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CARIBBEAN EXAMINATIONS COUNCIL

ADVANCED PROFICIENCY EXAMINATION

BIOLOGY

UNIT 1 – PAPER 03/2

ALTERNATIVE TO INTERNAL ASSESSMENT

2 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 THREE questions. Answer ALL questions.
2. The use of silent non-programmable calculators is allowed.

1. Amylase is an enzyme, which catalyses the hydrolysis of starch into a reducing sugar. It is commonly found in human saliva and germinating seeds.

You are required to carry out a simple investigation into the effect of substrate concentrations on the rate of reaction of amylase. Carefully read the instructions that follow before starting.

(a) You are provided with a stock solution of starch.
Using the distilled water provided prepare a series of starch solutions at different concentrations as follows:

(i) Label 8 test tubes A, B, C, D, A1, B1, C1, D1

(ii) To EACH test tube add the following:

A: 5 cm^3 stock starch solution
B: 4 cm^3 stock starch solution and 1 cm^3 distilled water
C: 3 cm^3 stock starch solution and 2 cm^3 distilled water
D: 2 cm^3 stock starch solution and 3 cm^3 distilled water
A1, B1, C1, D1: 5 cm^3 distilled water

(b) Place all the test tubes in a test tube rack in the water bath (37 °C) provided and leave for 5 minutes to allow the temperature of the solutions to reach the temperature of the water bath.

(c) Remove test tubes A and A1 from the water bath. To each tube quickly add 0.5 cm^3 of the amylase enzyme solution provided. Swirl the contents of the test tubes and rapidly put them back into the rack in the water bath.

(d) START THE STOP CLOCK. At intervals of 1 minute remove 1 drop of the reaction mixture from each test tube and place in separate wells of the marble spot plate provided. Immediately add a drop of Benedict's solution. Record the starch concentration and colour changes in Table 1 on page 3. Repeat this for a period of 5 minutes.

(e) Carry out the same procedure outlined in Steps (c) and (d) for the remaining pairs of solutions as follows:

B and B1
C and C1
D and D1

[7 marks]

(f) Write an appropriate title for Table 1.

_____

_____

[1 mark]

TABLE 1

Test Tube	Starch Concentration	Time Intervals (minutes)	Colour Changes
A 5 cm^3 starch solution		1	
		2	
		3	
		4	
		5	
A1 5 cm^3 distilled water		1	
		2	
		3	
		4	
		5	
B 4 cm^3 starch solution and 1 cm^3 distilled water		1	
		2	
		3	
		4	
		5	
B1 5 cm^3 distilled water		1	
		2	
		3	
		4	
		5	
C 3 cm^3 starch solution and 2 cm^3 distilled water		1	
		2	
		3	
		4	
		5	
C1 5 cm^3 distilled water		1	
		2	
		3	
		4	
		5	
D 2 cm^3 starch solution and 3 cm^3 distilled water		1	
		2	
		3	
		4	
		5	
D1 5 cm^3 distilled water		1	
		2	
		3	
		4	
		5	

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(g) Based on the results recorded what can you deduce about the relationship between substrate concentration and enzyme activity?

(2 marks)

(h) Comment on the purpose of the distilled water in test tubes A1 to D1.

[1 mark]

(i) Give TWO reasons for the colour changes recorded over the five-minute test period, when Benedict's solution was added to the reaction mixtures.

[2 marks]

(j) Outline the procedure that you might use to produce quantitative colour standards for the reaction mixtures using Benedict's solution.

[3 marks]

Total 16 marks

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2. (a) In a study to determine the effects of the steroidal plant hormone, 24-epibrassinolide (BL), on the mitotic index and growth of onion (*Allium cepa*) root tips, the effect of BL on cell division is measured by recording the number of cells in various stages of mitosis and the mitotic index (% of cells examined in mitosis) in controls and BL-treated root tips. The results are shown in Table 2.

Table 2: Effects of various concentrations of 24-epibrassinolide (BL) on the mitotic index of regenerating onion root tips. Data based on 400 cells counted from each of five root tips from each group (total of 2000 cells from each group).

Concentration of BL	# Cells in interphase	# Cells in prophase	# Cells in metaphase	# Cells in anaphase	# Cells telophase	# Cells counted	Mitotic index ± SD[1]
Control	1907	44	37	11	1	2000	4.65 ± 1.34
0.5 ppm	1918	52	15	12	3	2000	± 1.34
0.05 ppm	1869	82	28	20	1	2000	6.55 ± 0.69**
0.005 ppm	1807	112	46	24	11	2000	± 1.76*

[1]Percent of cells in mitosis ± SD; *P ≤ 0.001; ** P ≤ 0.03.

Table taken from www.funpecrp.com.br/.../gmr0259 full text.htm

(i) Calculate the mitotic index (% cells examined in mitosis) for root tips treated with 0.5 ppm BL and 0.005 ppm BL.

