AM 05/III. 06m **INDEX NUMBER:_____**

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

MATRICULATION CERTIFICATE EXAMINATION
ADVANCED LEVEL
MAY 2006

SUBJECT:	BIOLOGY
PAPER NUMBER:	III
DATE:	25th May 2006
TIME:	4.00 p.m. to 5.30 p.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

ADVANCED BIOLOGY III

1. A student is provided with three unidentified carbohydrates labelled **A**, **B** and **C** selected from the list in Table 1. All three carbohydrates have been ground to a fine powder. The student is also provided with the reagents listed in Table 2.

Table 1: Some common carbohydrates

Type of carbohydrate	Examples	Reducing/non-reducing	Solubility in water
Monosaccharide	Glucose	Reducing	Soluble
Monosaccharide	Fructose	Reducing	Soluble
Monosaccharide	Xylose	Reducing	Soluble
Disaccharide	Sucrose	Non-reducing	Soluble
Disaccharide	Maltose	Reducing	Soluble
Oligosaccharide	Starch	Non-reducing	Insoluble
Oligosaccharide	Glycogen	Non-reducing	Insoluble
Oligosaccharide	Cellulose	Non-reducing	Insoluble

Table 2: Reagents used to test for carbohydrates

Reagent	Reaction
Barfoed's	After boiling, rapid formation of a red-brown precipitate with all reducing monosaccharides. The reaction with reducing disaccharides is much slower.
Benedict's	After boiling, rapid formation of a red-brown precipitate with all reducing sugars.
Bial's	After boiling, a green coloration with Xylose.
Clinistix	Colour change from Pink to Blue with glucose only.
Iodine	Causes a colour change to blue-black with starch, purple-red with glycogen and no reaction with cellulose.
Schultze's	Purple coloration with cellulose.
Seliwanoff's	After boiling, a red coloration with fructose and sucrose.

1.1 Suggest why the unknown carbohydrates were ground to a fine powder before the investigation started.

_____

_____

[two marks]

1.2 Devise a logical, step-by-step scheme that the student could follow to identify an unknown carbohydrate from the list in Table 1. Your scheme should lead, through appropriate tests and recording of positive or negative results, to each of the carbohydrates listed in Table 1. Use the space provided in the box on the following page to devise your scheme.

[ten marks]

1.3 Carbohydrates **A**, **B** and **C** were observed to react as follows:

Table 3: Reactions for Carbohydrates A, B and C

Carbohydrate	Reactions
Carbohydrate **A**	• Insoluble in water • Turned blue-black with addition of Iodine
Carbohydrate **B**	• Soluble in water • Rapid formation of a red-brown precipitate when boiled with Benedict's Solution • Very slow development of a red-brown precipitate when boiled with Barfoed's Reagent
Carbohydrate **C**	• Soluble in water • Rapid formation of a red-brown precipitate when boiled with Benedict's Solution • Rapid formation of a red-brown precipitate when boiled with Barfoed's Reagent • No colour change with Clinistix • No colour change when boiled with Bial's Reagent • Red coloration when boiled with Seliwanoff's Reagent

1.4 Use the scheme you have devised and the data given in Table 3 to identify carbohydrates **A**, **B** and **C**.

Carbohydrate **A**: _____

Carbohydrate **B**: _____

Carbohydrate **C**: _____

[six marks]

1.5 Suggest ONE possible source of error that may be influencing the results obtained.

_____

_____

[two marks]

[Total: twenty marks]

ADVANCED BIOLOGY III

2. A researcher is provided with onion bulbs (*Allium cepa*) which are sprouting following dormancy (Figure 1). She intends to use these bulbs to study mitosis in onion cells.

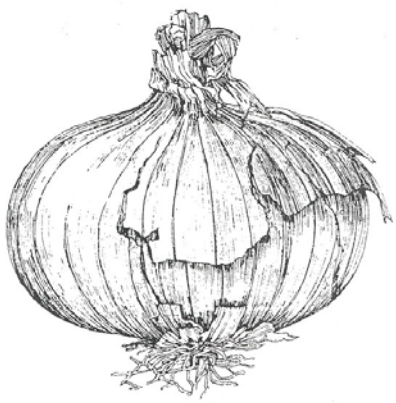

Figure 1: Exterior of *Allium cepa* bulb

Image source: http://www.exportersindia.com/dynamic-files/bc-full/80053/1000600.jpg

2.1 Describe how the researcher could use this bulb to prepare a microscope slide showing cells undergoing mitosis. Your description should refer to the following:

(a) the parts of the bulb which are suitable for this purpose;
(b) details of specimen preparation;
(c) details of any stains and staining procedures that may be required.

[twelve marks]

In a variant of this procedure, the researcher applies Colchicine, an alkaloid obtained from Autumn Crocus (*Colchicum autumnale*) to the relevant parts of the onion bulb. Colchicine inhibits spindle formation in cells during mitosis and is used to halt mitosis at metaphase.

2.2 Suggest a possible advantage of the application of Colchicine to the onion cells.

_____

_____

[three marks]

[Total: fifteen marks]

3. A scientist observes that the breadth of the inflorescence of Wild Carrot (*Daucus* spp.) in the Maltese Islands tends to be larger in plants close to cliff edges and smaller in plants that are colonising habitats further inland. She decides to test this observation by collecting data regarding inflorescence breadth from a number of plants in both habitats. The data collected are recorded in Table 4 below:

Table 4: Breadth of Inflorescence (cm) of *Daucus* spp. from cliff edges and inland habitats

Plants from Cliff edges	Plants from Inland habitats
11.3	7.6
12.8	5.2
10.1	9.0
12.0	10.0
8.4	11.3
9.8	7.5
10.6	9.0
12.4	8.4
13.4	9.2
8.1	9.1

3.1 Suggest a suitable null hypothesis for this investigation.

_____

[two marks]

3.2 Calculate the mean inflorescence breadth for plants from both habitats.

Cliff edges: _____

Inland habitats: _____

[two marks]

The scientist intends to test whether the difference in the arithmetic mean of the two samples is statistically significant. She first considers using a Matched Samples *t*-test but later concludes that it would be unsuitable for this purpose.

3.3 Why would a Matched Samples *t*-test not be suitable for this particular data set?

[three marks]

3.4 Suggest, giving reasons, a valid statistical test that the scientist could use to test her hypothesis.

[three marks]

The scientist now intends to test whether the breadth of the inflorescence is directly related to distance from the coast.

3.5 What additional data would she need to collect?

[one mark]

3.6 Suggest a method through which the scientist could analyse her data to determine whether breadth of inflorescence is directly related to distance from the coast.

[four marks]

[Total: fifteen marks]