

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

**MATRICULATION CERTIFICATE EXAMINATION
ADVANCED LEVEL
SEPTEMBER (SUPPLEMENTARY) SESSION 2003**

Subject Title	BIOLOGY
Paper No./Title	Paper 1
Date	3rd September 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	12	9	6	9	10	14	5	18	10	7	100

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Answer ALL questions.

1. The graph in Figure 1 represents the growth of a population of bacteria on a nutrient medium.

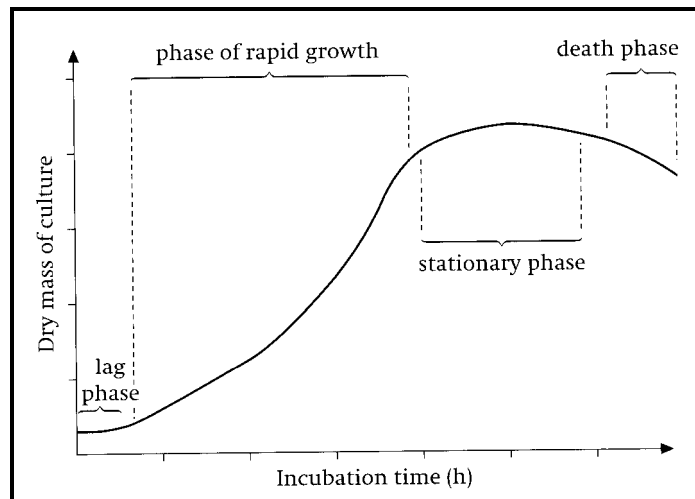


Figure 1

(from Lowrie, P. and S. Wells (2000). *Microbiology and Biotechnology*. Cambridge University Press)

Give a brief interpretation of each of the following phases of population growth:

- 1.1 Lag phase:

[two marks]

- 1.2 Rapid growth:

[two marks]

- 1.3 Stationary phase:

[two marks]

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Describe the expected effect of each of the following factors on bacterial growth:

1.4 Ambient temperature

[two marks]

1.5 *pH* of nutrient medium

[two marks]

1.6 Water potential of nutrient medium

[two marks]

[Total: twelve marks]

2. Two closely-related plants, A and B, have chromosome sets AA and BB respectively. When Plant A is crossed with Plant B a hybrid, possessing chromosome set AB, is produced. Such hybrids are sterile.

2.1 Why are the hybrid plants sterile?

[three marks]

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- 2.2 Fertile polyploid hybrids might develop from these sterile plants. Describe a sequence of events that would enable this to occur.

[three marks]

- 2.3 Given the results observed in these crosses, would you conclude that Plant A and Plant B belong to the same species or to different species? Justify your answer.

[three marks]

[Total: nine marks]

3. This question concerns transport of material in plants:

- 3.1 Fill in the blank spaces in the table below, stating which materials are transported in each tissue and identifying the source of energy for such movement:

Tissue	Materials transported	Source of energy
Xylem		
Phloem		

[two marks]

Define each of the following concepts concerned with uptake of water in plants:

- 3.2 Pressure potential:

[one mark]

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3.3 Solute potential:

[one mark]

3.4 The table below lists four factors that are known to affect transpiration rate in plants. Complete the table by stating whether each factor listed would be expected to increase or decrease rates of transpiration:

Factor	Effect on rate of transpiration
Increase in ambient temperature	
Decrease in wind speed	
Increase in relative atmospheric humidity	
Increased incidence of solar radiation	

[two marks]

[total: six marks]

4. This question concerns mammalian blood.

4.1 What is Haemoglobin (Hb)?

[two marks]

4.2 The concentration of oxygen carried by haemoglobin (Hb) varies with oxygen tension (pO_2) according to a well-defined pattern known as the Oxygen-Dissociation Curve (ODC). A number of comparative ODCs are represented in Figure 2, on the following page.

