

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

**MATRICULATION CERTIFICATE EXAMINATION
ADVANCED LEVEL
MAY SESSION 2004**

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	10	8	10	8	12	8	12	15	12	5	100

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Answer ALL questions.

1. This question concerns cell division.

1.1 Complete the following table using the terms TRUE or FALSE to indicate whether each of the events listed occurs during mitosis, meiosis or during both.

	Mitosis	Meiosis
Homologous chromosomes pair up		
Formation of chiasmata		
No crossing-over		
Pairs of chromatids line up on the equator of the spindle		
Pairs of chromosomes line up on the equator of the spindle		
Centromeres divide		
Identical numbers of chromosomes in parent cells and daughter cells		
Only occurs during formation of gametes		

[eight marks]

1.2 Briefly outline the role of meiosis in evolution.

[two marks]

[Total: ten marks]

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2. Isolation of a population may be a significant factor in the acceleration of evolutionary change in organisms.

2.1 Distinguish between pre-zygotic and post-zygotic mechanisms of isolation.

[two marks]

State, giving reasons, whether each of the situations described below is a consequence of pre-zygotic isolation or of post-zygotic isolation:

2.2 The Maltese Pyramidal Orchid (*Anacamptis urvilleana*) and the Pyramidal Orchid (*Anacamptis pyramidalis*) occupy the same habitats, are structurally almost indistinguishable and yet have maintained their identities as separate species. *A.urvilleana* flowers in late winter whilst *A.pyramidalis* flowers in spring.

[two marks]

2.3 The horse (*Equus equus*) and the ass (*Equus hemionus*) are closely-related species that have maintained their identities as separate species with no apparent intermediate form. A cross between the two species produces a sterile mule.

[two marks]

2.4 Populations of elephants and hippopotami trapped on the Maltese Islands during the Pleistocene period of geological time developed into dwarf forms that were distinct from the parent population.

[two marks]

[Total: eight marks]

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3. The diagram below shows a simplified representation of the nitrogen cycle.

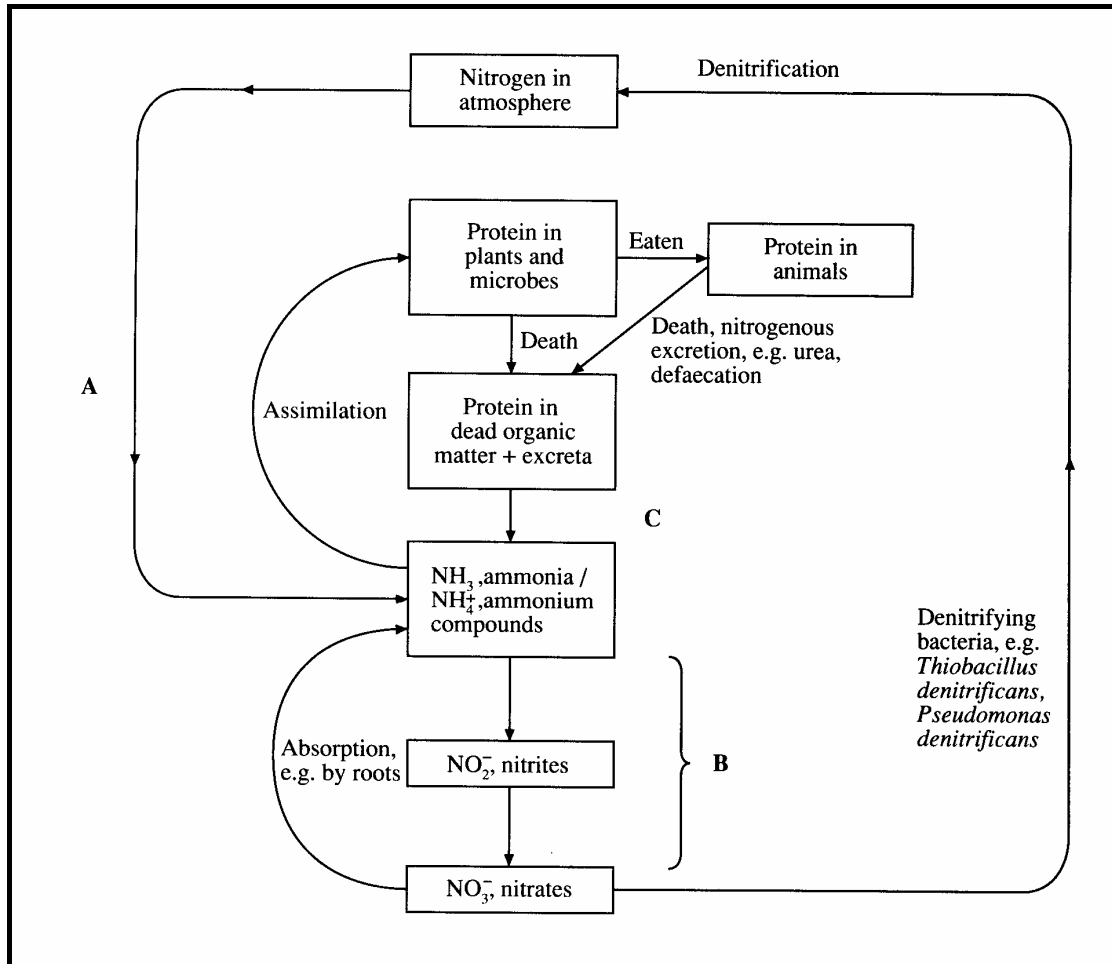


Figure 1: The Nitrogen Cycle. Adapted from Taylor, D.J., N.P.O. Green, G.W. Stout and R.Soper (1997). *Biological Science 1 & 2*. Third Edition. Cambridge University Press.

