UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
Cambridge International Level 3 Pre-U Certificate
Principal Subject

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

1349304685

BIOLOGY **9790/04**

Paper 4 Practical **May/June 2011**

2 hours 30 minutes

Candidates answer on the Question Paper.

Additional Materials: As listed on the Confidential Instructions.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use a soft pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A
Answer **both** questions.
Write your answers in the spaces provided on the Question Paper.
You will be given only 35 minutes for each question.

Section B
Answer **all** questions.
Write your answers in the spaces provided on the Question Paper.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
1	
2	
3	
4	
5	
Total	

This document consists of **21** printed pages and **3** blank pages.

DC (CW/JG) 42909/2

UNIVERSITY *of* CAMBRIDGE
International Examinations

[Turn over

BLANK PAGE

Section A

Answer **all** the questions in the spaces provided.

1 You are reminded that you should allow **35 minutes** for question 1.
You should read through the whole of this question carefully and then plan your use of the time to make sure that you finish all the work that you would like to do.

You are to investigate the production of glucose from lactose in milk by immobilised lactase.

Lactase catalyses the hydrolysis of the glycosidic bond in lactose.

You are provided with beads of immobilised lactase. Two 10 cm^3 syringes have been set up with beads of immobilised lactase already added, as in Fig. 1.1. A third empty syringe barrel is available to use as follows:

1 Use the spatula to transfer beads to the syringe barrel that has been prepared for you.

2 Make sure that the clips on the plastic tubing are closed tightly before starting the investigation.

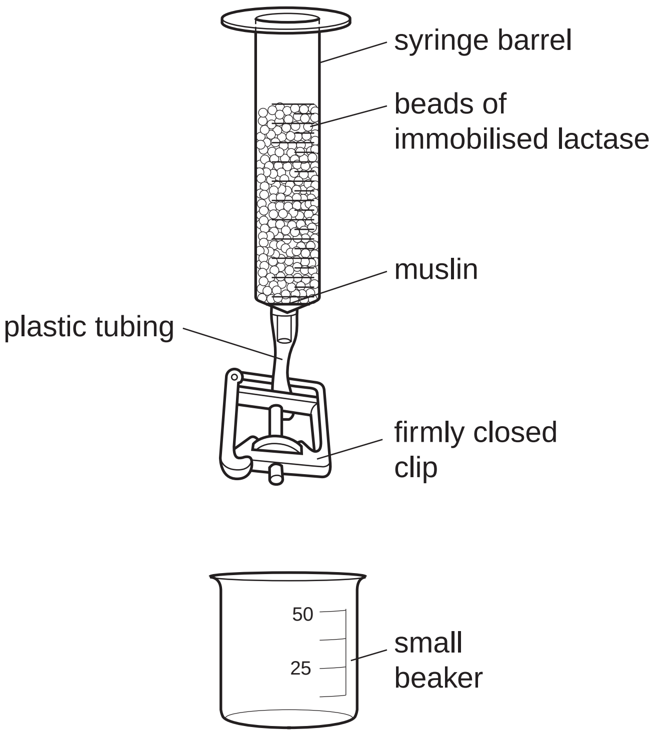

Fig. 1.1

For Examiner's Use

Diastix® test strips turn different colours depending on the concentration of **glucose** in the test liquids.

You are provided with a **colour chart** to show how to interpret the colours of the strips in terms of the concentrations of glucose in the test liquids.

Use the Diastix® test strips in the following way:

- dip a strip into the liquid to be tested and remove immediately
- shake off any liquid that remains attached to the coloured strip
- place on a white tile and start a stopwatch or stop clock
- after 30 seconds, match the colour of the test strip with the colour chart and note the glucose concentration in g 100 cm^{-3}
- ignore any colour changes that occur after 30 seconds.

glucose concentration / g 100 cm^{-3}	0	0.10	0.25	0.50	1.00	⩾2.00

For Examiner's Use

(a) Use the apparatus shown in Fig. 1.1 to investigate how changing the length of time that milk is in contact with immobilised lactase affects the production of glucose.

In a previous investigation, using this equipment, complete hydrolysis of the lactose occurred within 10 minutes.

You should present and record your observations and data in a clear, organised and logical way in the space provided below.

[6]

[Turn over

(b) Describe in detail how you used the apparatus to gain reliable results in your investigation.

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

.... [8]

For Examiner's Use

(c) A student investigated the effect of temperature on the activity of soluble and immobilised lactase.

For Examiner's Use

The student's results are shown in Table 1.1.

