

**MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD
UNIVERSITY OF MALTA, MSIDA**

**MATRICULATION CERTIFICATE EXAMINATION
ADVANCED LEVEL
MAY 2012**

SUBJECT: BIOLOGY
PAPER NUMBER: I
DATE: 10th May 2012
TIME: 4.00 p.m. to 7.00 p.m.

Directions to Candidates

- *Write your index number in the space at the top right-hand corner of this page.*
 - *Answer ALL questions. Write all your answers in the spaces provided in this booklet.*
 - *The mark allocation is indicated at the end of each question. Marks allocated to parts of questions are also indicated.*
 - *You are reminded of the necessity for good English and orderly presentation in your answers.*
 - *In calculations you are advised to show all the steps in your working, giving your answer at each stage.*
 - *The use of electronic calculators is permitted.*
-

For examiners' use only:

Question	1	2	3	4	5	6	7	8	9	Total
Score										
Maximum	9	14	10	7	8	17	10	14	11	100

Answer ALL questions.

1. This question is about plasma membranes.

1.1. The fluid mosaic model is used to describe plasma membranes. Explain what is meant by the term *fluid mosaic*.

[two marks]

1.2. Name and briefly explain ONE technique that can be used to prepare plasma membranes for electron microscopy.

[three mark]

1.3. Distinguish between *primary active transport* and *secondary active transport*, and give an example of each.

[four marks]
[Total: nine marks]

2. This question is about sugars.

Glucose is a reducing sugar which is used as a building block for a number of disaccharides and polysaccharides.

2.1. Name the type of reaction that occurs when two glucose molecules join to form a molecule of maltose. Give the name of the newly formed bond between the two glucose molecules.

[two marks]

2.2. Both maltose and sucrose are disaccharides containing glucose. Suggest how through a simple chemical test one can distinguish between the two.

[two marks]

2.3. Glycogen is a polysaccharide of glucose. Briefly explain the relationship between the structure and function of glycogen.

[three marks]

Galactosaemia is a metabolic disorder that follows an *autosomal recessive* mode of inheritance. Babies who are *homozygous* for the defective gene exhibit feeding difficulty, such as vomiting as soon as they are breast fed. They may also suffer from developmental delay as a result of the toxins which accumulate due to the inability to properly metabolize galactose.

2.4. What is meant by the term *autosomal recessive*?

[two marks]

2.5. Suggest why babies who are *heterozygous* for the defective gene exhibit no symptoms.

[two marks]

2.6. Given that breast fed milk contains lactose, suggest why babies suffering from galactosaemia should not be breast fed.

[two marks]

2.7. Suggest a simple treatment for a baby who has galactosaemia.

[one mark]
[Total: fourteen marks]

3. This question is about water uptake in plants and vegetation types.

3.1. Uptake of water within the roots can occur through the symplast or the apoplast. Distinguish between these two methods of water uptake.

[three marks]

3.2. Distinguish between water movement in the xylem and water movement in the phloem.

[three marks]

3.3. Locally one finds a number of terrestrial habitats which have unique vegetation types. Name TWO characteristic features that can be used to identify a garigue.

[two marks]

3.4. Name ONE example of a local plant which typically lives in garigue, and name ONE adaptation exhibited by the plant to live in such habitat.

[two marks]

[Total: ten marks]

4. This question is about support in animals.

4.1. Briefly distinguish between a hydroskeleton and an exoskeleton.

[four marks]

- 4.2. Using terrestrial animals as examples, name ONE animal that has a hydroskeleton and ONE animal that has an exoskeleton.