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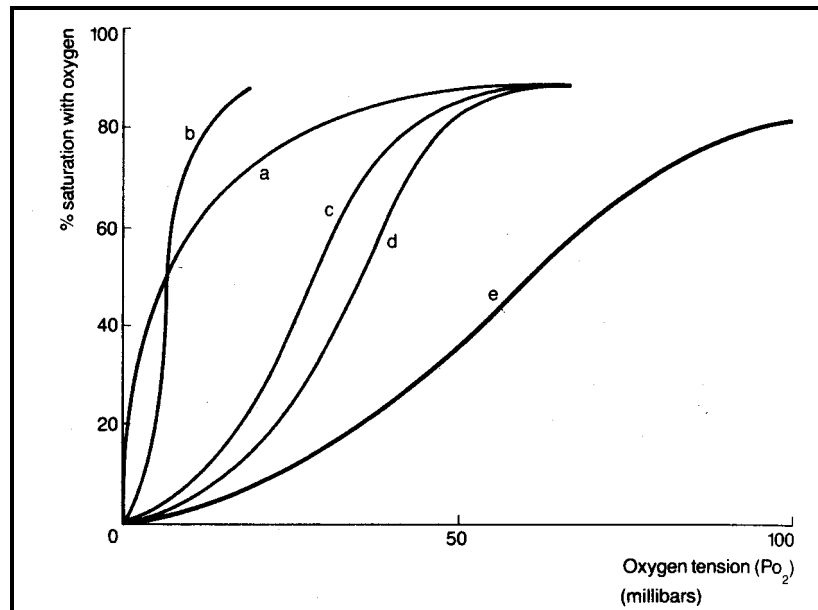


Figure 2: Oxygen dissociation curves for (a) Myoglobin, (b) Arenicola Hb, (c) human foetal Hb, (d) adult human Hb, (e) pigeon Hb.

From: Abercrombie, M., Hickman, M., Johnson, M.L. and M.Thain (1990). The New Penguin dictionary of Biology. Penguin Books.

The table below contains a number of statements about ODCs in general. State whether each is true or false by filling in the blanks spaces as indicated:

Statement	True/False
The ODC is generally S-shaped, rather than linear, because the properties of the Haemoglobin molecule vary with pO_2 .	
The amount of O_2 carried and released by haemoglobin depends not only on the pO_2 but also on pH .	
Myoglobin only gives up its oxygen at very low pO_2 .	
Foetal haemoglobin has a lower affinity for O_2 than adult haemoglobin.	
The higher the body temperature, the less saturated the blood is with O_2 .	

[five marks]

4.3 How does the ODC for Pigeon Hb (curve e) differ from the ODC for adult human Hb (curve d)?

[two marks]

[total: nine marks]

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5. The table below shows the results of an investigation into the flow and composition of fluids in a nephron from the human kidney. The positions of A, B, C and D are shown in Figure 3.

Position	Total flow rate ($\text{cm}^3 \text{min}^{-1}$)	Solute concentrations ($\text{g } 100 \text{cm}^{-3}$)		
		Protein	Glucose	Urea
A	1000	7.5	0.1	0.03
B	100	0.0	0.1	0.03
C	20	0.0	0.0	0.15
D	1	0.0	0.0	1.80