Table 1.1

temperature / °C	relative enzyme activity / percentage of maximum activity							
	soluble lactase				immobilised lactase			
	1	2	3	mean	1	2	3	mean
15	16	18	18	17.3	29	25	27	27.0
20	21	22	25	22.7	36	34	33	34.3
25	33	35	29	32.3	51	53	46	50.0
30	47	45	43	45.0	67	63	65	65.0
35	65	59	58	60.7	92	88	90	90.0
40	76	77	75	76.0	100	100	100	100.0
45	100	100	99	99.7	96	93	96	95.0
50	69	70	65	68.0	23	27	28	26.0
55	29	33	31	31.0	12	18	14	14.7

(i) State what should be calculated in order to assess the reliability of the data collected for each temperature.

.... [1]

(ii) Using the results shown in Table 1.1, compare the effect of temperature on the relative enzyme activities of soluble and immobilised lactase.

....

....

....

....

....

....

....

.... [3]

[Total: 18]

For Examiner's Use

2 You are reminded that you should allow **35 minutes** for question 2.
You should read through the whole of this question carefully and then plan your use of the time to make sure that you finish all the work that you would like to do.

P1 is a section of a region of the alimentary canal of a small mammal.

(a) **(i)** Draw a low power plan drawing of **P1**.

Label your plan drawing.

[2]

(ii) Use a ruler to measure your plan drawing and draw a line to show where you took the measurement. Now measure the actual size of **P1**. Calculate the magnification of your drawing.

Show your working.

magnification .... [2]

For Examiner's Use

(b) Use the high power lens of your microscope to search for **two** different cell types from the lining of the region of the alimentary canal in **P1**.

Make a drawing to show each of the two cell types you have chosen.

Do **not** draw more than three cells of each type.

Annotate your drawing to indicate the differences between the two cell types.

[6]

For Examiner's Use

(c) **P2** is a section of another region of the alimentary canal of the small mammal.

Compare, using a hand lens and microscope, the structures of **P1** and **P2**.

Present your comparison as a table in the space below.

[4]

(d) Fig. 2.1 shows an electronmicrograph of part of a cell from the alimentary canal of a small mammal.

For Examiner's Use

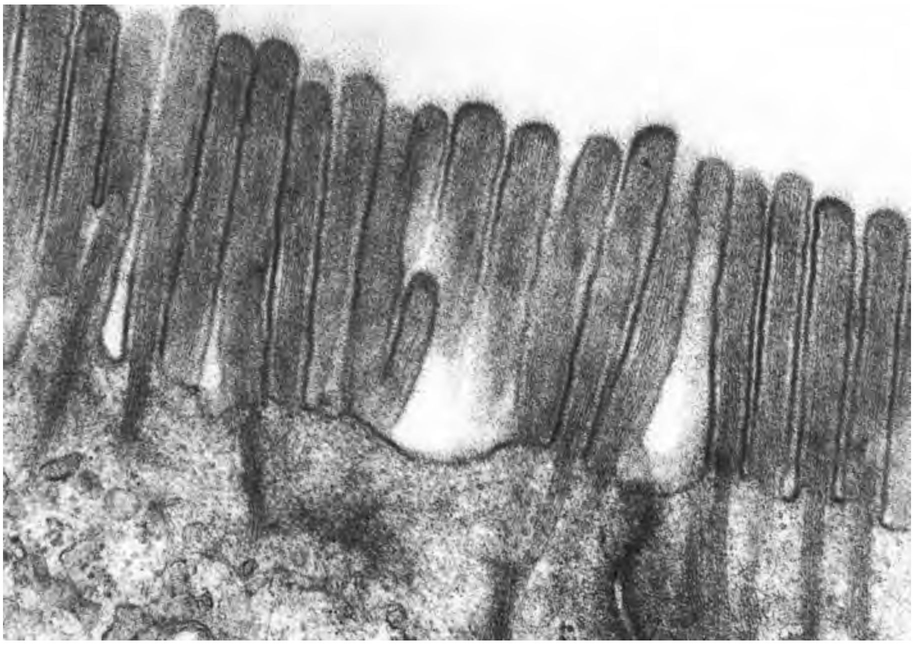

Fig. 2.1

Explain how the cell shown in Fig. 2.1 is adapted for its function.

....

....

....

.... [2]

[Total: 16]

Section B

Answer **all** the questions in the spaces provided.

You should allow **80 minutes** to spend on Section **B** of the examination.

3 You are required to plan an investigation to determine how the respiratory quotients (RQs) of seeds with different storage substances change during germination.

Cereal grains, such as those of maize, wheat and barley, primarily store starch whereas mung beans store a mixture of substances, such as starch, lipid and protein.