Give a **BRIEF** description of processes labelled A, B and C in Figure 1. Your answers should refer to any organisms that are involved in each process.

3.1 Process A:

[three marks]

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3.2 Process B:

[three marks]

3.3 Process C:

[three marks]

3.4 Atmospheric nitrogen may give rise to nitrate through a natural, non-biological process. What is this process called?

[one mark]

[Total: ten marks]

4. This question concerns the classification of living organisms.

4.1 What is a species?

[two marks]

4.2 Why is it desirable to have a system for classification of organisms?

[two marks]

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4.3 Describe **ONE** inherent shortcoming of any system of classification of organisms.

[two marks]

4.4 The Maltese Rock Centaury (*Palaeocyanus crassifolius*), the National Plant of Malta, was previously referred to as *Centaurea spathulata* whilst the Crown Daisy (*Glebionis coronaria*) was previously referred to as *Chrysanthemum coronarium*. Such changes in nomenclature are by no means uncommon. Suggest **ONE** reason as to why such changes are sometimes considered necessary.

[two marks]

[Total: eight marks]

5. This question concerns the reception of stimuli in animals.

5.1 What is a stimulus?

[one mark]

5.2 Reception of stimuli in animals generally involves localised sense organs. Such sense organs may be viewed as “energy transducers”. What is an energy transducer?

[one mark]

5.3 Give a BRIEF outline of the theory of trichromatic colour vision.

[four marks]

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The retina is the photoreceptive tissue in humans, comprising rods and cones as the sensory cells.

5.4 Distinguish between rods and cones.

[two marks]

Explain the significance of the following observations concerning the retina in humans:

5.5 The retina comprises approximately 150 million sensory cells, yet there are only approximately 1 million fibres in an optic nerve.

[two marks]

5.6 Less than 5% of the sensory cells in the retina are cones, yet most of these are concentrated in the fovea (1mm diameter) in the centre of the retina. Each cone is connected to a single sensory neurone in the optic nerve.

[two marks]

[Total: twelve marks]

6. Distinguish between each of the following:

6.1 Genetic diversity and species diversity.

[two marks]

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6.2 Bacteriophage and retrovirus.

[two marks]

6.3 Gastropods and bivalves.

[two marks]

6.4 Amphibians and Reptiles.

[two marks]

[Total: eight marks]

7. Write **brief** notes describing the significance of each of the following. Your answer should refer to at least one major group of organisms in which the structure or arrangement being described is present.

7.1 The pentadactyl limb.

[three marks]

7.2 Jointed appendages.

[three marks]

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7.3 Metameric segmentation.

[three marks]

7.4 Coelomate body plan.

[three marks]

[Total: twelve marks]

8. This question concerns proteins.

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

Proteins are made from amino acids and therefore always contain the elements carbon, _____, _____ and _____. Two amino acids, methionine and cysteine, also contain the element _____. Proteins are the most abundant organic molecules to be found in cells and constitute over 50% of their total dry mass. They are an essential component of the diet of animals and may be converted to both _____ and _____ by the cells. Amino acids combine through the formation of a _____ bond. This is formed when a water molecule is eliminated during the reaction between the amino group of one amino acid and the _____ group of another. Elimination of water is known as _____. Over 170 amino acids are known to occur in cells and tissues. Of these, only 20 are commonly found in proteins. Plants are able to synthesise all the amino acids they need from simpler substances. Animals, however, are incapable of synthesising all the amino acids that they need and must therefore obtain some ready-made amino acids from their diet. These are called _____ amino acids.

[ten marks]

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Proteins may, under certain conditions, become denatured.

8.2 What change has a protein undergone if it has been denatured?

[three marks]

8.3 List TWO agents that may cause denaturation of a protein:

[two marks]

[Total: fifteen marks]

9. The following question concerns the mammalian liver:

9.1 Distinguish between hepatocytes and liver lobules.

[two marks]

Give a **brief** description of the role of the liver in each of the following:

9.2 Metabolism of protein.

[four marks]

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9.3 Metabolism of fat.

[four marks]

9.4 The hepatic portal vein is the only blood vessel in the human body within which the blood has a highly variable sugar content. Suggest an explanation for this.

[two marks]

[Total: twelve marks]

10. The broad dietary preferences of vertebrates may be inferred by observing their dentition.

10.1 Why should different dietary preferences necessitate specialist dentition?

[two marks]

10.2 List two differences between the dentition of a generalised herbivore and that of a generalised carnivore.

[two marks]

10.3 Name ONE adaptation, characteristic of some herbivores, that is not concerned with specialist dentition.

[one mark]

[Total: five marks]