



TEST CODE **02107020**

**FORM TP 2019156**

MAY/JUNE 2019

**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 **THREE** questions. Answer **ALL** questions.
2. Write your answers in the spaces provided in this booklet.
3. Do **NOT** write in the margins.
4. You may use a silent, non-programmable calculator to answer questions.
5. You are advised to take some time to read through the paper and plan your answers.
6. If you need to rewrite any answer and there is not enough space to do so on the original page, you must use the extra lined page(s) provided at the back of this booklet. **Remember to draw a line through your original answer.**
7. **If you use the extra page(s), you MUST write the question number clearly in the box provided at the top of the extra page(s) and, where relevant, include the question part beside the answer.**

**DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.**

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Module 1 — Cell and Molecular Biology

1. (a) Figure 1 shows a light micrograph of the transverse section through the primary stem of a Dahlia (*Dahlia sp.*) plant, a typical dicotyledon.

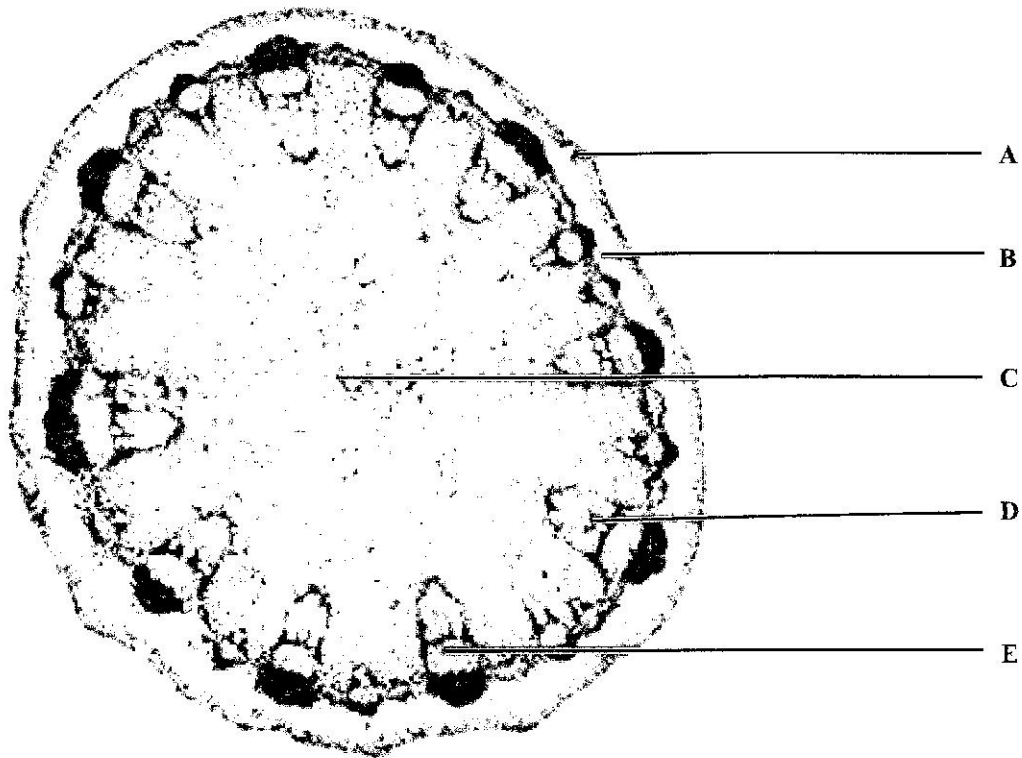


Figure 1. A light micrograph of a transverse section of a Dahlia plant stem

Source: [https://www.sciencephoto.com/image/572998\\_large/C0197068-Dahlia\\_stem\\_light\\_micrograph-SPL.jpg](https://www.sciencephoto.com/image/572998_large/C0197068-Dahlia_stem_light_micrograph-SPL.jpg)

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- (i) In the space below, construct a tissue diagram from the light micrograph of the plant section in Figure 1.