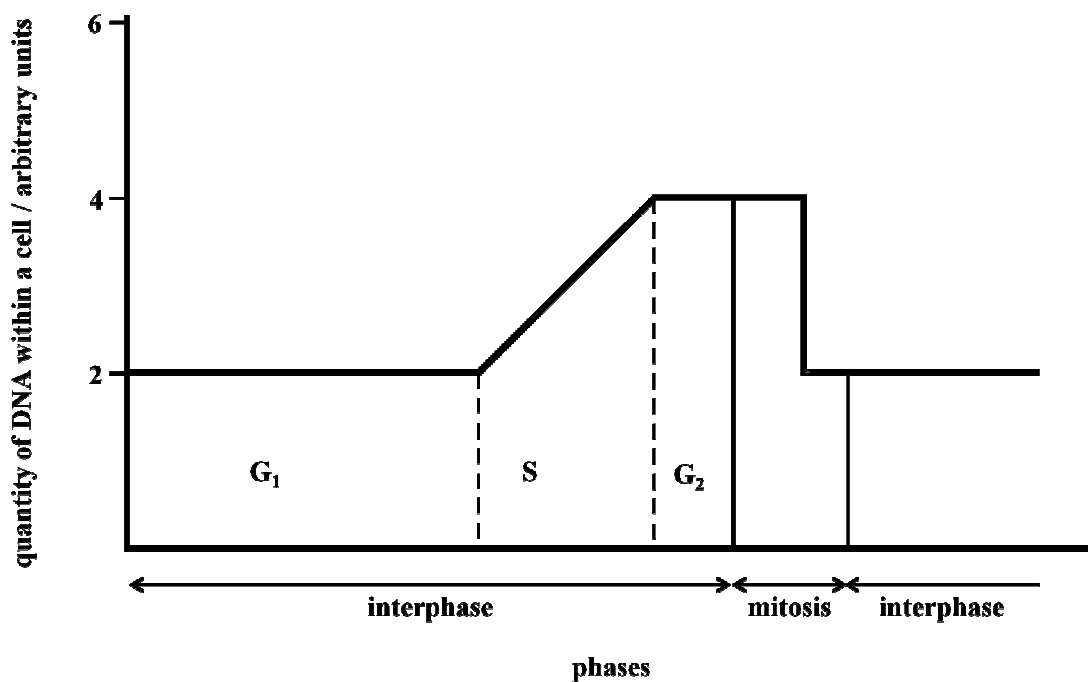
[one mark]

- 4.3. State the type of habitat in which an animal having a hydroskeleton is likely to be found. Give ONE biological reason for your answer.

[two marks]

[Total: seven marks]

5. The graph below illustrates how the quantity of DNA, within a mammalian somatic cell, varies during different phases of the cell's cycle. Additionally the graph shows the two growth phases, G_1 and G_2 , which are separated by an intermediate phase S.



- 5.1. In terms of the graph above, explain what is happening within the cell during phase S.

[two marks]

5.2. State ONE process other than cell growth which occurs during phase G₂.

[one mark]

5.3. Account for the changes in the quantity of DNA in the cell during mitosis.

[two marks]

5.4. Explain the significance of mitosis in living organisms.

[three marks]

[Total: eight marks]

6. This question is about heart muscle and the circulatory system.

Cardiac muscle is *myogenic* and produces a sequence of rhythmic contractions known as the cardiac cycle.

6.1. Give THREE structural characteristics of cardiac muscle.

[three marks]

6.2. Explain what is meant by the term *myogenic*.

[one mark]

6.3. Briefly explain how the sequence of muscular contraction in the heart is coordinated during the cardiac cycle.

[six marks]

6.4. Briefly explain how valves control the movement of blood through the heart.

[four marks]

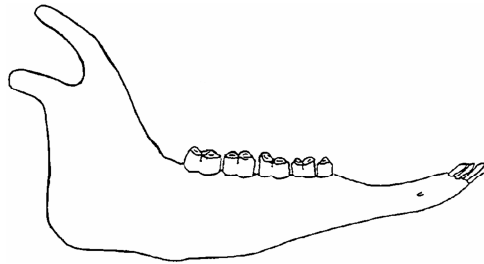
6.5. Why does foetal haemoglobin has a different affinity for oxygen than adult haemoglobin?

[three marks]

[Total: seventeen marks]

7. This question is about herbivores.

The diagram below represents the lower jaw of an herbivorous mammal.



