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

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

MATRICULATION CERTIFICATE EXAMINATION
ADVANCED LEVEL
SEPTEMBER 2005

SUBJECT:	BIOLOGY
PAPER NUMBER:	I
DATE:	2nd SEPTEMBER 2005
TIME:	9.00 a.m. to 12.00 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	10	11	5	14	13	7	11	8	10	11	100

ADVANCED BIOLOGY I

Answer ALL questions.

1. Write **brief** notes on a *named* organism from each of the following taxonomic groups:

1.1 Oligochaetae;

[two marks]

1.2 Polychaetae;

[two marks]

1.3 Hydrozoa;

[two marks]

1.4 Scyphozoa;

[two marks]

1.5 Chordata.

[two marks]

[Total: ten marks]

2. The diagram in Figure 1 shows three forms of epithelium:

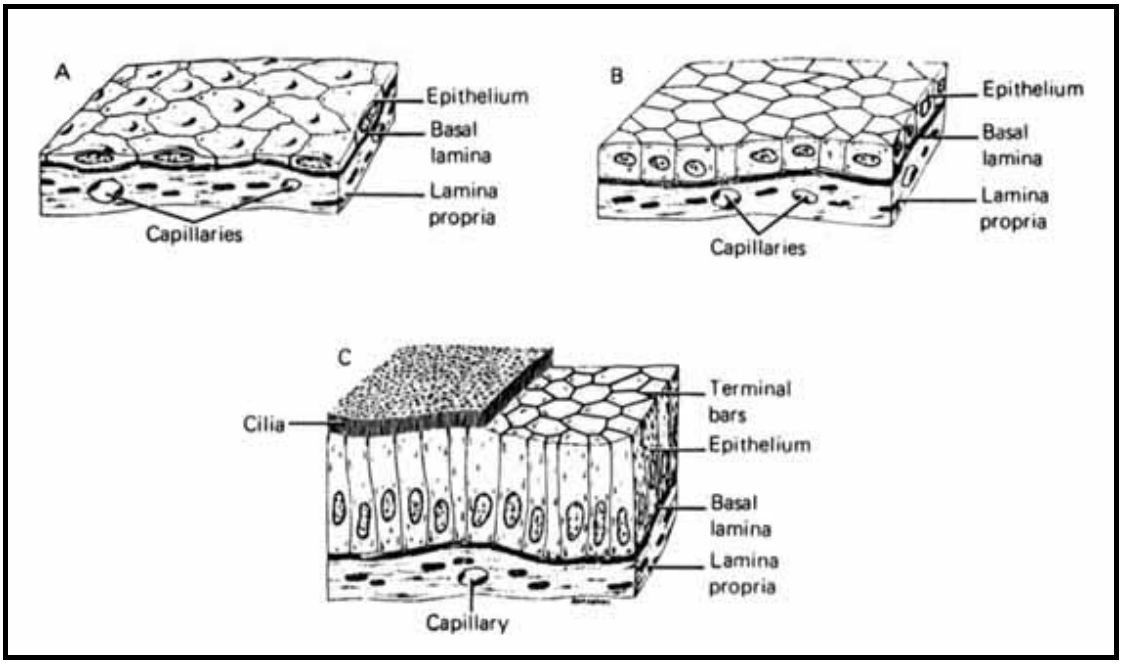

Figure 1: Epithelia. (Image source: http://www.kufm.kagoshima-u.ac.jp/~anatomy2/EPITH/EF01.jpg)

2.1 What is an *epithelium*?

[two marks]

2.2 Identify the forms of epithelium shown in Figure 1 and name one place in the human body where you would expect to find each form.

