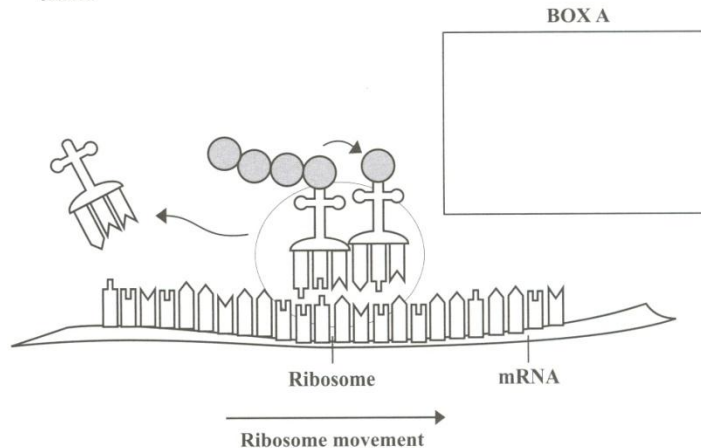
2. (a) (i) Protein synthesis requires two steps, transcription and translation. Table 1 is an incomplete comparison of some features of transcription and translation in eukaryotes. Complete Table 1 by writing the correct answers in the relevant spaces in the table.

TABLE 1: COMPARISON OF TRANSCRIPTION AND TRANSLATION

Feature	Transcription	Translation
Site	Generally in the nucleus	
Precursor molecule		mRNA
Enzymes and/or factors	RNA polymerase and other associated proteins	
Function		Produces the peptide sequence which is complementary to the mRNA

[4 marks]

- (ii) Figure 2 is a diagrammatic representation of the elongation phase of translation. In the box labelled A in Figure 2, sketch a diagrammatic representation of the tRNA molecule carrying the next amino acid to be added to the growing polypeptide chain.



Source: <http://www.motifolio.com/1021138.html>

Figure 2. Diagrammatic representation of the elongation phase of translation

[3 marks]

(b) In humans, the A, B, O blood groups are determined by multiple alleles of a single gene. The gene locus is usually represented by the symbol **I** and the blood genotypes may be represented as follows:

- $I^A I^A$ or $I^A i$ = blood group A
- $I^B I^B$ or $I^B i$ = blood group B
- ii = blood group O
- $I^A I^B$ = blood group AB

(i) Briefly explain the nature of the relationship between the alleles in the AB blood group.

[2 marks]

(ii) In a paternity suit, a female with blood type O has accused a male with blood type B of being the father of her child. The child has blood type O.

a) Deduce the blood genotype of the accused male which will clearly prove that he is NOT the father of the child. Give a brief explanation to justify your answer.

Blood genotype of male (no symbols required): _____

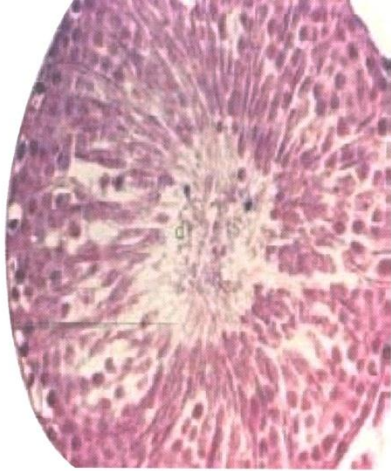
Justification: _____

[3 marks]

b) If the male parent in (b) (ii) a) above has blood type B, demonstrate the inheritance of the blood type (O) of the child. Use the given symbols and a Punnett square.

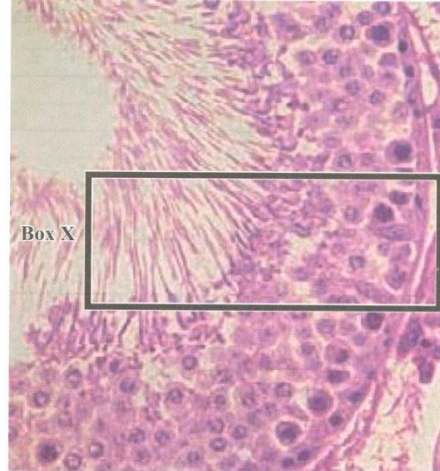
[3 marks]

