AM 05/I.03 **INDEX NUMBER:**_____

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

MATRICULATION CERTIFICATE EXAMINATION
ADVANCED LEVEL
MAY SESSION 2003

Subject Title	**BIOLOGY**
Paper No./Title	**Paper 1**
Date	**19th May 2003**
Time	**9.00 a.m. to 12 noon**

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	10	**Total**
Score											
Maximum	**11**	**10**	**11**	**9**	**11**	**8**	**9**	**10**	**12**	**9**	**100**

ADVANCED BIOLOGY I

Answer ALL questions.

1. Individual plants belonging to a particular species of angiosperm vary considerably in appearance. Much of the variation is due to the colour of the petals and to the distribution of chlorophyll in the leaves. Petal colour may be blue or white, with no intermediate, while chlorophyll may be present throughout the leaves (giving green leaves), only present in patches (giving variegated leaves) or altogether absent. A researcher is investigating the inheritance of these characteristics by crossing plants with blue petals and green leaves, known to be pure breeding for both characteristics, with plants having white petals and variegated leaves. The F_1 generation from this cross was made up of plants with blue petals and green leaves and plants with blue petals and variegated leaves in a 1:1 ratio.

1.1 Construct a genetic diagram explaining how this cross produced the F_1 generation that was observed.

[three marks]

The F_1 plants with blue petals and variegated leaves were self-pollinated and 1300 seeds sown. All the seeds that were sown germinated successfully. Phenotypic patterns in the F_2 plants were noted three months after germination. The following results were recorded:

Phenotype	Number
Plants with **blue** petals and **green** leaves	248
Plants with **blue** petals and **variegated** leaves	502
Plants with **white** petals and **green** leaves	80
Plants with **white** petals and **variegated** leaves	164

1.2 Construct a genetic diagram explaining how this cross produced the F_2 generation that was observed.

[six marks]

1.3 How are the F_2 genotypes related to the F_2 phenotypes observed?

_____

_____

_____

[two marks]

[Total: eleven marks]

2. This question concerns the mammalian heart.

2.1 What type of muscle is the heart made up of?

_____

[one mark]

2.2 The following table lists some factors that are known to influence human heart rate. Complete the table by stating whether each factor accelerates or decelerates heart rate.

Factor	Effect on heart rate
High blood pressure in aorta and major arteries	
Low oxygen concentration in blood	
Low blood *p*H	
High adrenaline concentration in serum	
High body temperature	
Increased sympathetic nerve stimulation of the heart	

[three marks]

2.3 Briefly describe ONE situation that may lead to a decrease of blood *p*H.

_____

_____

[two marks]

2.4 What is the physiological significance of an increase in adrenaline level?

_____

_____

[one mark]

2.5 Give a brief outline of the principal events in the cardiac cycle.

[three marks]

[Total: ten marks]

3. Organisms from different phyla have evolved numerous adaptations for controlling body temperature. One of the most basic distinctions is that between ectotherms and endotherms.

3.1 Name TWO sources of heat that contribute to the body temperature of animals.

(i)

(ii)

[one mark]

3.2 Distinguish between ectotherms and endotherms.

[one mark]

3.3 Complete the following table by giving one example of each thermoregulatory mechanism in mammals.

Thermoregulatory mechanism	**Example**
Structural	
Behavioural	
Physiological	

[three marks]

Explain the following observations:

3.4 Mammals and birds generally hunt reptiles and amphibians shortly after dawn. The percentage of successful hunts decreases sharply during the late morning and afternoon.

_____

_____

[two marks]

3.5 A number of animals hibernate during the winter months.

_____

_____

[two marks]

3.6 The Sandhill Snail (*Theba pisana*), a native of the Maltese Islands, spends the summer months attached to the upper parts of the stalks of tall vegetation.