The respiratory quotient of germinating seeds is influenced by

- the type of substances stored
- the type of respiration
- any interconversion between substances, e.g. lipid to carbohydrate.

A simple respirometer, such as that shown in Fig. 3.1, should be used in your plan.

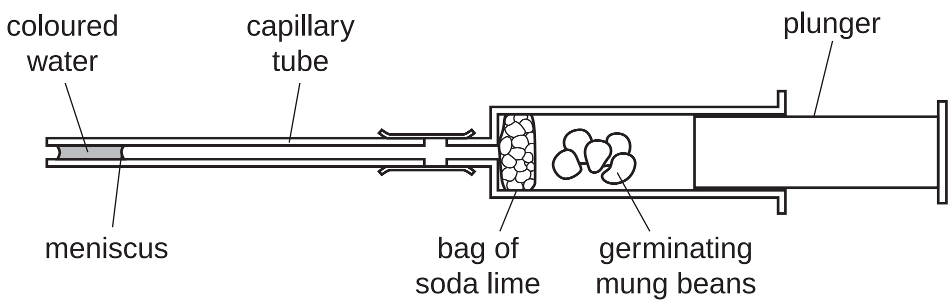

Fig. 3.1

The following equipment may be used in your plan or not as you wish. You may **not** use any additional equipment.

- maize, wheat or barley grains that have been soaked for 24 hours
- mung bean seeds that have been soaked for 24 hours
- small bags of soda lime
- an unlimited supply of syringes and lengths of capillary tubing to make simple respirometers as shown in Fig. 3.1
- beaker of coloured water
- thermometers
- an electronic top-pan balance accurate to 0.1 g (or 0.01 g)
- forceps
- temperature-controlled chamber
- stop watch or electronic timer
- a ruler marked in mm
- a marker pen

Your plan should:

- include a clear statement of the hypothesis or prediction
- identify the key variables
- give full details and explanations of the procedures that you would adopt to ensure that the results are as precise and reliable as possible
- include a brief risk assessment
- be written in clear scientific language.

For Examiner's Use

For Examiner's Use

[Total:16]

For Examiner's Use

4 Dogwhelks, like limpets, are molluscs that cling to the surfaces of rocks using a muscular foot and a secretion of a sticky mucopolysaccharide.

Some students investigated the morphology of the common dogwhelk, *Nucella lapillus*, on sheltered and exposed shores. The wave action on exposed shores is much greater than on sheltered shores.

The students tested the hypothesis that dogwhelks on the exposed shore would have relatively larger apertures as they need to have a relatively larger area for the foot to emerge and cling to rock surfaces.

The students took random samples of 20 dogwhelks on both an exposed shore and on a sheltered shore. They measured the length of the aperture through which the foot emerges and the total length of the shell as shown in Fig. 4.1. They then calculated the ratio of the aperture length to the total length.

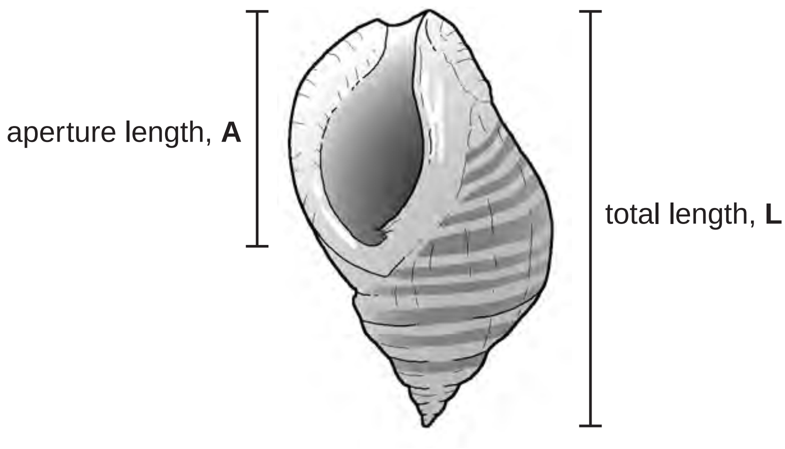

Fig. 4.1

(a) Explain why it is important that the students took random samples.

....

....

....

.... [2]

For Examiner's Use

(b) The students made their measurements of the dogwhelks with rulers.

Comment on this method of obtaining data **and** describe how the students should calculate the uncertainty in the measurements.

....

....

....

....

....

....

....

....

....

.... [4]

The students' results are shown in Table 4.1.

