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

MATRICULATION CERTIFICATE EXAMINATION
ADVANCED LEVEL
SEPTEMBER 2006

SUBJECT:	BIOLOGY
PAPER NUMBER:	I
DATE:	4th September 2006
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	13	15	9	11	6	10	9	5	12	100

DO NOT WRITE IN THIS SPACE

Answer ALL questions.

1. The diagram in Figure 1 shows the pedigree of two families in which there are a number of albino individuals. Square symbols represent males and circles represent females. Solid (black) symbols represent affected individuals whilst clear (white) symbols represent unaffected individuals. Albinism is a condition in which melanin is not formed and is caused by homozygozity of a recessive allele.

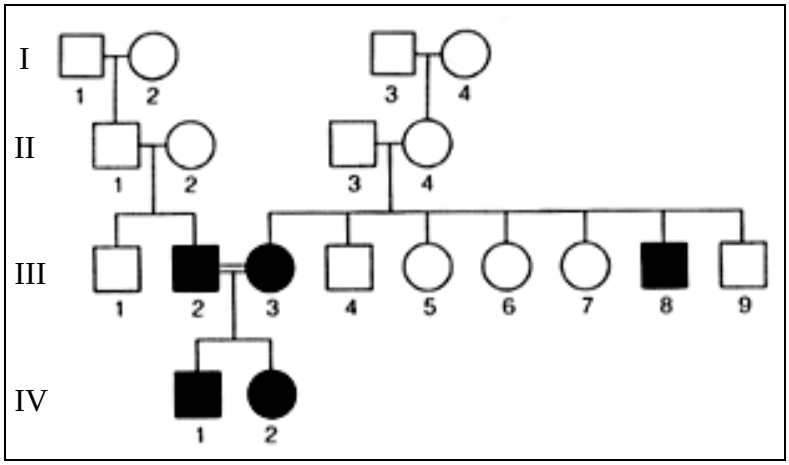

Figure 1: pedigree of two families with albinism

1.1 Give the genotypes of the following family members using the symbols **M** and **m** to represent the dominant and recessive alleles respectively of the gene controlling production of melanin.

Person	**Genotype**
Male IV_1	
Female III_3	
Male II_1	
Female II_2	
Male II_3	
Female II_4	

[six marks]

1.2 What is the probability of Male III_1 being a carrier for albinism? Show your reasoning.

_____

_____

[one mark]

DO NOT WRITE IN THIS SPACE

1.3 What are the possible genotypes of Male I_1 and Female I_2? Show your reasoning.

[two marks]

1.4 Is albinism a sex-linked trait? Explain your answer.

[one mark]

[Total: ten marks]

2. AAT (a-1-antitrypsin) is a human glycoprotein formed in the liver and found in blood. It is an inhibitor of protease enzymes such as trypsin and elastase. A rare mutation of the AAT gene inactivates AAT leading to uncontrolled activity of various proteases. One effect of this mutation appears in the lungs, where elastase digests the elastic tissue of the alveoli, causing emphysema. This condition can be treated by inhaling an aerosol spray containing AAT. The gene for AAT production as been characterised and cloned and AAT may now be produced by genetically-modified sheep.

2.1 What is a glycoprotein?

[one mark]

2.2 Why is it impractical for the pharmaceutical industry to extract AAT directly from human blood instead of using genetically-modified sheep?

[one mark]

2.3 Why does the glycoprotein structure of AAT make its production in bacteria problematic?

[one mark]

DO NOT WRITE IN THIS SPACE

2.4 Briefly outline the sequence of events through which AAT is produced in sheep.

[five marks]

2.5 During this process, the gene or AAT production is coupled to a promoter for the milk protein b-lactoglubulin. What is the purpose of this modification?

[two marks]

2.6 How is AAT harvested from genetically-modified sheep?

[one mark]

2.7 What further processing must AAT undergo after being collected from genetically-modified sheep?

[one mark]

2.8 Not all the sheep used in this process actually produce AAT. Why is this?

[one mark]

[Total: thirteen marks]

DO NOT WRITE IN THIS SPACE

3. The electron micrograph in Figure 2 shows a mitochondrion, an organelle that is involved in cellular respiration, where a 6-carbon sugar, such as glucose, enters the cell and is utilised to produce ATP. The processes concerned include glycolysis, Krebs' Cycle and the use of an electron transport chain.

Figure 2: mitochondrion

Source: http://www.a3243g.com/image_mitochondria.asp

3.1 Indicate, the site of the following processes on Figure 2 using the suggested labels:

(a) the site of glycolysis using the letter G;
(b) the site of Krebs' Cycle using the letter K;
(c) the site of the electron transport chain using the letter E.

[three marks]

3.2 How does glucose enter the cell from the surrounding tissue fluid?

_____

_____

[one mark]

3.3 Name ONE hormone that can regulate the entry of glucose into the cell.

_____

[one mark]

3.4 Why does glucose undergo phosphorylation upon entering a cell?

_____

_____

[two marks]

DO NOT WRITE IN THIS SPACE

3.5 Distinguish between substrate-level phosphorylation and oxidative phosphorylation.

[two marks]

3.6 What is the role of Nicotinamide Adenine Dinucleotide (NAD) in aerobic respiration?

[one mark]

3.7 Why would a lack of oxygen interrupt the process of aerobic respiration?

[one mark]

3.8 Briefly describe how a proton gradient is created across the inner mitochondrial membrane.

[two marks]

3.9 Briefly describe the role of the proton gradient in the production of ATP.

[two marks]

[Total: fifteen marks]

DO NOT WRITE IN THIS SPACE

4. This question concerns nervous transmission in the human body.

4.1 Briefly outline the principal differences between *sensory neurons*, *intermediate neurons* and *motor neurons*.

[three marks]

4.2 What is the advantage of transmitting nerve impulses along a path interrupted by several synapses rather than along a single, continuous axon?