7.1. With reference to the diagram above, list TWO features which indicate that the jaw is that of a herbivore. Include the function of such features.

<i>Feature</i>	<i>Function</i>

[four marks]

7.2. Name ONE structural difference that would be present in the jaw of a typical carnivore but is not observed in that of a herbivore. Give ONE reason for this difference.

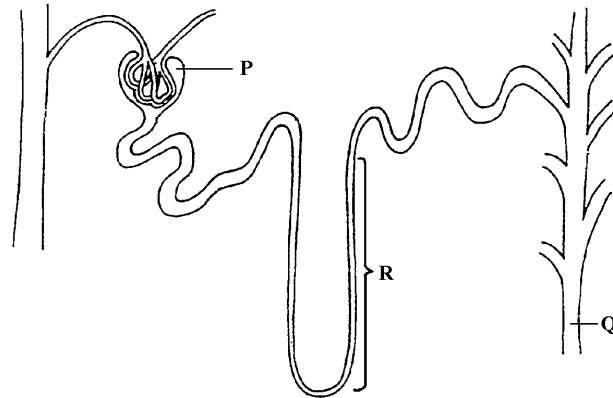
[two marks]

7.3. Apart from their dentition, some herbivores have additional adaptations that make them particularly suited for a herbivorous mode of life. Give ONE example of a hind-gut fermenter and briefly explain how hind-gut fermenters have unique mechanisms to maximize nutrient absorption from their food.

[four marks]

[Total: ten marks]

8. The diagram below shows the simplified structure of a human nephron.



- 8.1. Identify the structures:

P: _____ Q: _____ [one mark]

- 8.2. Briefly describe the following processes in the context of urine formation in humans.

- a) Ultrafiltration.

 _____ [two marks]

- b) Selective reabsorption of glucose.

 _____ [three marks]

The table below represents the quantities of water, glucose and urea passing through P and Q over a period of time, while the last column shows the percentage reabsorption during the same period of time.

Substance	Quantity passing through P	Quantity passing through Q	% reabsorbed
Water	180 dm ³	1.5 dm ³	99.17 %
Glucose	180 g	0 g	100 %
Urea	53 g	25 g	52.8 %

8.3. Relate the role of structure R to the filtrate composition as it passes through Q.

[five marks]

8.4. Explain the biological significance of the percentage reabsorption of water and urea.

[three marks]

[Total: fourteen marks]

9. Biotechnology is being utilized to produce a number of biomolecules using *transgenic organisms*. The end products of these processes include those used in human protein replacement, gene therapy and pest resistant crops.

9.1. What is a transgenic organism?

[one mark]

9.2. Name ONE example of a human protein which is synthesised using transgenic organisms.

[one mark]

9.3. Discuss ONE advantage of gene technology over traditional methods in the use of the above named protein.

[two marks]

9.4. Name ONE disease that can be treated by gene therapy. Give the principles behind this technique.

[five marks]

9.5. Briefly explain ONE environmental implication for the use of transgenic crops.

[two marks]

[Total: eleven marks]

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD
UNIVERSITY OF MALTA, MSIDA

MATRICULATION CERTIFICATE EXAMINATION
ADVANCED LEVEL
MAY 2012

SUBJECT:	BIOLOGY
PAPER NUMBER:	II
DATE:	12 th May 2012
TIME:	9.00 a.m. to 12.00 noon

Directions to Candidates

- *Answer the question in Section A, any TWO questions from Section B and ONE question from Section C. Write all your answers in the separate booklet provided.*
 - *If more than two questions from Section B are attempted, only the first two answers shall be taken into consideration.*
 - *If more than one question from Section C is attempted, only the first answer shall be taken into consideration.*
 - *The mark allocation is indicated at the end of each question. Marks allocated to parts of questions are also indicated.*
 - *You are reminded of the necessity for good English and orderly presentation in your answers.*
 - *In calculations you are advised to show all the steps in your working, giving your answer at each stage.*
 - *The use of electronic calculators is permitted.*
-

SECTION A (this section is **obligatory**)

1. Read carefully the following extract. Then using the information provided and your knowledge of biology, answer the questions that follow. The numerals in the left-hand margin are line numbers.