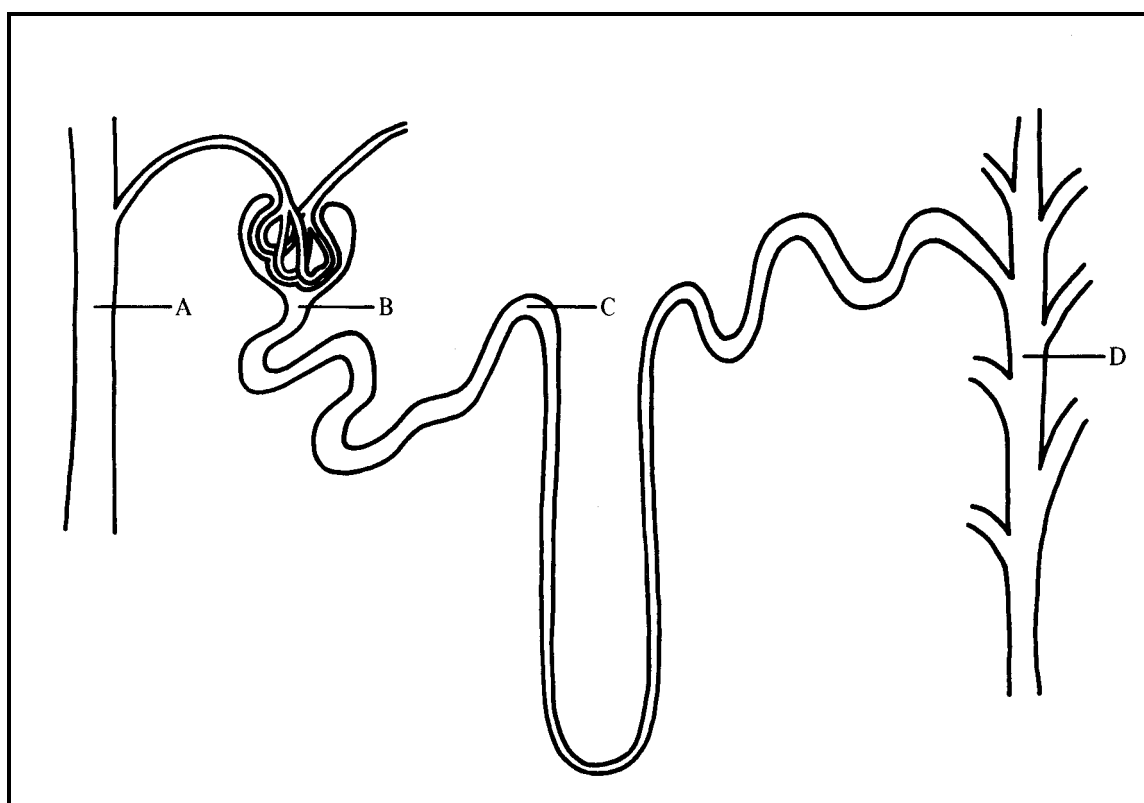


Figure 3: Nephron from human kidney

- 5.1 What is the broad function of the nephron?

[one mark]

- 5.2 Identify structures A and D

A: _____

D: _____

[one mark]

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Explain each of the following observations:

5.3 The difference in protein concentration between A and B.

[two marks]

5.4 The difference in glucose concentration between B and C.

[two marks]

5.5 The difference in urea concentration between B and C.

[two marks]

5.6 The difference in urea concentration between C and D.

[two marks]

[total: ten marks]

6. Write brief notes on each of the following:

6.1 ATP

[two marks]

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6.2 Creatine Phosphate

[two marks]

6.3 Coenzymes

[two marks]

6.4 Prosthetic groups

[two marks]

6.5 List THREE properties of water that are of importance to living organisms.

[three marks]

6.6 Why are most enzymes composed of protein?

[three marks]

[total: fourteen marks]

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7. Distinguish between each of the following components or processes of cells:

7.1 Cell wall and cell membrane:

[one mark]

7.2 Endoplasmic reticulum and Golgi apparatus:

[one mark]

7.3 Exocytosis and endocytosis:

[one mark]

7.4 Cytoskeleton and centrioles:

[one mark]

7.5 Nucleus and nuclear envelope:

[one mark]

[total: five marks]

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8. This question concerns the classification of living organisms.

8.1 Give ONE limitation of currently-used systems of classification.

[one mark]

8.2 Re-arrange the following classification categories in **ascending** order of taxonomic rank:
Order, Phylum, Class, Family, Phylum, Species, Kingdom, Genus

[two marks]

8.3 List ONE unique structural feature of each of the following Kingdoms:

Protoctista:

Monera:

Fungi:

Animalia:

Plantae:

[five marks]

8.4 Read the passage below and insert the appropriate terms in the blank spaces:

In deuterostomes, the _____ eventually forms the anus, whilst in _____, it eventually forms the _____. There are _____ classes of vertebrates, which are all distinguished from other animal sub-phyla in that they possess a well-developed _____. The development of _____ in mammals has allowed the suckling of young and a higher survival rate, whilst the development of a _____ in this same class has led to a much more efficient mode of respiration.

[seven marks]

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8.5 Identify the errors of biological nomenclature in each of the following names of species:

Cynomorium Coccineum:

cynomorium coccineum:

Cynomorium coccineum:

[three marks]

[Total: eighteen marks]

9. Write BRIEF notes on each of the following:

9.1 Cnidaria:

[two marks]

9.2 Platyhelminthes:

[two marks]

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9.3 Echinodermata:

[two marks]

9.4 Mollusca:

[two marks]

9.5 Arachnida:

[two marks]

[total: ten marks]

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10. This question concerns reproductive processes in living organisms.

10.1 What is asexual reproduction?

[one mark]

10.2 Distinguish between asexual reproduction and hermaphroditism.

[one mark]

10.3 List ONE form of asexual reproduction used by plants and ONE form used by animals.

[one mark]

10.4 List ONE advantage and ONE disadvantage of asexual reproduction when compared with sexual reproduction.

[two marks]

10.5 Why do small organisms generally reproduce asexually during periods of favourable environmental conditions?

[two marks]

[total: seven marks]