[two marks]

4.3 What is the role of *acetylcholine* and *acetylcholinesterase* in nervous transmission?

[two marks]

4.4 Briefly describe the effect of amphetamines on nervous transmission.

[two marks]

[Total: nine marks]

DO NOT WRITE IN THIS SPACE

5. The diagram in Figure 3 shows a nephron from a kidney in the human body.

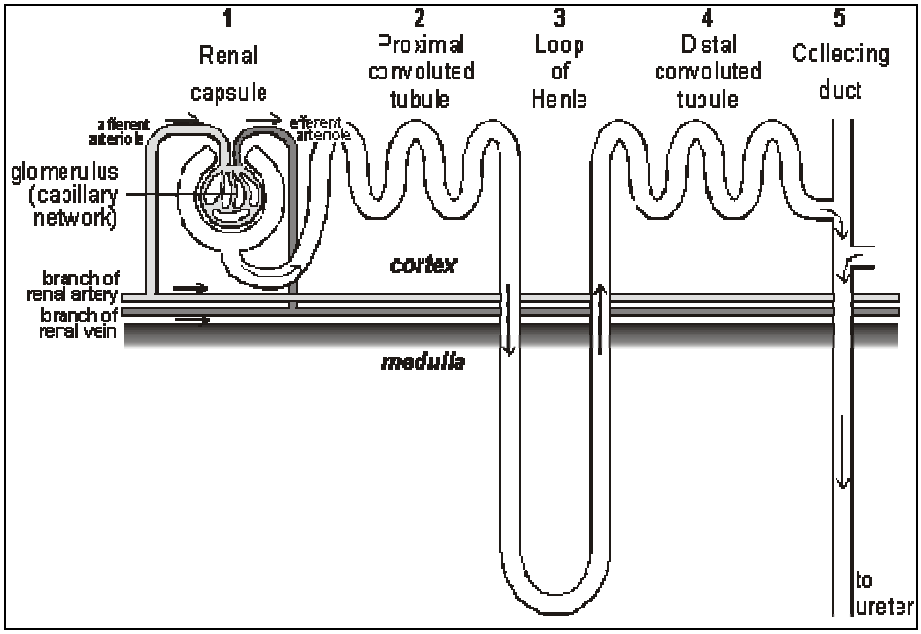

Figure 3: nephron from human kidney

(Source: http://www.biologymad.com)

Briefly describe the role of each of the following parts of a nephron in the formation of urine.

5.1 Renal capsule **(1)**.

_____

_____

[one mark]

5.2 Proximal convoluted tubule **(2)**.

_____

_____

[one mark]

5.3 Loop of Henle **(3)**.

_____

_____

[one mark]

DO NOT WRITE IN THIS SPACE

5.4 Distal convoluted tubule **(4)**.

[one mark]

5.5 Collecting duct **(5)**.

[one mark]

The urea cycle, also known as the ornithine cycle, is a sequence of biochemical reactions that produces urea from ammonia (NH_3).

5.6 Why is it necessary for humans to convert ammonia to urea?

[one mark]

5.7 Use the space below to outline the principal reactions of the ornithine cycle. Indicate the part of the cell where each reaction takes place.

[five marks]

[Total: eleven marks]

DO NOT WRITE IN THIS SPACE

6. Biological diversity refers to the variety of life in all its forms, levels and combinations and may be expressed at three levels: *species diversity*, *genetic diversity* and *ecosystem diversity*.

6.1 What is a *species*?

_____

_____

[one mark]

6.2 How do *genetic diversity* and *species diversity* differ?

_____

_____

_____

[two marks]

6.3 Classification schemes have traditionally been based on morphological characteristics of organisms. The application of genetic studies to evolutionary questions is now revising many fundamental notions of phylogeny (evolutionary relationships). Why is this so?

_____

_____

_____

_____

[three marks]

[Total: six marks]

DO NOT WRITE IN THIS SPACE

7. This question is concerned with a number of characteristics that are fundamental for classification systems.

7.1 What is a coelom?

_____

_____

[two marks]

7.2 What advantages does the presence of a coelom present to coelomate organisms?

_____

_____

[two marks]

Explain the following observations.

7.3 Cnidaria lack a coelom yet are not classified as acoelomates.

_____

_____

[two marks]

7.4 Triploblastic organisms are generally characterised by bilateral symmetry. However, echinoderms are triploblastic and radially symmetrical.

_____

_____

[two marks]

7.5 The evolution of a notochord provided chordates with a distinct advantage over animals with an exoskeleton.

_____

_____

[two marks]

[Total: ten marks]

DO NOT WRITE IN THIS SPACE

8. This question concerns the human heart and its associated circulatory system.

8.1 Give a brief description of the cardiac cycle.

[three marks]

8.2 Why does heart rate increase when a person is exercising?

[one mark]

8.3 How does the cardiovascular centre of the brain interact with the sino-atrial node to modify cardiac output?

[two marks]

Briefly explain the following observations.

8.4 Decreasing the *p*H of blood stimulates higher cardiac output.

[one mark]

8.5 Dehydration may be accompanied by an increase in heart rate.

[one mark]

DO NOT WRITE IN THIS SPACE

8.6 Lymph flows through the body even though the lymphatic system has no central pumping organ.

[one mark]

[Total: nine marks]

9. Cells are capable of synthesizing new proteins, which are essential for the modulation and maintenance of cellular activities.

9.1 Why are proteins "essential for the modulation and maintenance of cellular activities"?

[two marks]

Briefly outline the role of the following eukaryotic organelles in the synthesis and processing of proteins.