_____

_____

[two marks]

[Total: eleven marks]

4. This question concerns photosynthesis.

4.1 Where, in a mesophyll cell, would the light reaction and dark reaction of photosynthesis occur?

Light reaction: _____

Dark reaction: _____

[one mark]

4.2 How are C_4 plants better adapted to tropical conditions than C_3 plants?

_____

_____

[one mark]

4.3 Briefly describe the role of each of the following compounds in photosynthesis:

Ribulose bisphosphate (RuBP):

Glycerate phosphate (GP):

Triose phosphate (TP):

[six marks]

4.4 State TWO reasons why not all the light falling on a leaf of a plant is used in photosynthesis.

(i)

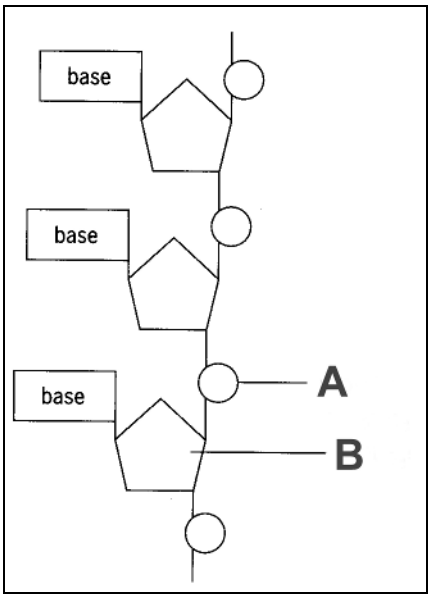
(ii)

[one mark]

[Total: nine marks]

ADVANCED BIOLOGY I

5. The diagram below represents part of a DNA strand.



5.1 Identify the structures A and B represented on the diagram:

Label	Structure
A	
B	

[two marks]

5.2 Draw a ring on the diagram enclosing a single nucleotide.

[one mark]

5.3 How does structure B differ between DNA and RNA?

_____

_____

[one mark]

5.4 Name the type of chemical reaction that occurs when nucleotides join together to form a DNA strand.

_____

[one mark]

5.5 Which two organic bases in DNA are classified as purines and which two as pyrimidines?

Purines: _____

Pyrimidines: _____

[two marks]

5.6 Which organic base is replaced by uracil in RNA?

_____

[one mark]

5.7 What form of bonding binds two complementary DNA strands?

_____

[one mark]

5.8 The bond between guanine and cytosine is more difficult to break than that between adenine and thymine. Suggest a reason for this.

_____

_____

[two marks]

[Total: eleven marks]

ADVANCED BIOLOGY I

6. Mitochondria are among the largest organelles in eukaryotic cells, occupying as much as 25% of cytoplasmic volume.

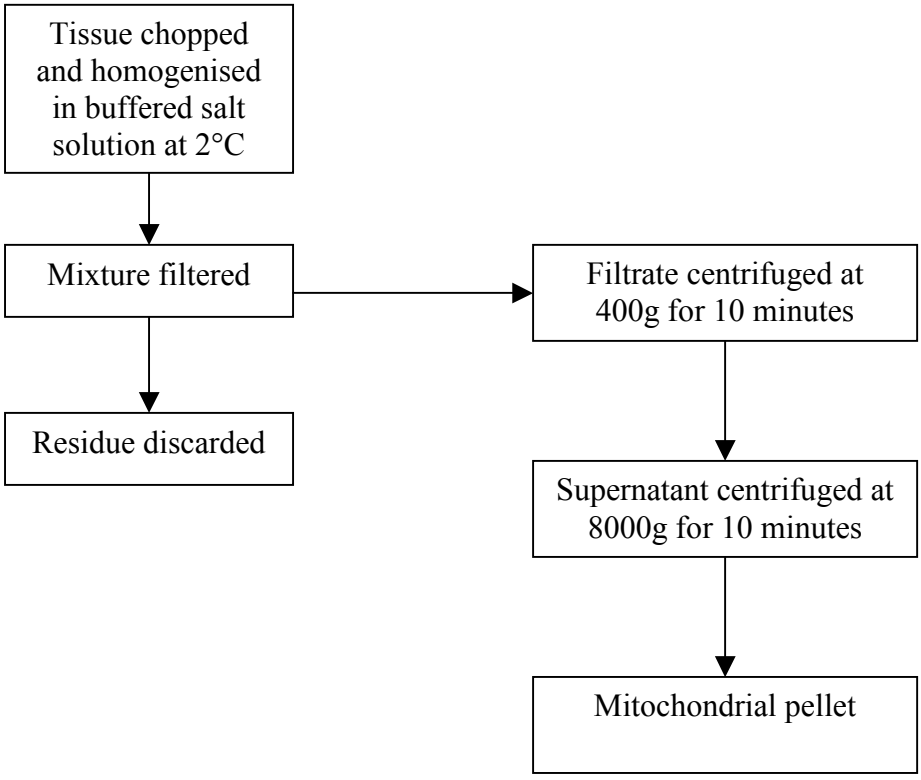
6.1 What is the role of mitochondria in eukaryotic cells?