Total 15 marks



A

Figure 3. Photomicrograph of a section of a seminiferous tubule

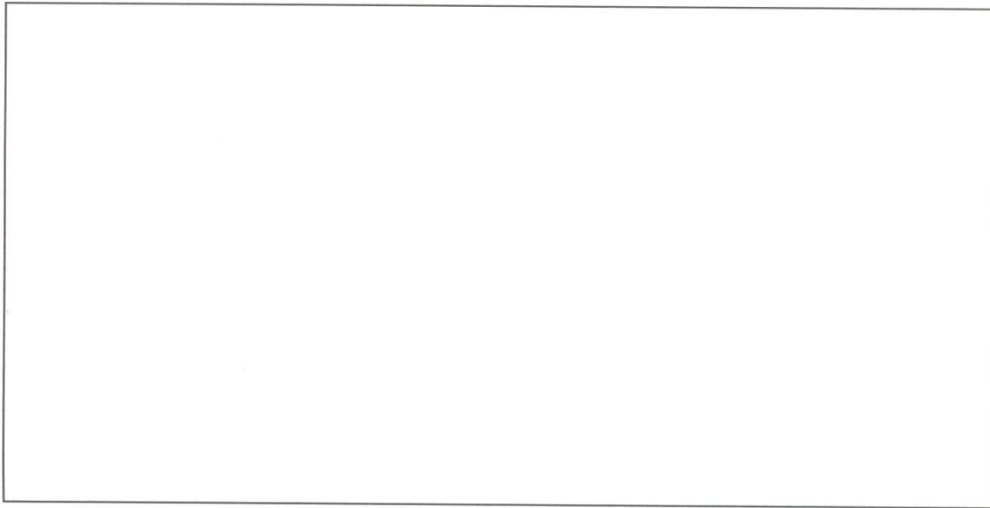


<http://www.pmrc.org.pk>

B

Figure 4. Part of Tubule A

- (i) Make a detailed labelled drawing of the region highlighted by Box X in Figure 4 B. **[6 marks]**



- (ii) Using Figure 3 or Figure 4 as a guide, outline the key development stages of spermatozoa within the seminiferous tubule.

[3 marks]

- (b) An experiment is conducted to investigate the effect of sucrose concentration on the germination of pollen grains for a particular plant species. The results are shown in Figure 5.

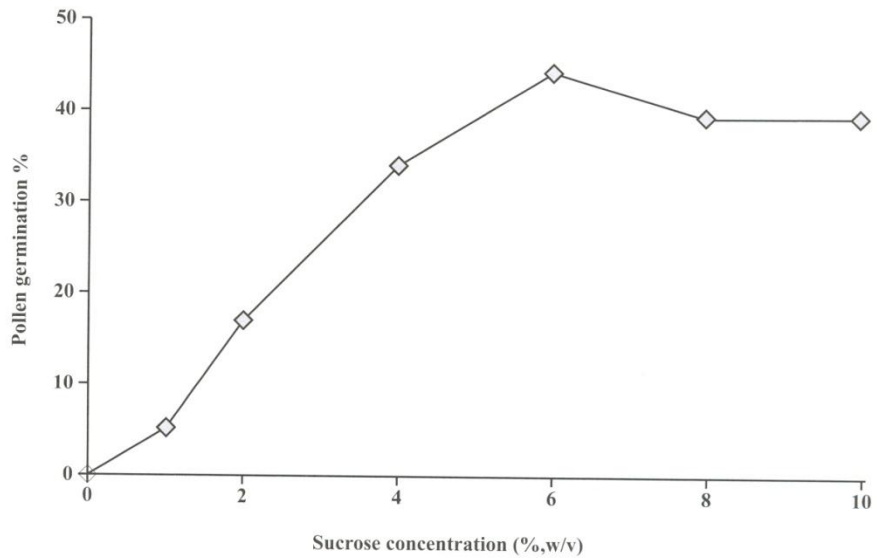


Figure 5. Effect of sucrose concentration on germination of pollen grains

- (i) Briefly describe the results of this experiment shown in Figure 5.

[2 marks]

- (ii) Explain the significance of this response for the pollination process.

[4 marks]

Total 15 marks

SECTION B

Answer ALL questions.

Write your answers in the spaces provided at the end of each question.

4. (a) Outline the structure of a molecule of water and explain how this structure allows water to be an excellent solvent. **[5 marks]**
- (b) Discuss TWO major roles of water in cell function. **[4 marks]**
- (c) Distinguish between endocytosis and exocytosis, and briefly comment on ONE cellular process that involves exocytosis. **[6 marks]**

Total 15 marks

Write the answer to Question 4 here.

5. (a) State FOUR observations and THREE deductions that formed the basis of Darwin's theory of natural selection. **[5 marks]**
- (b) Use the theory of natural selection to explain how a new species can evolve from an existing one by allopatric (geographical) speciation. **[4 marks]**
- (c) Discuss THREE potential threats to humans, and other organisms, of the use of genetically modified crops. Include a definition of the term 'genetically modified organism'. **[6 marks]**

Total 15 marks

Write the answer to Question 5 here.

6. (a) (i) Explain why vegetative propagation is NOT considered a form of sexual reproduction. Include in your explanation a brief definition of 'vegetative propagation'. **[3 marks]**
- (ii) Comment on why vegetative propagation is especially beneficial to agriculturists and horticulturists. Limit your commentary to FOUR main points. **[4 marks]**
- (b) (i) Give a concise explanation of how combined oral contraceptives work to prevent pregnancy. **[3 marks]**
- (ii) A young, recently married couple seeks advice at a family planning clinic. The 23-year-old female explains that her last normal menstrual cycle started two weeks ago and they both confirm that they have not engaged in sexual intercourse since then. She would like to begin using combined oral contraceptives immediately, as she has been advised that there are no medical reasons which prevent her from using this form of contraception.
- Suggest what advice should be given to the couple about the most appropriate way to use combined oral contraceptives. Include in your account, justification of your advice in relation to the physiological details provided by the couple and your knowledge of the menstrual cycle. **[5 marks]**

Total 15 marks

Write the answer to Question 6 here.