9.2 Ribosomes.

[one mark]

9.3 Rough endoplasmic reticulum.

[one mark]

9.4 Golgi apparatus.

[one mark]

[Total: five marks]

DO NOT WRITE IN THIS SPACE

10. Explain the following observations regarding cell organelles.

10.1 Peroxisomes contain oxidative enzymes.

[two marks]

10.2 The interior of a lysosome (*p*H 4.8) is more acidic than the surrounding cytosol (*p*H 7).

[two marks]

10.3 Mitochondria have a double membrane and their own set of DNA, distinct from that of the parent cell.

[two marks]

10.4 Red blood cells are eukaryotic yet do not possess a nucleus.

[two marks]

10.5 Cytoplasm occupies almost half the volume of most animal cells but a far lower proportion in most plant cells.

[two marks]

10.6 The nuclear envelope is perforated by numerous nuclear pores.

[two marks]

[Total: twelve marks]

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

MATRICULATION CERTIFICATE EXAMINATION
ADVANCED LEVEL
SEPTEMBER 2006

SUBJECT:	BIOLOGY
PAPER NUMBER:	II
DATE:	5th September 2006
TIME:	9.00 a.m. to 12.00 noon

Directions to Candidates

- *Answer ALL questions 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 (Answer **all** questions in this section):

1. Read the extract below carefully and afterward, from the information given and from your knowledge of biology, answer the questions that follow. The numerals in the left-hand margin are line numbers.

Mussels evolve quickly to defend against invasive crabs

Scientists at the University of New Hampshire (UNH) have found that invasive crab species may precipitate evolutionary change in blue mussels in as little as 15 years. The study, by UNH graduate student Aaren Freeman with associate professor of zoology James Byers and published in the Aug. 11 issue of the journal *Science*, indicates that such a response can evolve in an evolutionary nanosecond compared to the thousands of years previously assumed. "It's the blending of ecological and evolutionary time," says Freeman. "It's an important development in the arms race between these crabs and the mussels." Crabs prey on blue mussels by crushing their shells.

Freeman looked at the inducible defense – shell thickening – of blue mussels (*Mytilus edulis*) in the presence of two invasive crab species in New England: the Asian shore crab (*Hemigrapsus sanguineus*) and the green crab (*Carcinus maenas*). While *Carcinus* was introduced to New England from Europe between 150 and 200 years ago, *Hemigrapsus* is a relative newcomer, arriving from Asia to New Jersey in 1988. While previous research had established that mussels recognize *Carcinus*, it had not been determined whether they recognize *Hemigrapsus*. And, crucial to the design of Freeman's study, *Hemigrapsus* is not present north of mid-coast Maine.

"This set up a chance to look at populations that had been exposed to the predators for varying lengths of time," says Freeman. "We wanted to know, how is it that these mussels can recognize a crab that is historically not present in North America?"

Freeman exposed mussels native to the northern – above mid-coast Maine – and southern New England to both *Carcinus* and the *Hemigrapsus*. Both populations thickened their shells when exposed to waterborne cues of *Carcinus*, but only the southern mussels expressed inducible shell thickening in the presence of *Hemigrapsus*.

"The mussel's inducible response to *Hemigrapsus* reflects natural selection favoring the recognition of this novel predator through rapid evolution of cue specificity or thresholds," Freeman and Byers write.

Findings were consistent in two experiments over two years, one in a laboratory setting in Nahant, Mass., and one in the field at Woods Hole, Mass. "The consistency over two years and two sites really suggests an underlying robust mechanism," says Byers, who is Freeman's dissertation advisor.

While this sort of rapid evolutionary response to predators has been exhibited in some other species, all have been vertebrates. The blue mussel, which Freeman describes as the lab rat of marine biologists, is an invertebrate "that people assume is not very bright," he says. Yet his findings indicate that within the brief span of 15 years, it has evolved an inducible response to a new predator.

How do mussels evolve so quickly? In southern New England, the scientists say, mussels are prey to many crabs as well as other marine species. "When *Hemigrapsus* came along the mussels' wheels were well-greased to respond," says Byers. "That's our best guess."

Byers helps put the impact of the research in context. Because extensive data does not exist on invasive ecology, "there's a tendency to extrapolate any data you get on an invasive species. But here we show that the response from the prey differs over just a couple of hundred kilometers." Nonetheless, Shellfishers in Northern Maine and Canada are concerned that the arrival of *Hemigrapsus* in the ecosystem would have a disastrous effect on mussel populations and, therefore, on their own economic activities. "Although 15 years is fast to evolve better defences to your predator, it can be painfully long if you're a shellfisherman," Byers adds.

Adapted from: University of New Hampshire news release. 10th August 2006.
Source: http://www.eurekalert.org/pub_releases/2006-08/uonh-meq080706.php

1.1 In which phylum is *Mytilus edulis* classified (lines 10-11)? **[one mark]**

1.2 How may *Hemigrapsus*, an Asian species, have reached the eastern coast of North America (line 14)? **[one mark]**

1.3 What does the investigator mean by “evolutionary time” and “ecological time” (lines 6 -7)? **[two marks]**

1.4 Briefly describe the evolutionary mechanisms through which mussels would have evolved defences against predation by crabs. **[four marks]**

1.5 What form of natural selection is the mussel population undergoing? Explain your reasoning. **[three marks]**

1.6 ‘How do mussels evolve so quickly?.... "When *Hemigrapsus* came along the mussels' wheels were well-greased to respond," ’. What, in biological terms, does this statement mean (lines 38-40)? **[two marks]**