Label	Form of epithelium	Location in body
A		
B		
C		

[six marks]

2.3 Give ONE function of each of the three forms of epithelium represented in Figure 1.

A: _____

B: _____

C: _____

[three marks]

[Total: eleven marks]

3. Examine the diagram in Figure 2 and answer the questions that follow.

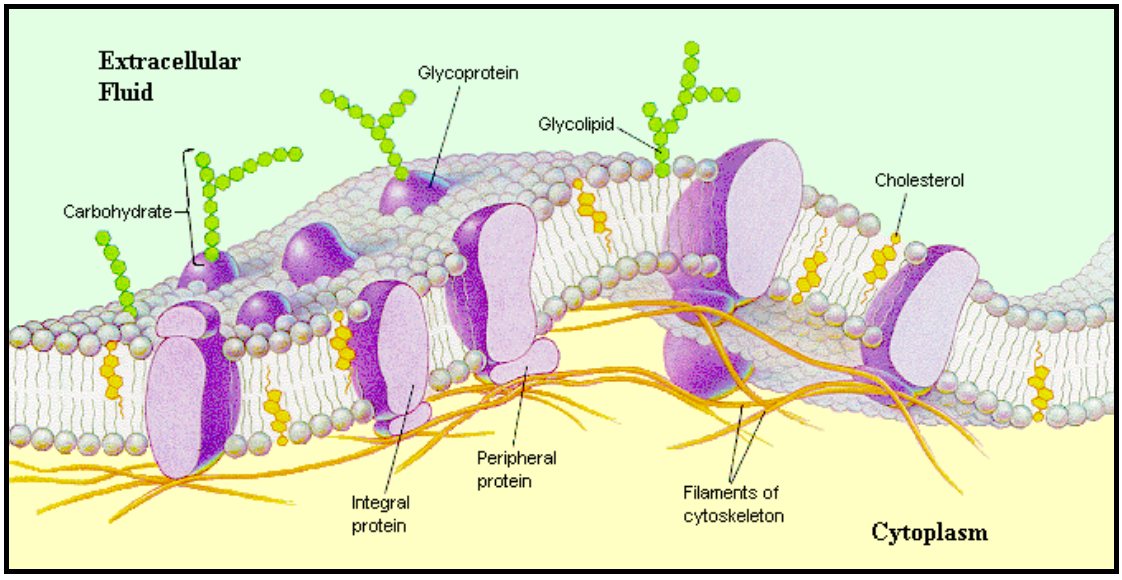

Figure 2: Fluid mosaic model of the cell membrane (from Chiras, *Human Biology*)

3.1 Briefly explain how the charge on phospholipid molecules is involved in the maintenance of membrane structure.

[two marks]

Describe the role of each of the following cellular components referred to in Figure 2:

3.2 Carbohydrate chains on the extracellular surface of the membrane;

[one mark]

3.3 Integral proteins within the membrane;

[one mark]

3.4 Cytoskeletal filaments in the cytoplasm.

[one mark]

[Total: five marks]