Unique life form is half plant, half animal.

In nature, you'll find animals that undergo vast transformations, becoming almost unrecognizable in their new forms. Caterpillars becoming butterflies and tadpoles becoming frogs, and if we couldn't watch them do so, we might not even suspect that the two stages belong to the same species.

- 5 However all stages of these animals belong to the same biological taxonomic rank, Animalia. This means that caterpillars still behave as animals in their new shapes, and thus are still classified as Animalia. But that is not what *Mesodinium chamaeleon* does. This single-celled organism is a unique mix of animal and plant life.

10 *Mesodinium chamaeleon*, a ciliate found in the oceans, was first discovered in Nivå Bay (Baltic Sea) in Denmark by a scientific team from the University of Copenhagen. Other specimens have been found off the coasts of Finland and Rhode Island.

15 Ciliates use their hair-like appendages to move around rapidly in the oceans. They get their food by ingesting other organisms. However, some *Mesodinium* species are different. They engulf their prey, generally other microorganisms like a type of algae called cryptomonads, and then form a partnership. A hybrid organism like this exhibits both animal-like and plant-like features, making it hard to classify, and basically collapses the division between animals and plants. Thus *M. chamaeleon* is halfway between a pure animal and a hybrid.

20 *M. chamaeleon* takes in algal cells, and even though it doesn't keep them on a permanent basis, it doesn't digest them immediately. Instead, the algal cells will remain intact for several weeks before they are broken down, during which time, they continue to photosynthesise. *M. chamaeleon* changes colours depending on whether it's hosting red or green algae, or even both.

25 This method of taking up other cells is one of life's prime inventions. In fact around two billion years ago one such process offered power to all complex cells, which eventually led to the formation of multicellular life.

Adapted from New Scientist January 2012

- 1.1 Briefly explain the process by which a 'caterpillar becomes a butterfly' (line 2).
[three marks]
- 1.2. Briefly discuss ONE limitation of the currently-used classification system.
[two marks]
- 1.3. Both butterflies and frogs belong to the Kingdom Animalia. Name their respective taxonomic Class, including TWO diagnostic features (for each) that can be used in their classification.
[three marks]
- 1.4. In which taxonomic group are ciliates typically classified? Name TWO diagnostic features that used in their classification.
[two marks]
- 1.5. Quote ONE sentence from the text that marks ciliates as quite animal-like.
[one mark]
- 1.6. What is meant by the term *hybrid* (line 15)?
[one mark]
- 1.7. What is the term used to explain the partnership between two organisms?
[one mark]
- 1.8. What is gained by the partnership described between *Mesodinium* and cryptomonads?
[three marks]
- 1.9. Why does the ciliate *M. chamaeleon* collapse the division between plants and animals (lines 16 to 17)?
[two marks]
- 1.10. What theory is being referred to in the text as being '*one of life's prime inventions*' (line 24)? Briefly discuss THREE pieces of evidence that give support to this theory.
[four marks]
- 1.11. Briefly discuss TWO advantages to multicellularity.
[three marks]

[Total: twenty five marks]

SECTION B

(Answer any **TWO** questions from this section; your answers should take the form of essays. Each question carries twenty five marks).

2. Give an account of the processes leading to speciation.
3. Compare and contrast the gaseous exchange mechanisms in fish and mammals.
4. Hormonal feedback mechanisms play an important role in human reproduction. Discuss.
5. Compare and contrast the life cycle of a named moss with that of a named fern.

[Total: fifty marks]

SECTION C

(Answer **ONE** question from this section).

6. Use your knowledge of biology to explain the evolutionary importance of the following:

- 6.1. the cleidoic egg;
- 6.2. chiasmata formation and independent assortment during meiosis;
- 6.3. the nocturnal eye;
- 6.4. the leaf structure of *Marram* grass;
- 6.5. C₄ plants.