1.7 What characteristic of the mussels is actually undergoing rapid evolutionary change? **[two marks]**

1.8 Suggest why shellfishers are concerned about the arrival of *Hemigrapsus*. If their mussels have already been exposed to *Carcinus*, wouldn’t they already have thickened shells (lines 45-47)? **[one mark]**

1.9 How may the shellfishers reduce the economic damage caused by *Hemigrapsus* without waiting for evolutionary change to occur (lines 48-49)? **[two marks]**

1.10 Why are native North American crabs not considered invasive in this ecosystem? **[two marks]**

[Total: twenty marks]

2. Stomatal responses of the 'living fossil' *Ginkgo biloba* L. to changes in atmospheric CO_2 concentrations

(adapted from Beerling DJ, McElwain JC & CP Osborne (1998). Stomatal responses of the 'living fossil' *Ginkgo biloba* L. to changes in atmospheric CO_2 concentrations. Journal of Experimental Botany, **49** (326) pp 1603-1607)

Introduction

The gas exchange of leaves of terrestrial plants is regulated by short-term movements of the stomatal complexes in response to changes in the environment where the direct effects of atmospheric CO_2 on stomatal formation may also play a role in regulating the carbon and water balance of leaves. The effect of CO_2 on stomatal formation was researched through a three-year CO_2 enrichment experiment investigating the stomatal responses of the gymnosperm *Ginkgo biloba* L., an ancient taxon described by Darwin as a 'living fossil' and now widely planted as an ornamental species in municipal gardens.

Materials and methods

Sixteen saplings of *Gingko biloba* of uniform size and age were grown at either ambient (350ppm) or elevated CO_2 concentrations (560ppm) in four heated greenhouses, mean temperature 25°C, under natural irradiance throughout the experiment.

Each of the four greenhouses was divided into two, providing four replicated ambient and elevated CO_2 environments. Two saplings were grown in each treatment, giving eight replicates per CO_2 concentration. Treatment began in April 1995 and was continued for three years. Plants were well-watered throughout to avoid drought effects.

Stomatal density counts and calculation of stomatal indices were made at the end of this three-year period. Counts were made on acetate impressions of the lower surface of two mature leaves per plant from all eight plants (n=16 leaves per CO_2 treatment). Stomatal and epidermal cell densities were used to calculate stomatal index as [(stomatal density) / (stomatal density + epidermal cell density) x 100]. Ten such counts were made per leaf. Measurements of stomatal density were also made on leaf cuticles prepared from Upper Triassic and Lower Jurassic fossil leaves of *G.marginatus*, Middle Jurassic leaves of *G.huttonii* and Upper Triassic leaves of *G.troedssonii*.

Results

The results of the stomatal density and stomatal index measurements are shown in Figure 1 and Figure 2 respectively.

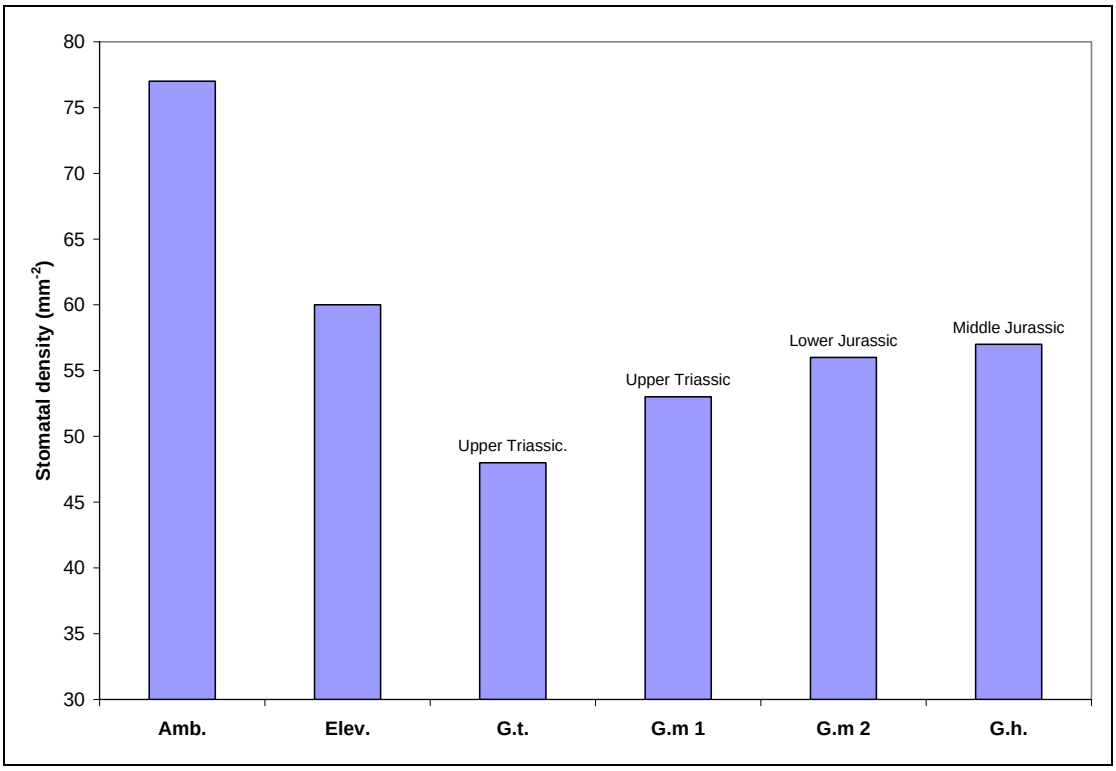

Figure 1: Stomatal densities of *Gingko biloba* leaves from ambient (Amb.) and elevated (Elev.) CO_2 concentrations and those measured from cuticles of fossils of *G.troedssonii*, *G.marginatus* and *G.huttonii*.