[3 marks]

- (ii) Provide annotations to describe EACH labelled structure, A–E.

A .....

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B .....

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C .....

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D .....

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E .....

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[5 marks]

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- (b) The graph in Figure 2 shows the change in the rate of uptake of two substances, Substance A and Substance B, as the concentration of each substance increases across a lipid bilayer.

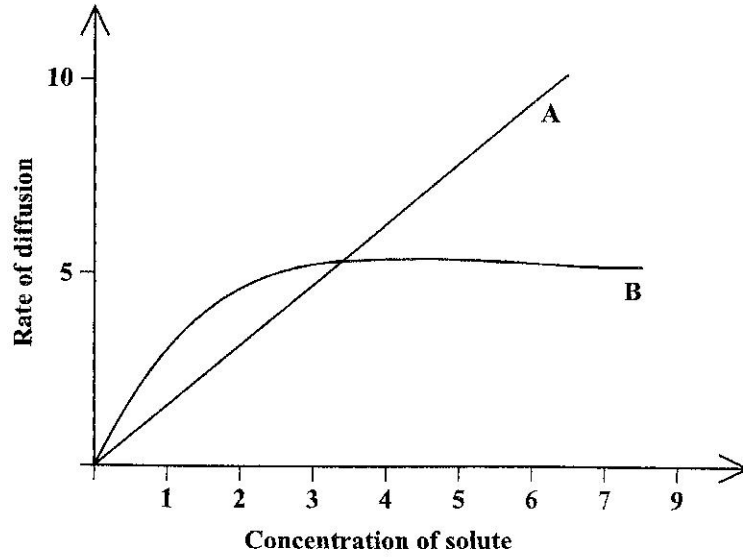


Figure 2. Graph of change in the rate of substance uptake

- (i) Describe the changes in the rate of uptake of Substance A and Substance B as the concentration of solute increases as depicted in Figure 2.

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[2 marks]



- (ii) Identify the types of diffusion illustrated for Substance A and Substance B in Figure 2.

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[2 marks]

- (iii) Compare and contrast the two types of diffusion identified in (b) (i).

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[4 marks]

- (iv) Arrange the following molecules according to their ability to diffuse through the lipid bilayer: CO<sub>2</sub>, glucose, water, RNA. Begin with the molecule that diffuses the easiest. Explain the order of your arrangement.

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[6 marks]