[five marks each]

7. Use your knowledge of biology to explain the following statements:

- 7.1. glycolysis involves the conversion of glucose to pyruvate;
- 7.2. exocytosis is an important process in synaptic transmission;
- 7.3. small woodland plants typically flower very early in the year;
- 7.4. whales usually have a thick layer of blubber underneath their skin;
- 7.5. nitrogen fixing bacteria and nitrifying bacteria are important for the ecosystems.

[five marks each]

[Total: twenty five marks]

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD
UNIVERSITY OF MALTA, MSIDAMATRICULATION CERTIFICATE EXAMINATION
ADVANCED LEVEL
MAY 2012

SUBJECT:	BIOLOGY
PAPER NUMBER:	III
DATE:	18 th May 2012
TIME:	9.00 a.m. to 10.30 a.m.

Directions to Candidates

- Write your index number in the space at the top right-hand corner of this page.
 - Answer ALL questions. Write all your answers in the spaces provided in this booklet.
 - The mark allocation is indicated at the end of each question. Marks allocated to parts of questions are also indicated.
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 - In calculations you are advised to show all the steps in your working, giving your answer at each stage. Unless otherwise specified, you are advised to list results to one decimal place.
 - The use of electronic calculators is permitted.
-

For examiners' use only:

Question	1	2	3	Total
Score				
Maximum	18	19	13	50

PLEASE DO NOT WRITE ABOVE THIS LINE

1. An environmental manager, who is responsible for the management of a lake, wanted to estimate the population size of a native fish species.

1.1. List FOUR factors which may affect the population size of the native fish species.

[two marks]

1.2. One of the methods used by the environmental manager to determine the size of the population was the capture-recapture technique. Briefly describe how this method can be applied to determine the population size of the fish in question.

[four marks]

1.3. Name THREE limitations that must be considered when using the capture-recapture technique.

[three marks]

PLEASE DO NOT WRITE ABOVE THIS LINE

- 1.4. In the management of wildlife, information about population sizes is of utmost importance. Why should an environmental manager be interested in determining the population size?

[two marks]

When analysing the data collected from a prolonged study, the environmental manager noted that the population density of the native fish species started to change at the same time as an alien fish species was introduced into the lake. (The data collected is represented below).

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006
Estimated population density of the native fish species (individuals / km ²)	3680	3690	3660	3670	3520	2900	2850	2620	2300
Estimated population density of the alien fish species (individuals / km ²)	0	0	0	0	10	25	50	90	120

- 1.5. Distinguish between the terms *native species* and *alien species*.

[two marks]

- 1.6. Give TWO biological reasons that might explain the observed changes in the native fish population density.

[five marks]

[Total: eighteen marks]

PLEASE DO NOT WRITE ABOVE THIS LINE

2. Malvidin is a pigment that makes the petals of the plants from the genus *Primula* appear blue. The synthesis of malvidin is controlled by the dominant allele **A** that produces the precursor for malvidin. The production of malvidin can be suppressed by another molecule which is the product of the dominant allele **D** (Figure 1). These two alleles occur on two unlinked genes.

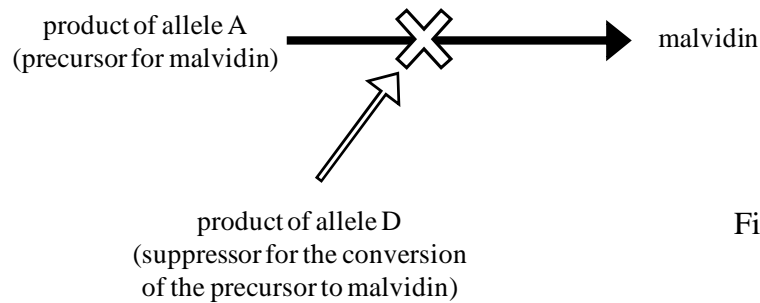


Figure 1

- 2.1. What is meant by the term *two unlinked genes*?

[one mark]

- 2.2. What is the relationship between the two genes called?