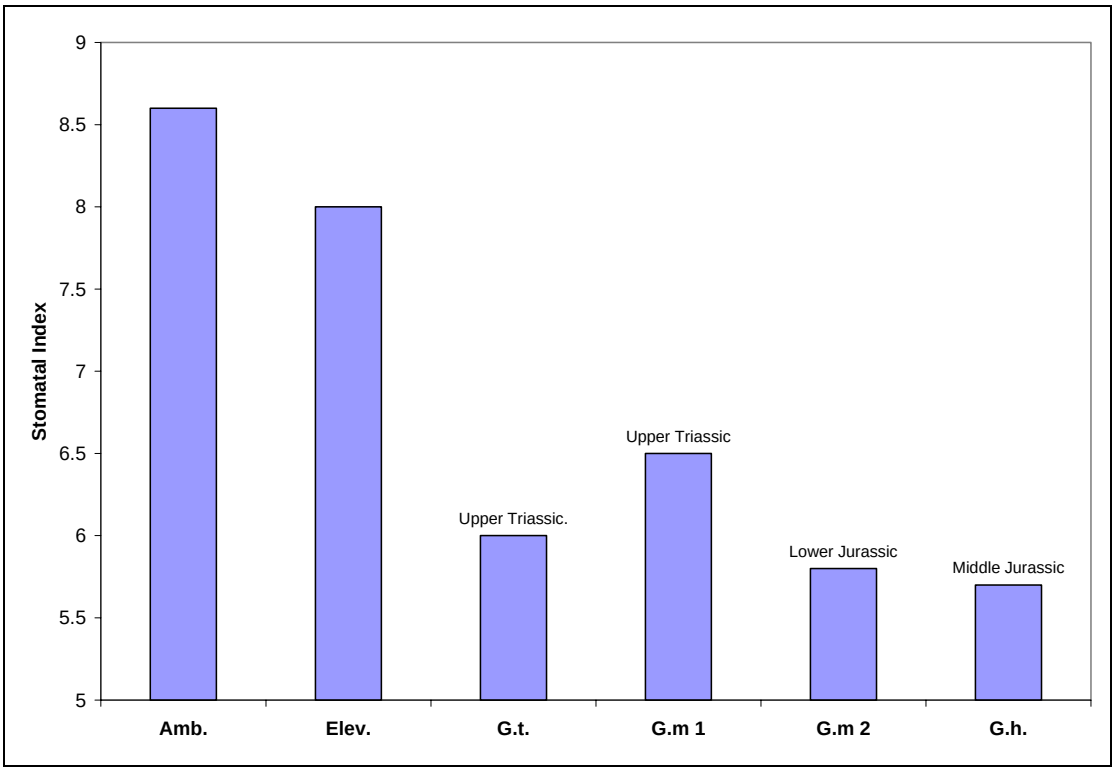

Figure 2: Stomatal indices of *Gingko biloba* leaves from ambient (Amb.) and elevated (Elev.) CO_2 concentrations and those measured from cuticles of fossils of *G.troedssonii*, *G.marginatus* and *G.huttonii*.

2.1 What general conclusions may be drawn from the results obtained?

[three marks]

2.2 Why were stomatal counts taken from the underside of the leaves?

[one mark]

2.3 What are stomatal density and stomatal index actually measuring?

[one mark]

2.4 Why did the experiment last as long as three years?

[two marks]

2.5 Suggest a biological basis for the difference in the stomatal densities and indices obtained from ambient and elevated CO_2 concentrations.

[three marks]

2.6 Explain why these results may be used as an indicator of climatic conditions.

[three marks]

2.7 What conclusions can you draw about climatic conditions during the Upper Triassic (approximately 206 million years ago), Lower Jurassic (approximately 200 million years ago) and Middle Jurassic (approximately 180 million years ago) periods of geological time?

[three marks]

2.8 The investigators carrying out the experiment are using results collected in a laboratory setting to derive conclusions of a more general nature about these plants. Is this justified? Explain your reasoning.

[two marks]

2.9 The investigators are comparing results obtained from leaves of *Gingko biloba* with fossil data from different species (*G.troedssonii*, *G.marginatus* and *G.huttonii*). Is this justifiable? Explain your reasoning.

[two marks]

[Total: twenty marks]

SECTION B

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

3. Describe how the ecological dynamics of plant communities may lead to the development of a climax community.

4. "Green algae and brown algae look like plants so they should be classified in the plant kingdom." Discuss.

5. Compare and contrast the circulatory systems of an insect and a fish.

6. Give an illustrated account of the life cycle of a named moss OR a named fern.

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

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

   7.1 Scientists searching for life on other planets would often look for signs of liquid water.

   7.2 The discovery of the amino acid glycine in interstellar space has been interpreted, by some scientists, as indicating that life is commonplace in the universe. Other scientists do not share this view.

   7.3 The temperature on the surface of Titan, Saturn's largest moon, is about minus 178°C. Most biologists consider this environment to be too cold for living organisms to survive in.

   7.4 Bacterial spores were recently isolated from water trapped in a billion-year-old salt crystal and the spores produced living bacteria.

   [five marks each]

   [Total: twenty marks]

8. Use your knowledge of biology to explain the following.

   8.1 Inadequate treatment of sewage may lead to high biological oxygen demand (BOD) in bodies of water.

   8.2 High concentrations of chlorofluorocarbons in Earth's stratosphere may promote higher rates of genetic mutation in organisms living on Earth's surface.

   8.3 Emission of sulphur oxides and nitrogen oxides from combustion of fossil fuels is leading to higher than average death rates of trees in forests.

   8.4 A study published in *New Phytologist* in 2002 suggests that emissions that cause global warming may also increase agricultural produce in some areas.