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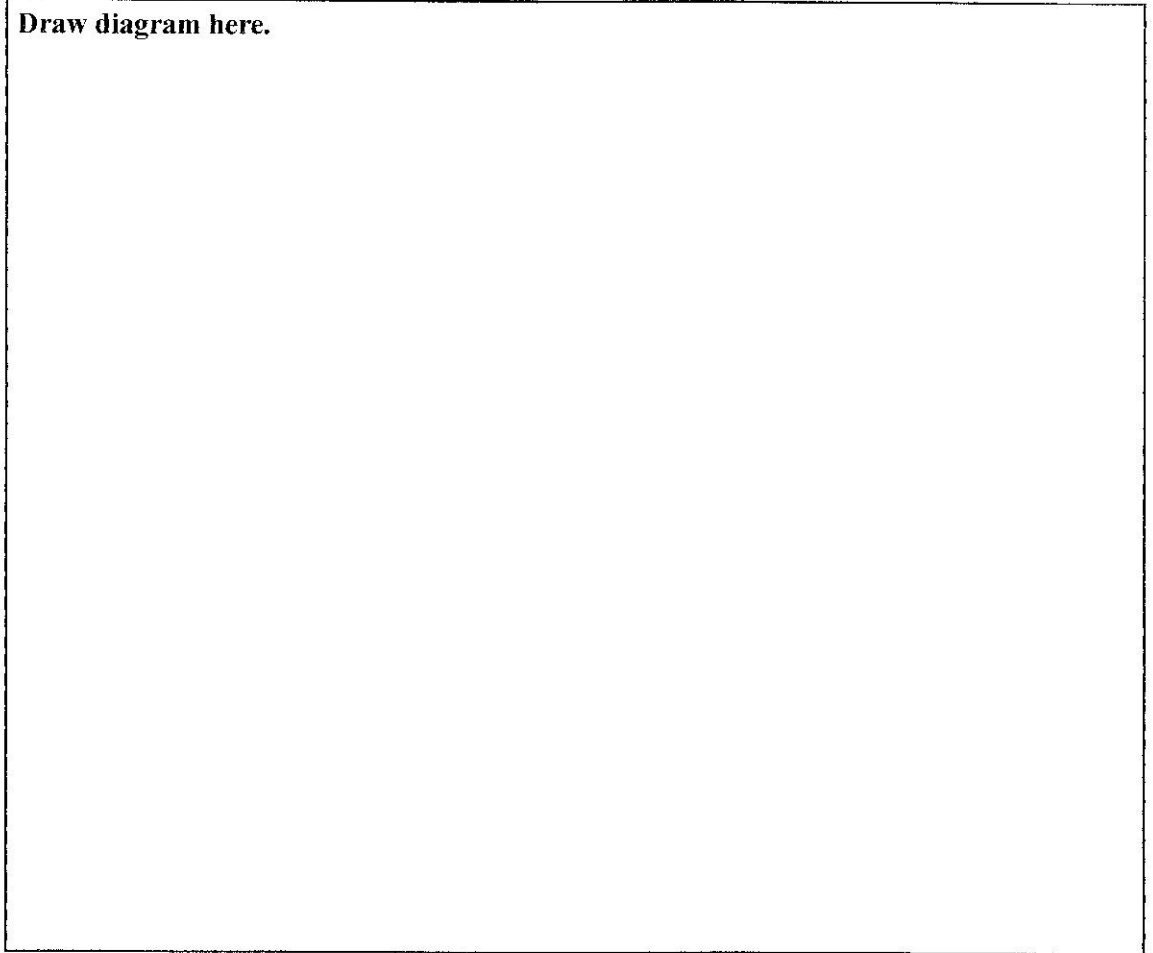


- (c) Phospholipids are major components of all cell membranes.

With the aid of an annotated diagram, explain the organization of membrane lipids.

Discuss the structure of a cell membrane specifying the organization of membrane lipids and the various ways in which proteins can associate with the membrane.

**Draw diagram here.**



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**Module 2 — Genetics, Variation and Natural Selection**

2. (a) Table 1 shows the relative growth rate data for sensitive strains and resistant strains of *S. typhimurium* bacteria, exposed to varying concentrations of tetracycline antibiotic.

**TABLE 1: RELATIVE GROWTH RATE DATA FOR SENSITIVE STRAINS OF BACTERIA**

<b>Tetracycline Conc. (µg/ml)</b>	<b>Relative Growth Rate of Sensitive Strain</b>	<b>Relative Growth Rate of Resistant Strain</b>
0.00	1.00	1.00
0.10	0.67	1.02
0.20	0.47	1.04
0.30	0.31	1.01
0.40	0.23	0.99
0.50	0.16	1.01
0.60	0.13	1.01
0.70	0.08	1.01
0.80	0.08	1.01

- (i) On the grid provided on page 11, plot a line graph showing the relative growth rate (y-axis) vs tetracycline concentration (x-axis) for the sensitive and resistant strain of bacteria. **[6 marks]**



- (ii) Outline the effect of EACH of the following antibiotic concentrations on BOTH bacterial populations at 0.1 ug/ml and 0.7 ug/ml antibiotic concentrations.

0.1 ug/ml .....

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0.7 ug/ml .....

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[4 marks]

- (iii) Explain how the differences between the growth rates of the bacteria could lead to natural selection.

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[4 marks]





(b) Figure 3 below illustrates how mutation brings about genetic variation.