[one mark]

An experiment was conducted where a malvidin producing *Primula* plant **AAdd** was crossed with another *Primula* plant that does not produce malvidin **aaDD**.

- 2.3. What would the genotype of the F₁ generation be?

[one mark]

- 2.4. Would the F₁ generation be producing any malvidin?

[one mark]

PLEASE DO NOT WRITE ABOVE THIS LINE

2.5. In a second experiment the F_1 generation was self-pollinated. What are the expected phenotypic ratios (plants without malvidin : plants with malvidin) for the F_2 generation of this cross?

[six marks]

2.6. Given that 1200 F_2 individuals were analysed. How many F_2 individuals are expected to lack malvidin and how many are expected to have this pigment?

[two marks]

PLEASE DO NOT WRITE ABOVE THIS LINE

In the actual experiment the phenotypes of the F₂ generation were:

<i>Primula</i> plants without malvidin	:	<i>Primula</i> plants with malvidin
961	:	239

- 2.7. One of the analyses conducted on the above experimental data was a Chi-Squared test. What is the null hypothesis used for such a test?

[two marks]

- 2.8. A Chi-Squared value of 1.07 was obtained for this experiment, while the critical Chi-Squared value for one degree of freedom at a P-value of 0.05 is 3.84 (Table below). Explain whether the experimental data of the F₁ generation cross should be accepting or rejecting the null hypothesis at a P-value of 0.05?

<i>degrees of freedom</i>	<i>level of significance (P-values)</i>						
	0.90	0.50	0.20	0.10	0.05	0.01	0.001
1	0.16	0.45	1.64	2.71	3.84	6.64	10.83

Table above shows the critical Chi-squared values for one degree of freedom at various levels of significance.

[three marks]

- 2.9. Explain what might happen if a point mutation by insertion of one base occurs on the gene coding for the suppressor molecule.

[two marks]

[Total: nineteen marks]

PLEASE DO NOT WRITE ABOVE THIS LINE

3. The following question is about supporting tissue.

3.1. Figure 2 is a photomicrograph of a transverse section through a *Zea mays* stem. Label and annotate the photomicrograph to indicate the different types of plant cells shown.