   [five marks each]

   [Total: twenty marks]

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

MATRICULATION CERTIFICATE EXAMINATION
ADVANCED LEVEL
SEPTEMBER 2006

SUBJECT:	BIOLOGY
PAPER NUMBER:	III
DATE:	6th September 2006
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.*
- *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. 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	20	15	15	50

DO NOT WRITE IN THIS SPACE

1. This diagram in **Figure 1** represents a transverse section through part of the human ileum as seen through low power magnification of a light microscope. The area enclosed by the black square has been viewed under high power magnification and is shown in **Figure 2**.

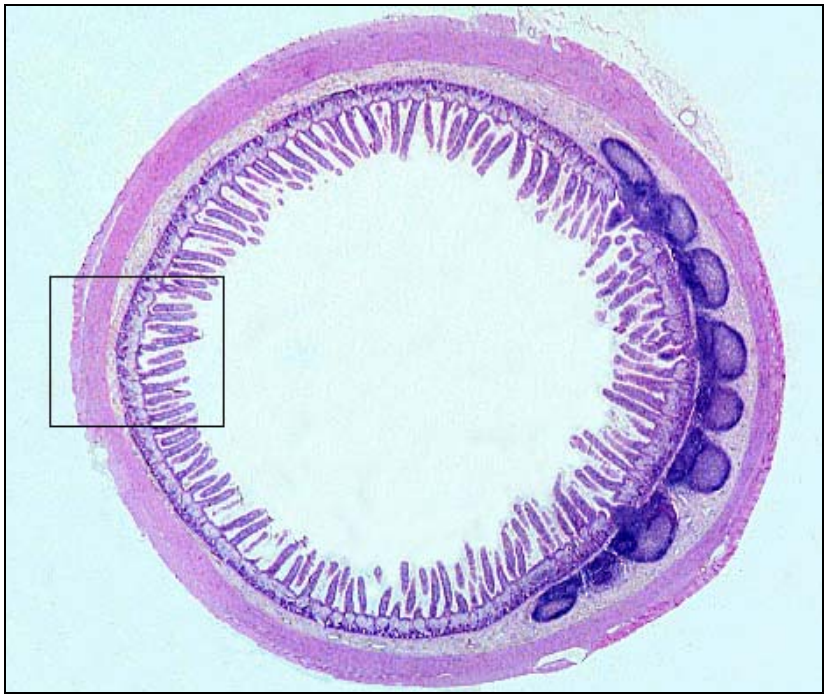

Figure 1: transverse section through human ileum

(Image source: http://www.bu.edu/histology/p/12001oca.htm)

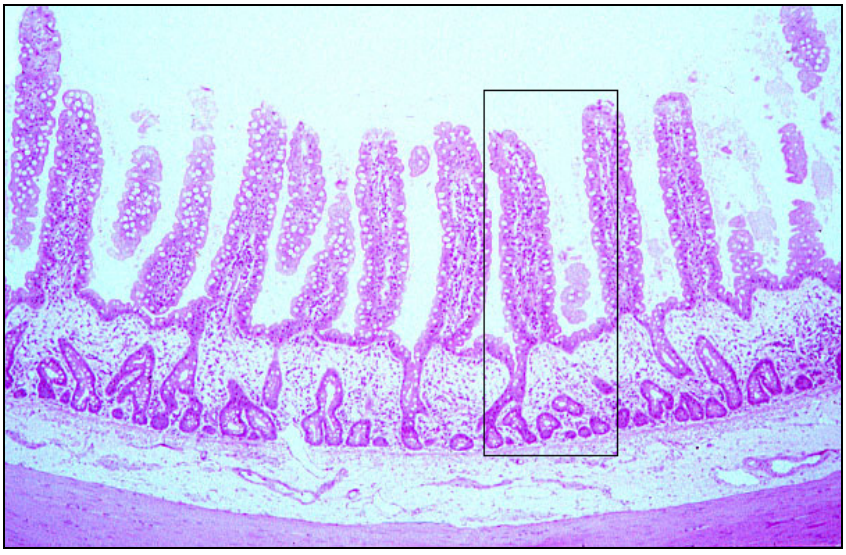

Figure 2: detail of ileum wall

(Image source: http://www.bu.edu/histology/p/12010ooa.htm)

DO NOT WRITE IN THIS SPACE

1.1 Draw an annotated map of the structure shown in **Figure 1**. Use the space provided in the box below for your drawing.

[ten marks]

DO NOT WRITE IN THIS SPACE

1.2 Draw an annotated diagram of the section enclosed by the black rectangle in **Figure 2**. Use the space provided in the box below for your drawing.

[ten marks]

[Total: twenty marks]

DO NOT WRITE IN THIS SPACE

2. The diagram in **Figure 3** shows a simple respirometer consisting of a specimen tube in which a number of soaked, germinating peas have been placed. The peas are suspended above the base of the tube by a gauze cage below which some pellets of Chemical A, have been placed. This chemical indirectly allows the investigator to monitor the uptake of oxygen by the peas. The specimen tube is sealed with a rubber stopper through which a length of glass tubing is inserted. A drop of oil is introduced into the glass tubing. The peas were treated with a disinfectant prior to the start of the experiment.