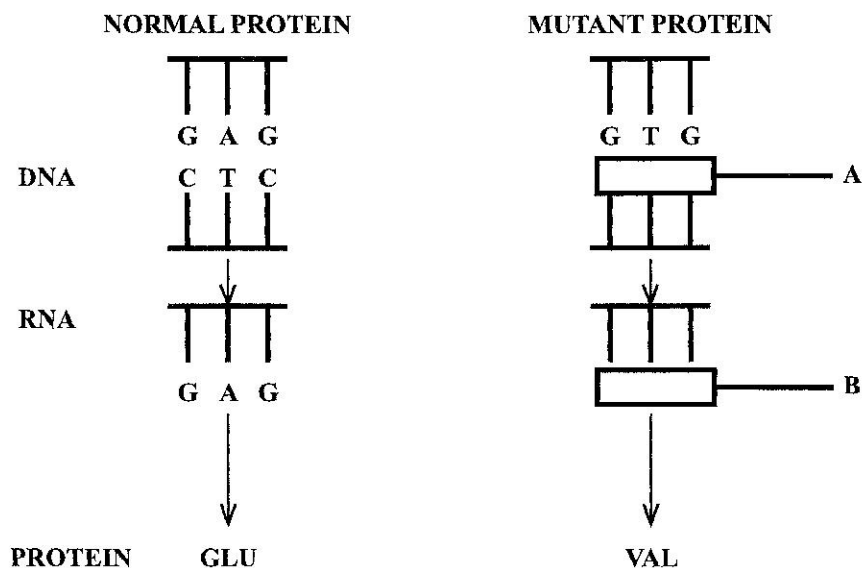


Figure 3. Mutation and genetic variation

(i) Complete the missing codons in the boxes labelled A and B in Figure 3.

A .....

B .....

[2 marks]

(ii) With reference to the mutation in Figure 3, explain how mutation brings about genetic variation at the DNA, protein and cellular level.

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**Module 3 — Reproductive Biology**

3. (a) Gametogenesis is the development and production of the male and female germ cells required to form a new individual.
- (i) Draw a well-labelled flow diagram of the process of oogenesis starting from the primary oocyte.

**[5 marks]**

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(ii) State the role of ONE **named** hormone in oogenesis.

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[2 marks]



(iii) Figure 4 shows a diagram of a sperm cell.

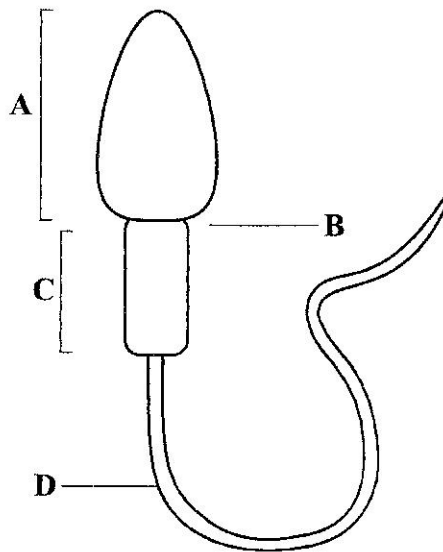


Figure 4. Diagram of a sperm cell

Provide annotations on ONE function of EACH of the structures labelled A–D in the diagram of a sperm cell shown in Figure 4.

- A .....
- .....
- B .....
- .....
- C .....
- .....
- D .....
- .....

[4 marks]



(iv) Relate any ONE structural feature of a sperm cell to its functions.

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[2 marks]

(b) (i) Self-incompatibility is determined by multiple alleles at the S locus. Complete the following table, using the key given below, to show the extent to which fertilization is possible between the genotypes of the parents.

Key: (-) no fertilization possible

(+) fertilization possible by all pollen grains

(- +) fertilization only possible by half pollen grains

Genotype of Male Parent	Genotype of Female Parent		
	$S_1S_2$	$S_1S_3$	$S_3S_4$
$S_1S_2$			

[3 marks]



(ii) Differentiate between EACH of the following pairs of terms:

Self-incompatibility and male sterility

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[2 marks]

Monoecy and dioecy

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[2 marks]

Protandry and protogyny

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[2 marks]