4. The diagram in Figure 3 is a representation of the human heart:

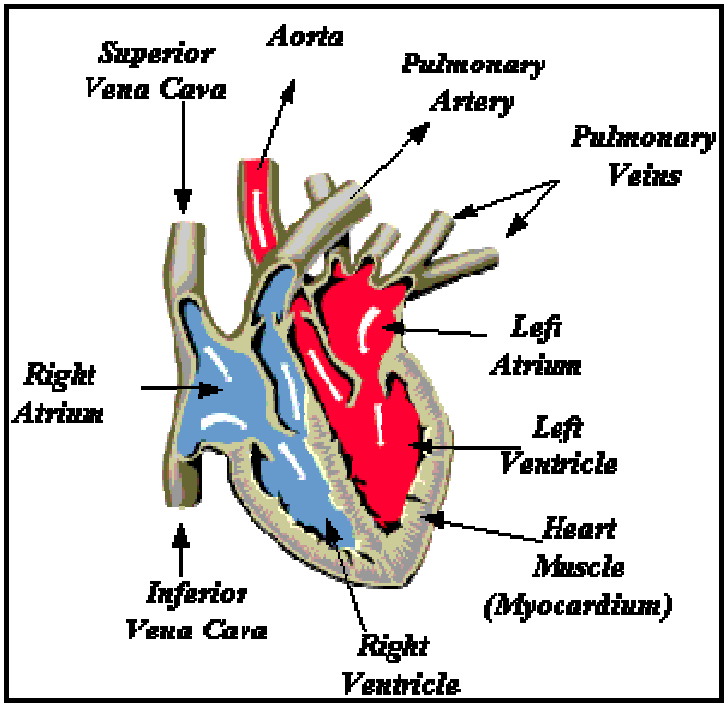

Figure 3: Human Heart. Image source: http://biology.about.com/library/graphics/cycle.gif

4.1 With reference to the diagram in Figure 3, outline, in point form, the sequence of events that occur during diastole and systole, the two main phases of the cardiac cycle.

Diastole:

Systole:

[eight marks]

Distinguish between each of the following pairs of circulation, giving one example of each:

4.2 Open circulation and closed circulation;

[three marks]

4.3 Single circulation and double circulation.

[three marks]

[Total: fourteen marks]

5. Explain the following statements:

5.1 Magnesium is an essential nutrient for most plants;

[two marks]

5.2 Many plants forming part of the undergrowth on the rainforest floor have very broad, dark-green leaves;

[two marks]

5.3 C4 plants are well adapted for survival in tropical regions;

[three marks]

5.4 CAM (Crassulacean Acid Metabolism) plants are well adapted for desert and semi-desert conditions;

_____

_____

_____

[three marks]

5.5 Photorespiration reduces the net productivity of a plant.

_____

_____

_____

[three marks]

[Total: thirteen marks]

6. The diagram in Figure 4 shows part of the spinal cord of a human in transverse section:

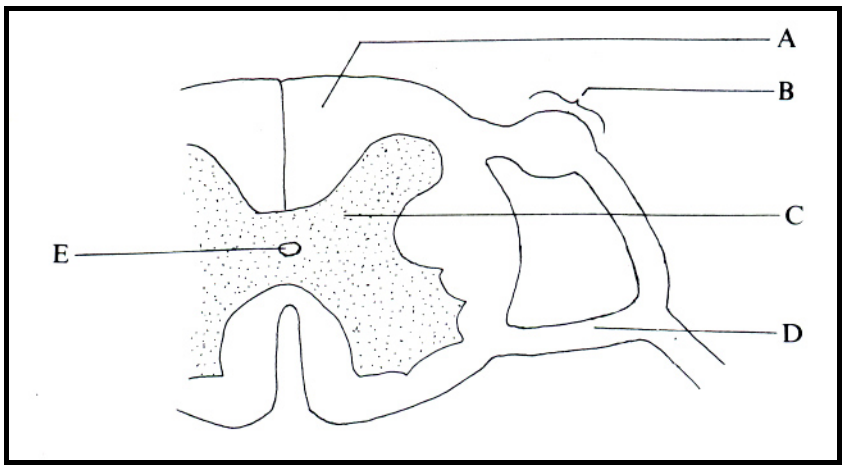

Figure 4: Part of spinal cord in transverse section

6.1 Identify the structures labelled A through D:

Label	Structure
A	
B	
C	
D	

[two marks]

Touching a hot surface would generally cause a person to contract their biceps, retracting the arm and hand away from the stimulus. This reflex action involves three neurones.

6.2 What is a *reflex action*?

_____

_____

[one mark]

6.3 Name the three types of neurones involved in a reflex action and indicate the approximate position of each on the diagram in Figure 4.

_____

_____

_____

[three marks]

6.4 State ONE function of the fluid found in structure E.

_____

[one mark]

[Total: seven marks]

7. The diagram in Figure 5 illustrates the life cycle of the Bracken Fern (*Pteridium aquilinum*). Labels A, B, C, D, E, e and F represent stages in the life cycle. Structure B is a fertile pinnule and Structure C is a section through a sorus.