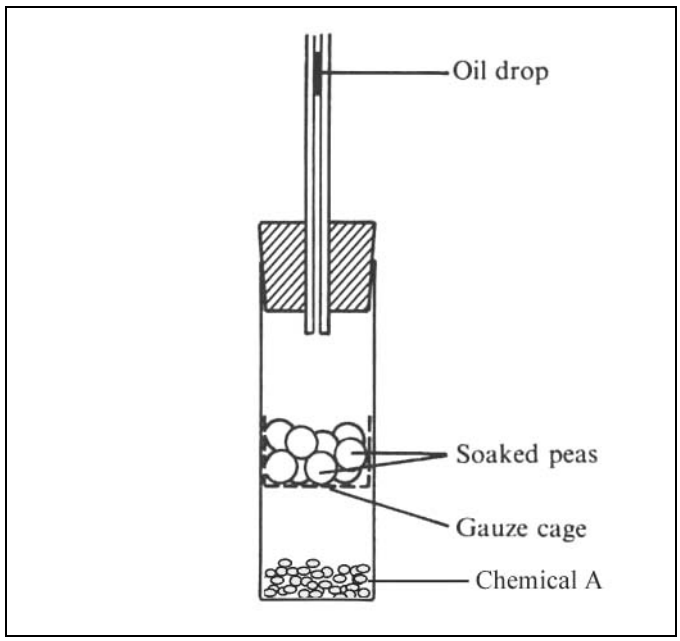

Figure 3: simple respirometer

2.1 What is a respirometer?

_____

_____

[one mark]

2.2 Why were the peas soaked in water before the start of the experiment?

_____

_____

[one mark]

2.3 What parameter is the respirometer actually measuring?

_____

[one mark]

DO NOT WRITE IN THIS SPACE

2.4 In which direction would the drop of oil be expected to travel? Give a reason for your answer.

[one mark]

2.5 What is the possible identity of Chemical A?

[one mark]

2.6 Simple respirometers such as this are sometimes inserted in a water bath. What advantage would this have?

[one mark]

2.7 Suggest ONE simple modification to this apparatus that would enable more accurate measurements to be made.

[two marks]

2.8 Why were the peas treated with disinfectant before the start of the experiment?

[two marks]

2.9 Suggest a suitable control for this experiment.

[one mark]

DO NOT WRITE IN THIS SPACE

2.10 List ONE precaution that should be taken at the start of the experiment.

_____

[one mark]

2.11 List ONE possible source of error that may be influencing the results obtained.

_____

[one mark]

2.12 How would you expect the results to differ if the experiment was carried out using a living leaf still attached to the parent plant, instead of soaked peas?

_____

_____

_____

[two marks]

[Total: fifteen marks]

DO NOT WRITE IN THIS SPACE

3. The diagram in **Figure 4** shows five crustacean larvae collected off the coast of Northern Chile. Organism **a** is a Mysis larva, **b** is a Nauplius larva, **c** is a Protozoea larva, **d** is a Zoea larva whilst **e** is a Megalopa larva.

