Candidate Name	Centre Number	Candidate Number
		2

General Certificate of Education
Advanced

316/01

BIOLOGY PRACTICAL – BI6
SPRING AND SUMMER 2008

For examiner's use	
1	
2	
3	
Total	

INSTRUCTIONS TO CANDIDATES

Write your name, centre number and candidate number in the spaces provided above.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the necessity for good English and orderly presentation in your answers.

You are reminded that this is a record of your own work and that no certificate will be awarded to a candidate detected in any unfair practice.

Recommended maximum times:

Question 1 45 minutes

Question 2 1hr 15 minutes implementation, 45 minutes analysis

Question 3 60 minutes

Question 1: Planning. This is a planning exercise only. There is no need to carry out the investigation.

Investigation:

Bacterial growth is dependent on a number of factors, including temperature. Storage at different temperatures therefore influences the viable count of bacteria found in yoghurt.

Design an experiment that will show that storage temperature of yoghurt influences bacterial growth.

(a) Give a prediction for this investigation. [1]

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(b) Explain your prediction using biological principles. [3]

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(c) After the incubation of yoghurt there are two distinct stages to this investigation, one being the serial dilution of the yoghurt and the second being the plating of the serially diluted samples. Give the apparatus required for the:

(i) serial dilution stage; [1]

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(ii) plating of samples. [1]

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(d) (i) Why is the method of serial dilution employed in this situation? [1]

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(ii) Using labelled diagrams, illustrate the process of serial dilution. [3]

(e) Identify the key variables under the following headings:

(i) Independent variable, including range. [1]

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(ii) Dependent variable. [1]

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(iii) List **two** variables, which must be kept constant throughout the experiment. [1]

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(f) (i) When conducting this experiment it would be necessary to employ aseptic techniques. Why is this necessary? [1]

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(ii) Briefly describe **two** of the aseptic techniques that should be used. [2]

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(g) The agar plates are incubated at 25°C, what risk does this minimise? [1]

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(h) Give an account of the steps involved in your investigation. It is essential that your method would be repeatable by another person. Do not include **details** for serial dilution steps. [8+1]

Examiner only

(Total 26 marks)

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Turn over.

Question 2: Analysis and Evaluation

Different antibiotics have differing success when controlling microbial growth. Two antibiotics, A and B, have been tested on the same microbe, *Micrococcus luteus*, and the agar plates provided show clear zones where no bacterial growth has occurred. There are 15 discs for each of the antibiotics tested.

(a) For each of the antibiotics measure the diameter of the clear zone produced by each disc. Record your results in a suitable table below. (If the clear zone is not circular measure it at its widest point.) [2]

(b) Formulate a null hypothesis. [2]

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(c) Calculate the standard deviation for the clear zones recorded in each sample using the following formula and table to help you. [2]

$$s = \sqrt{\frac{\sum(x - \bar{x})^2}{n - 1}}$$

Where x = clear zone size
$\bar{x}$ = mean clear zone size
n = number of repeats
$\sum$ = sum

Antibiotic A	Diameter (mm)	Deviation from the mean $(x - \bar{x})$	Deviation squared $(x - \bar{x})^2$
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
Mean			$\sum$ =
Antibiotic B			
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
Mean			$\sum$ =

Standard deviation (s_1) for Antibiotic A = ☐

Standard deviation (s_2) for Antibiotic B = ☐

(d) Substitute your results into the formula below and calculate the value of t. [3]

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1 - 1} + \frac{s_2^2}{n_2 - 1}}}$$

$\bar{x}_1$ = mean diameter for antibiotic A
$\bar{x}_2$ = mean diameter for antibiotic B
s_1 = standard deviation Antibiotic A
s_2 = standard deviation Antibiotic B
n_1 = number of readings Antibiotic A
n_2 = number of readings Antibiotic B

(e) (i) How many degrees of freedom are there? [1]

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Using the table provided:

t-distribution						
p =		**0.25**	**0.1**	**0.05**	**0.01**	**0.001**
v =	**1**	2.41	6.31	12.71	63.66	636.6
	2	1.6	2.92	4.3	9.92	31.6
	5	1.3	2.02	2.57	4.03	6.87
	10	1.22	1.81	2.23	3.17	4.59
	14	1.20	1.75	2.13	2.95	4.07
	24	1.18	1.71	2.06	2.8	3.75
	28	1.17	1.70	2.04	2.75	3.65

(ii) What level of probability are you going to select from the **t**-table? [1]

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(iii) Find the critical value for **t**. [1]

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(f) Do you accept or reject your null hypothesis? Describe how you came to this decision. [1]

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(g) Suggest **two** possible sources of error, suggesting in **each** case how you would overcome them. [4]

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(h) Bacteria can be classified into two distinct groups according to their reaction to the Gram stain.

(i) Which type of Gram stained bacteria is more likely to be resistant to some antibiotics? [1]

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(ii) Describe the structure of the cell wall of the Gram stained bacteria named in part (i). [2]

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(iii) What colour would you expect from Gram staining *Micrococcus luteus*? [1]

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(iv) Describe the difference between *bacteriostatic* and *bactericidal* antibiotics. [2]

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(Total 23 marks)

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Question 3: Observation and microscopy.

The following are provided for you:-
Microscope, eyepiece graticule, micrometer and a slide of T.S. primary root dicotyledon.

(a) Produce an outline **low** power plan drawing of the specimen supplied. Label the completed drawing. [5]

(b) Calibrate the microscope using the **high** power objective. Show your workings. [3]

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(c) Draw **three** adjacent xylem vessels under high power. [2]

(d) Measure the width of these three xylem vessels in eyepiece units and then calculate the mean. [1]

Xylem vessel 1 = ...

Xylem vessel 2 = ...

Xylem vessel 3 = ...

Mean width xylem vessel = ...

(e) Using your calibration, calculate the mean actual width of the xylem vessels. [2]

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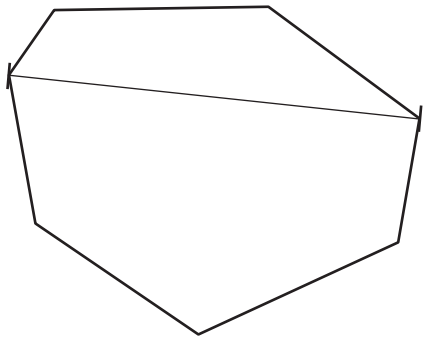
(f) Below is a drawing produced by Gwenllian of a sieve tube cell, which has a diameter of **22 eyepiece units**. Assuming that Gwenllian's microscope calibration is the same as yours, calculate the magnification of the drawing. [2]



Actual width of sieve tube cell = ...

Width of sieve tube cell from drawing = ...

Magnification =

.....

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(Total 15 marks)