_____

_____

[one mark]

A preparation of mitochondria can be made from cells by following the procedure summarised in the flow-diagram below:



6.2 Explain the meaning of the term "supernatant".

_____

_____

[one mark]

6.3 Explain why the solution in which the tissue was suspended was kept at 2°C.

_____

_____

[one mark]

6.4 Explain why the solution was centrifuged twice.

_____

_____

[one mark]

6.5 Name one plant tissue and one animal tissue that would have a high volume density of mitochondria. Give one reason for each answer.

Plant tissue: _____

_____

_____

[two marks]

Animal tissue: _____

_____

_____

[two marks]

[Total: eight marks]

7. This question concerns the variety of living organisms.

7.1 Read the passage below and insert the appropriate term in the blank spaces:

Echinoderms exhibit both _____and_____symmetry during different stages of their life cycle. The _____and triploblastic mode of organization is distinguished by the absence or presence of the_____. After the establishment of _____in annelids, individual or small groups of segments could become further specialised and modified. The independent movement of body segments in Arthropoda was achieved through the rise of_____.

[three marks]

7.2 List one structural feature that may be used to distinguish between organisms in each of the following pairs of taxonomic classes:

Hydrozoa and Schyphozoa: _____

Oligochaetae and Polychaetae: _____

Insecta and Arachnida: _____

[three marks]

7.3 Complete the matrix below by inserting the correct terms in the appropriate spaces. Two spaces have been filled in as an example.

	Bryophyta (mosses)	Filicophyta (ferns)	Pinophyta (conifers)	Anthophyta (flowering plants)
Is the conspicuous generation the sporophyte or gametophyte?			**Sporophyte**	
Homosporous or heterosporous?		**Homosporous**		

[three marks]

[Total: nine marks]

8. Explain the following observations:

8.1 The biomass of consumers in a food chain is always less than that of producers.

_____

_____

[two marks]

8.2 Several species characteristic of sand dune ecosystems are common along Mediterranean beaches but rare or absent from the beaches of the Maltese Islands.

_____

_____

[two marks]

8.3 The niche volume of an organism is reduced in the presence of competing species.

[two marks]

8.4 Decomposers are keystone species in food chains.

[two marks]

8.5 An undisturbed Mediterreanean garrigue may develop into a Mediterranean maquis.

[two marks]

[Total: ten marks]

9. This question concerns cellular organisation and function:

9.1 What is a prokaryote?

[one mark]

9.2 What is a eukaryote?

[one mark]

9.3 List three advantages of eukaryotic organisation over prokaryotic organisation.

(i)

(ii)

(iii)

[three marks]

9.4 Briefly describe the role of the cytoskeleton in eukaryotic cells.

[three marks]

Explain the following observations:

9.5 Some cells are characterised by membranes folded into microvilli.

[two marks]

9.6 The inner membrane of mitochondria is folded into cristae.

[two marks]

[Total: twelve marks]

10. Write brief notes on each of the following processes. Your answer should identify the site where each process occurs:

10.1 Glycolysis

[three marks]

10.2 Krebs' Cycle

[three marks]

10.3 Oxidative phosphorylation

_____

_____

_____

[three marks]

[Total: nine marks]