For Examiner's Use

Table 4.1

sample no.	sheltered shore			exposed shore		
	aperture length (**A**) / mm	total length (**L**) / mm	ratio **A** / **L**	aperture length (**A**) / mm	total length (**L**) / mm	ratio **A** / **L**
1	18	28	0.64	17	29	0.59
2	17	26	0.65	17	28	0.61
3	16	23	0.70	17	22	0.77
4	19	32	0.59	16	28	0.57
5	18	29	0.62	16	22	0.73
6	17	30	0.57	16	28	0.57
7	17	28	0.61	18	26	0.69
8	16	27	0.59	16	29	0.55
9	15	24	0.63	19	25	0.76
10	16	26	0.62	20	30	0.67
11	16	28	0.57	17	27	0.63
12	17	29	0.59	19	28	0.68
13	17	29	0.59	17	29	0.59
14	19	33	0.58	18	26	0.69
15	19	31	0.61	19	26	0.73
16	14	23	0.61	21	27	0.78
17	18	32	0.56	19	25	0.76
18	14	23	0.61	16	23	0.70
19	12	21	0.57	17	24	0.71
20	17	28	0.61	19	29	0.66
mean	16.6	27.5	0.605	17.7	26.6	0.672
standard deviation	1.8	3.4	0.033	1.5	2.4	0.073

(c) Explain why the students calculated the ratio of aperture length to total length for each dogwhelk.

....

.... [1]

The students carried out a t-test and found that the *P* value for the difference between the means for the ratios was less than 5%.

For Examiner's Use

(d) Discuss:

(i) the extent to which the results support the hypothesis that there is no significant difference between aperture to total length ratios of the dogwhelks on the exposed and sheltered shores

....

....

....

....

....

....

.... [3]

(ii) whether or not dogwhelks are adapted for different conditions on different shores.

....

....

....

....

.... [2]

[Total: 12]

5 Maize plants have two genes, **A** / **a** and **B** / **b**, that are expressed in their pollen grains.

A = allele that gives pollen grains a yellow colour
a = allele that gives pollen grains a white colour

B = allele that gives non-waxy pollen grains
b = allele that gives waxy pollen grains

Assume that the two genes are **not** on the same chromosome.

Pollen was collected from the anthers of three plants that were heterozygous for both genes.

(a) State the genotype of the plants. .... [1]

The pollen grains showed four different phenotypes. The number of pollen grains of each phenotype is shown in Table 5.1.

Table 5.1

	number of pollen grains of each phenotype			
	yellow non-waxy	yellow waxy	white non-waxy	white waxy
genotypes of pollen grains	....	....	....	....
plant 1	314	279	190	321
plant 2	324	420	513	432
plant 3	478	340	435	366
total	1116	1039	1138	1119

(b) Complete Table 5.1 by writing in the genotypes of the **pollen grains**. [2]

(c) The ratio of phenotypes **expected** in the pollen is 1:1:1:1.

The chi squared (χ^2) test is used to check whether or not the number of each phenotype is in agreement with the expected ratio.

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

Σ = sum of ......
O = observed value
E = expected value
degrees of freedom = number of classes – 1

Table 5.2

phenotypes	yellow non-waxy	yellow waxy	white non-waxy	white waxy
observed number (O)	1116	1039	1138	1119
expected number (E)	1103	1103	1103	1103
O – E	13	....	35	16
$(O - E)^2$	169	....	1225	256
$\frac{(O - E)^2}{E}$	0.15	....	1.11	0.23

$\chi^2 = \sum \frac{(O - E)^2}{E}$	....

(i) Complete Table 5.2 and calculate χ^2. [2]

(ii) State the null hypothesis for this investigation.

....

.... [1]

(iii) State the number of degrees of freedom for this investigation.

.... [1]

For Examiner's Use

For Examiner's Use

Table 5.3

degrees of freedom	distribution of χ^2						
	probability, *p*						
	0.90	**0.50**	**0.10**	**0.05**	**0.02**	**0.01**	**0.001**
1	0.02	0.45	2.71	3.84	5.41	6.64	10.83
2	0.21	1.39	4.61	5.99	7.82	9.21	13.82
3	0.58	2.37	6.25	7.82	9.84	11.35	16.27
4	1.06	3.36	7.78	9.49	11.67	13.28	18.47

(iv) Using Table 5.3, state, with a reason, whether or not the calculated value for χ^2 supports the assumption that genes **A**/**a** and **B**/**b** are **not** on the same chromosome.

....

....

....

.... [1]

[Total: 8]

BLANK PAGE

BLANK PAGE

BLANK PAGE