0.5 ppm BL _____

0.005 ppm BL _____

[2 marks]

(ii) Based on the results given in Table 2, what TWO pieces of information can be deduced about the effect of the steroidal plant hormone on cell division in onion root tips?

_____

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_____

_____

[2 marks]

GO ON TO THE NEXT PAGE

(b) In experiments investigating the inheritance of mutations in *Drosophila melanogaster*, students are given a stock of mutant flies with the following mutations:

1. Mutant flies have lighter than normal body colour – **yellow body colour**
2. Mutant flies have wings which **lack the normal veins**

In the **first part of the experiment**, crosses were made as follows:

A. True breeding normal (wildtype) virgin females are crossed with true breeding mutant males.

B. True breeding mutant virgin females are crossed with normal (wildtype) true breeding males.

The results of cross A produced F_1 progeny (male and female flies) which were wildtype with normal body colour and wings with veins. For B, the male F_1 progeny had all the mutations, while none of the F_1 female offspring had mutations (all wildtype).

For the second part of the experiment, the F_1 progeny from the cross B, are crossed together. The results of the second cross are given in Table 3.

TABLE 3: RESULTS OF F_1 CROSSES FROM B

Phenotype	Total
All mutants	475
Wildtype	785
Normal body colour, mutant wings	78
Mutant body colour, normal wings	62
TOTAL	1400

(i) Based on the results of the **first part of the experiment,** what can be deduced about the nature of the inheritance of the mutations?

_____

[1 mark]

GO ON TO THE NEXT PAGE

(ii) Draw a genetic diagram to show the genotypes and phenotypes of the parents and offspring of the two crosses, A and B, of the **first part of the experiment**.

CROSS A

CROSS B

[8 marks]

(iii) Using the data from Table 3 on page 6, calculate the percentage of offspring exhibiting non-parental phenotypes.

[2 marks]

(iv) Explain the significance of finding offspring from the second cross (F_2) exhibiting non-parental conditions.

_____

_____

_____

_____

[1 mark]

Total 16 marks

3. (a) Specimen A is a stained transverse section of the ovary of a mammal.

(i) Make a labelled plan drawing of Specimen A in the box below.

[6 marks]

(ii) Examine the specimen and locate a mature Graafian follicle. Calculate the diameter of the mature oocyte. Show your calculations.

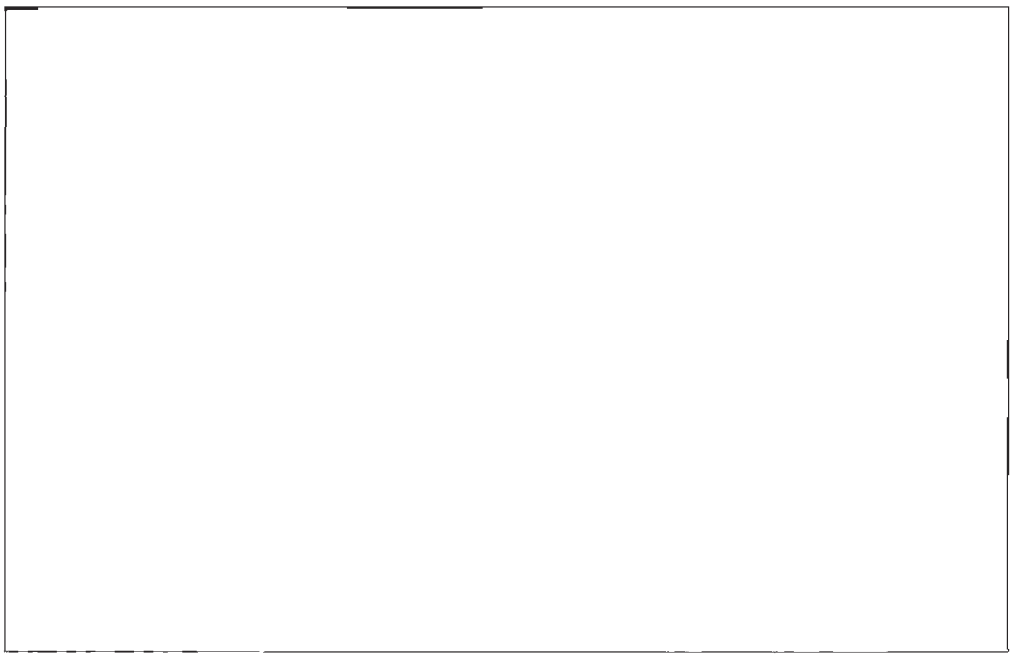
Calculations:

Diameter of oocyte _____

[2 marks]

(b) Specimen B is a transverse section of an immature anther of a lily.

(i) Examine the specimen and locate a pollen sac. Make a DETAILED labelled drawing of a pollen sac in the box below.



[6 marks]

(ii) Comment on TWO key differences that you might expect to see if you were to observe the pollen sac in a section of a completely mature anther.

1. _____

2. _____

[2 marks]

Total 16 marks

END OF TEST