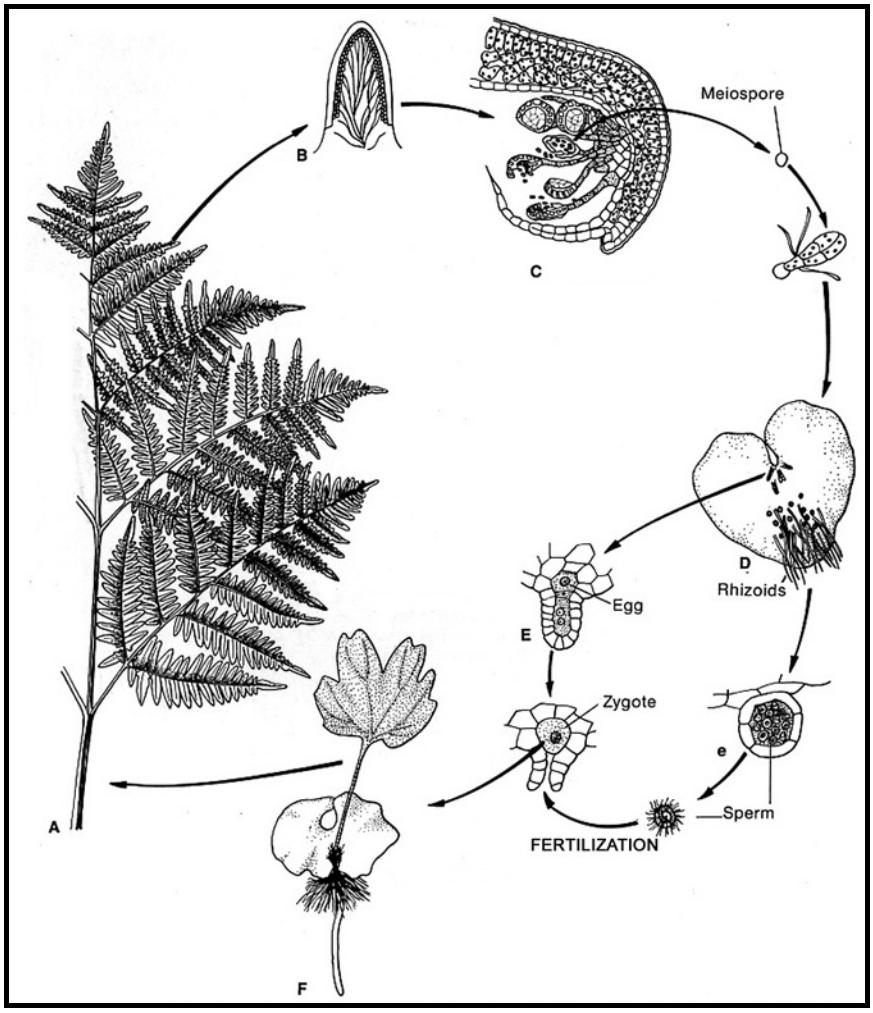

Figure 5: Life cycle of Bracken Fern *Pteridium aquilinum*
Image source: http://www.ualr.edu/~botany/fernlh.jpg

7.1 Identify the following structures shown in Figure 5:

Label	Structure
A	
D	
E	
e	

[four marks]

7.2 At which stage in this life-cycle would you expect meiosis to occur?

_____

_____

[two marks]

7.3 What is the meaning of the term "*alternation of generations*" in the context of this life-cycle?

_____

_____

[two marks]

7.4 State ONE difference between the life-cycle of a fern and that of a moss.

_____

_____

[one mark]

7.5 Ferns and mosses do not generally thrive in arid conditions, whilst many flowering plants can. Briefly explain why ferns and mosses are usually restricted to moist environments.

_____

_____

[two marks]

[Total: eleven marks]

8. Write brief notes on each of the following terms associated with genetics, giving an example of the phenotypic expression of each.