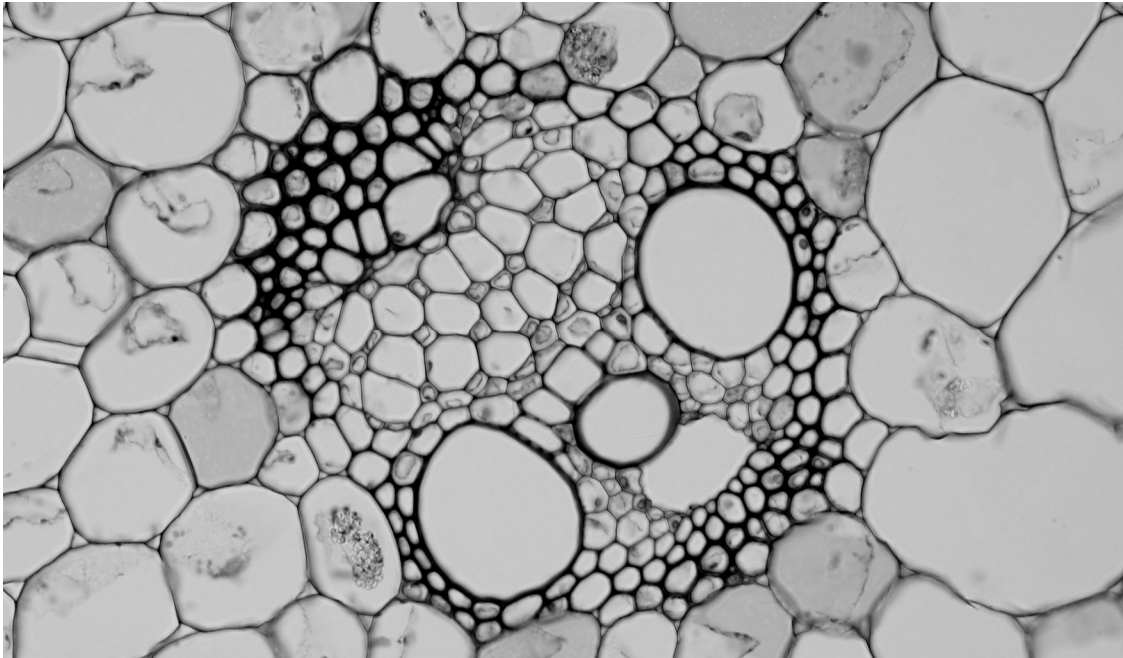


Figure 2

<http://botit.botany.wisc.edu/Resources/Botany/Shoot/Stem/Zea%20stem/Vascular%20bundle%20zea.jpg.html>

[five marks]

PLEASE DO NOT WRITE ABOVE THIS LINE

3.2. The photomicrograph in Figure 3 shows part of the transverse section of a human compact bone.



Figure 3
http://medcell.med.yale.edu/histology/bone_lab/haversian_system.php

Use the space below to draw an annotated map of the compact bone shown in Figure 3.

A large, empty rectangular box provided for drawing an annotated map of the compact bone shown in Figure 3.

[eight marks]
[Total: thirteen marks]

Index Number: _____

AM 05/IV.12m

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD
UNIVERSITY OF MALTA, MSIDA
MATRICULATION CERTIFICATE EXAMINATION
ADVANCED LEVEL
MAY 2012

SUBJECT: BIOLOGY
PAPER NUMBER: IV – *Practical*
DATE: 8th June 2012
TIME: 1 hr 30 min

Directions to Candidates

- Write your index number in the space at the top left-hand corner of this page.
 - Answer **ALL parts of this paper**. Write all your answers in this booklet.
 - Marks allocated to parts of the question are indicated.
 - You are reminded of the necessity for good English and orderly presentation in your answers.
 - In calculations you are advised to show all the steps in your working, giving your answer at each stage.
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-

For examiners' use only:

	Total
Score	
Maximum	40

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1. The fermentation of sugar by yeast (*Saccharomyces cerevisiae*) is an economically important process. Different sugars are fermented at different rates. It is possible to estimate the rate of fermentation by measuring the amount of one of the products produced during the fermentation reaction.

You are required to devise and implement an experiment to compare the rate of fermentation of two different sugars by yeast cells.

You are provided with the following material:

- a yeast cell suspension (has to be mixed well prior to usage)
- a sucrose solution and a maltose solution of the same concentration
- one syringe connected to a capillary tubing
- distilled water
- plastic containers
- graduated pipettes
- other laboratory apparatus as required

1.1. Summarise the fermentation process by means of a simple chemical equation.

[one mark]

1.2. What are the objectives of your experimental investigation?

[two marks]

1.3. Give a **BRIEF** general statement summarising the method through which your objectives will be investigated.

[two marks]

DO NOT WRITE ABOVE THIS LINE

1.4. Describe in **DETAIL**, how you would devise an experiment to estimate the rate of fermentation of yeast in the presence of different sugars, utilizing only the apparatus provided. (*Any mixtures of yeast suspension and sugar solution should be mixed at a ratio of 1:1*)

[fourteen marks]

DO NOT WRITE ABOVE THIS LINE

1.5. Devise and compile a suitable **TABLE** for recording your results. Do not enter any values in the table at this stage. Use the space below for the results table.

--

[five marks]

Carry out the investigation that you devised in Question 1.4., and insert the results in the table you prepared in your answer to Question 1.5.