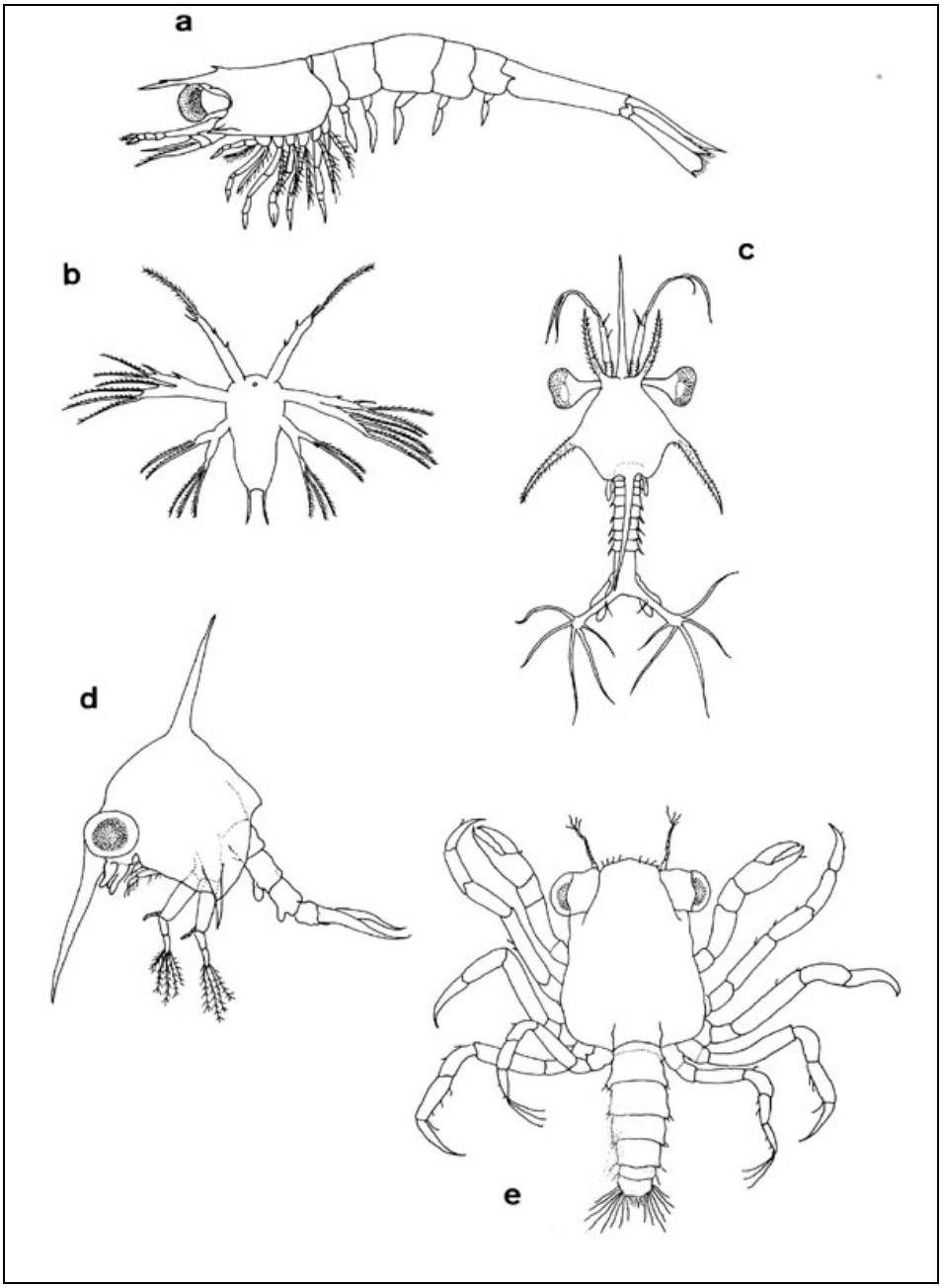

Figure 4: Types of decapod crustacean larval stages collected off northern Chile during El Niño 1982-83 event. a. Mysis, b. Nauplius, c. Protozoea, d. Zoea, e. Megalopa

(from: BAEZ, Pedro. Key to the families of decapod crustacean larvae collected off northern Chile during an El Niño event. *Investig. mar.*, 1997, vol.25, p.167-176.)

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3.1 What shared morphological features distinguish crustaceans from other animals?

[two marks]

3.2 Use features visible in the drawings in **Figure 4** to construct a dichotomous key that would enable you to distinguish these organisms from one another.

[ten marks]

3.3 What are the principal limitations of the key that you constructed in your answer to Question 3.2?

[three marks]

[Total: fifteen marks]

AM 05/IV.06S **INDEX NUMBER:_____**

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

UNIVERSITY OF MALTA, MSIDA

MATRICULATION CERTIFICATE EXAMINATION
ADVANCED LEVEL
SEPTEMBER 2006

SUBJECT:	BIOLOGY
PAPER NUMBER:	IV (Practical)
DATE:	2nd September 2006
TIME:	1 hour 30 minutes

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 this answer booklet. Drawings of biological material and graphical representations of data are to be made on the appropriate pages within 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	Total
Score				
Maximum	15	15	10	40

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1. You are provided with specimens **A**, **B**, **C** and **D**:

1.1 For each of specimens **A**, **B**, **C** and **D**, name **TWO** major taxonomic groups (any two from Kingdom, Phylum/Division and Class) within which the organism is classified. Write your answers in the table below:

	First major taxonomic group	Second major taxonomic group
Specimen **A**		
Specimen **B**		
Specimen **C**		
Specimen **D**		

[two marks]

1.2 For each of specimens **A**, **B**, **C** and **D**, list those structural features **visible in the specimen provided** which are diagnostic of the particular phylum or division to which it belongs.

Specimen **A**:

Specimen **B**:

Specimen **C**:

Specimen **D**:

[eight marks]

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1.3 Select any **TWO** specimens from **A, B** and **C** (do not use specimen **D** for this part of the exercise) and:

(a) Comment on the probable mode of life of the organisms you have selected as indicated by their visible structural adaptations.

[two marks]

(b) Compare and contrast the visible structural adaptations of the two organisms you have selected.

[two marks]

1.4 Write brief notes on the structural features visible in Specimen **D**.

[one mark]

[Total: fifteen marks]

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2. Yeasts are capable of utilising different sugars as substrates for respiration, each of which is fermented at a specific rate. In the following investigation, the rates at which a yeast, *Saccharomyces cerevisiae*, ferments various sugars shall be compared, using alkaline phenolphthalein as an indicator of progress of each reaction. This indicator changes from pink to colourless as the acidity of the sugar/yeast mixture increases.

You are provided with the following materials:
A suspension of yeast cells
Phenolphthalein indicator made alkaline with sodium hydroxide
A 2% solution of each of the following sugars:
Fructose (monosaccharide)
Glucose (monosaccharide)
Xylose (monosaccharide)
Maltose (disaccharide; glucose + glucose)
Sucrose (disaccharide; glucose + fructose)

Procedure:
(a) Label five test tubes with the names of the sugar solutions (fructose, glucose, xylose, maltose and sucrose). Use a different test tube for each solution.
(b) Introduce $5cm^3$ of each sugar solution into the appropriate test tubes.
(c) Add $2cm^3$ of indicator to each test tube.
(d) Add $2cm^3$ of yeast suspension to each test tube.
(e) Once the yeast suspension is added, stopper each tube as quickly as possible, shake the tube vigorously, transfer to a test-tube rack and leave standing at room temperature.
(f) Examine the tubes at regular intervals over a maximum period of one hour and record the time taken for the contents of each tube to become colourless.

2.1 Suggest a suitable null hypothesis for this investigation.

[one mark]

2.2 Tabulate your results in appropriate form. Use the spaces in the following pages for your tabulation.

[three marks]

2.3 Give a brief interpretation of the results obtained for each disaccharide investigated:

Maltose:

Sucrose:

[two marks]

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2.4 Give a brief interpretation of the results obtained for each monosaccharide investigated:

Fructose:

Glucose:

Xylose:

[three marks]

2.5 List ONE precaution that should be taken before starting the investigation.

[one mark]

2.6 List ONE source of error that may be influencing the results obtained.

[one mark]

2.7 Briefly describe an alternative experimental design that would be expected to give more reliable results.

[four marks]

[Total: fifteen marks]

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Title:

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Blank space to be used in conjunction with Question 2.

Title:

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3. Examine the biological material provided. Draw clear, carefully labelled and annotated figures to describe the structural features of the specimen you have been presented with. Use the space provided in the box below and in any of the blank spaces on the following pages for your drawings.

[Total: ten marks]

Title:

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Blank space to be used in conjunction with Question 3.

Title:

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