8.1 Multiple alleles;

_____

_____

_____

[two marks]

8.2 Epistasis;

_____

_____

_____

[two marks]

8.3 Polygenic inheritance;

_____

_____

_____

[two marks]

8.4 Sex linkage.

_____

_____

_____

[two marks]

[Total: eight marks]

9. One of the seminal events in the study of biological evolution was the publication of Charles Darwin's work titled "*On the Origin of Species by means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life*" in 1859.

9.1 What does "*Natural Selection*" mean in this context?

_____

_____

[one mark]

9.2 The statement that "evolution proceeds through survival of the fittest" is often disputed by scientists who argue that evolution may also be a matter of luck. Name ONE chance event that can alter the course of evolution on a global scale.

_____

[one mark]

What form of selection is occurring in the examples cited below? Support your answer with reasons.

9.3 The black form of Peppered Moth (*Biston betularia*) was favoured during the industrial revolution when soot began to blacken the trees and provide camouflage. The frequency of the dark allele increased from less than 1% to over 98% in just 50 generations. Since the 1950s, attempts to reduce industrial pollution in Britain have resulted in an increase in numbers of the light form.

[two marks]

9.4 Overuse/misuse of antibiotics has resulted in many resistant strains of bacteria.

[two marks]

9.5 African butterflies (*Pseudacraea eurytus*) range from orange to blue. Both the orange and blue forms mimic other foul tasting species so they are rarely eaten. Natural selection eliminates the intermediate forms because they do not look like the foul-tasting species.

[two marks]

9.6 Human birth weight averages about 3.2 kilograms. Very light or very heavy babies have lower chances of survival.

[two marks]

[Total: ten marks]

10. The graph in Figure 6 shows a generalised growth curve of a bacterial population in batch culture.

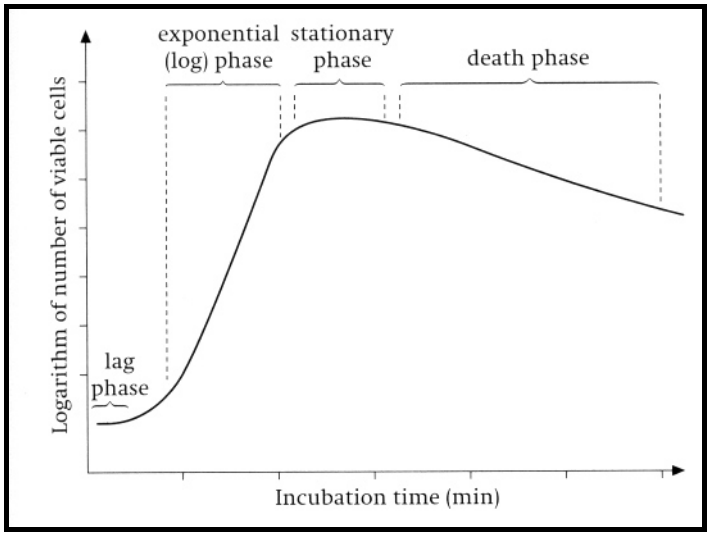

Figure 6: Growth curve of a bacterial population in batch culture
from: Lowrie & Wells (2000). Microbiology and Biotechnology. Cambridge University Press.

With reference to the graph in Figure 6, give a brief description of the population events occurring during each of the following phases:

10.1 Lag phase;

_____

_____

[one mark]

10.2 Exponential phase;

_____

_____

[one mark]

10.3 Stationary phase;

_____

_____

[one mark]

10.4 Death phase.

_____

_____

[one mark]

10.5 Briefly explain how batch culture techniques differ from continuous culture techniques.

[two marks]

10.6 List TWO advantages of growing micro-organisms in batch culture and TWO advantages of growing micro-organisms in continuous culture.

Batch culture:

Continuous culture:

[two marks]

10.7 In the space provided below, sketch the expected growth curve for a bacterial population grown in continuous culture.

[three marks]

[Total: eleven marks]