1.6. Draw a graph to present your results. *Use the graph paper provided in this booklet.*

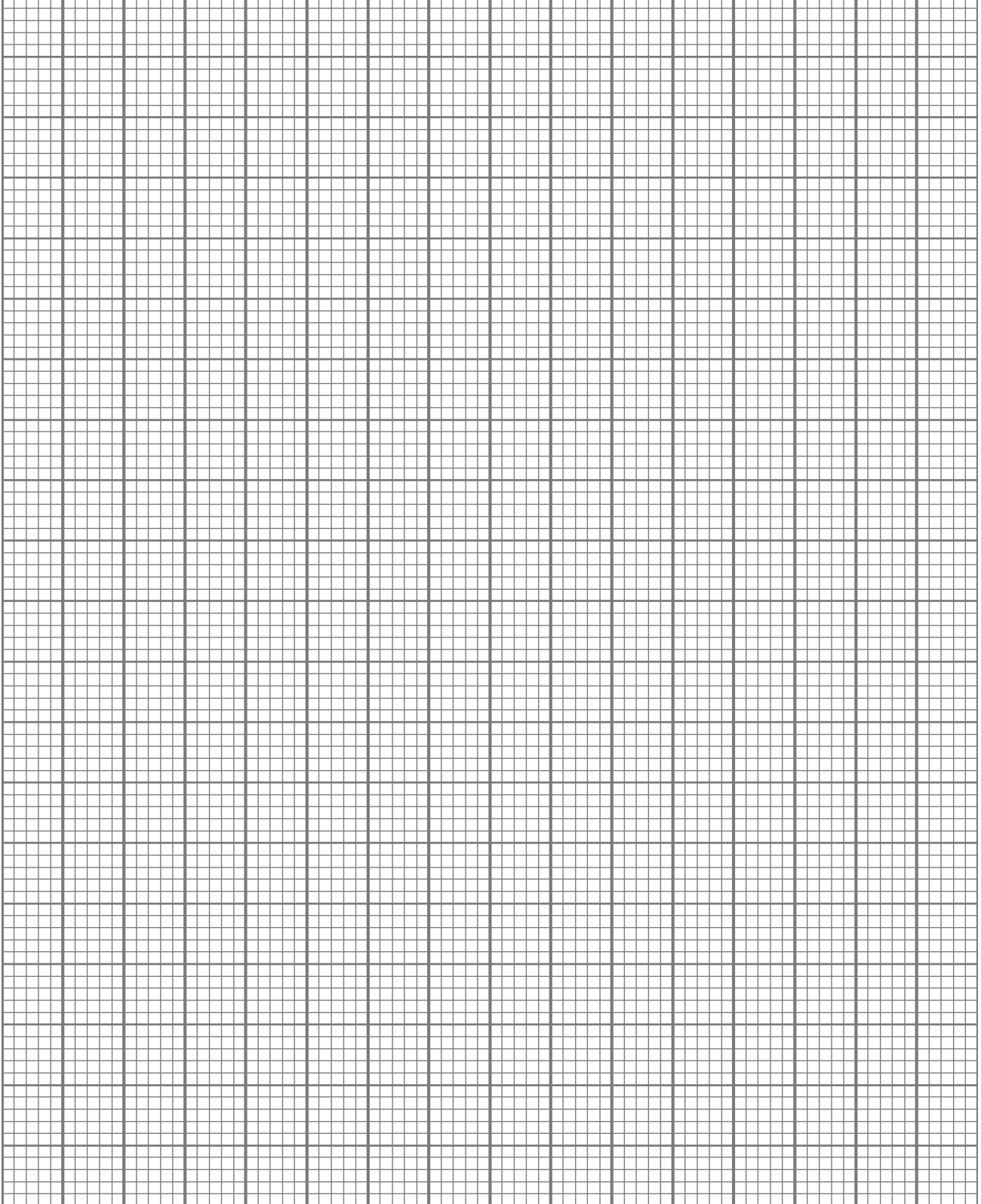
[five marks]

1.7. Describe any patterns observed from the results obtained.

[two marks]

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Graph Paper to be used in conjunction with Question 1.6.



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1.8. Using your knowledge of biology, what conclusions can be drawn from these results?

[three marks]

1.9. List and justify TWO relevant precautions that should be taken before the start of the experiment.

[two marks]

1.10. List TWO sources of error, and explain how they might have influenced your results.

[four marks]

[Total: forty marks]

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