Manipulation of Measure

Question Paper 3

Level	Pre U
Subject	Biology
Exam Board	Cambridge International Examinations
Topic	Manipulation of Measure
Booklet	Question Paper 3

Time Allowed: **58 minutes**

Score: **/48**

Percentage: **/100**

1 You are reminded that you have only **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.

T1 is a transverse section of the testis of a small mammal.

(a) Make a low power plan drawing of **T1** to show the arrangement of five seminiferous tubules and any tissues found between them. Individual cells should not be drawn.

Label your plan drawing.

[6]

(b) Use the eyepiece graticule and the stage micrometer to measure the diameter of each of the five seminiferous tubules that you have drawn.

Identify each tubule by writing the letters **A** to **E** on your drawing.

Calculate the mean diameter of the seminiferous tubules and the standard deviation.

Calculate the standard deviation using the formula:

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

Record your measurements and the results of your calculations in the space below.

mean diameter of seminiferous tubules = ...

standard deviation = ... [7]

(c) Sertoli cells, sometimes known as nurse cells, are large cells in the lining of the seminiferous tubules.

Use the high power lens of your microscope to locate a Sertoli cell.

Make a labelled drawing to show **one** Sertoli cell and the cells immediately surrounding it.

[7]

[Total: 20]

2 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.

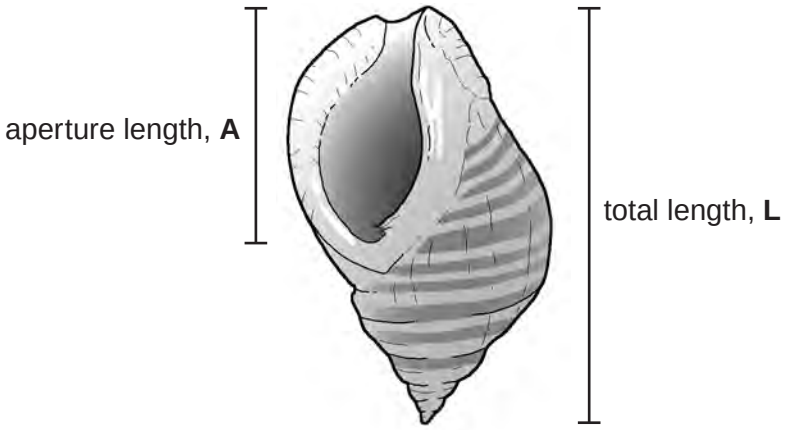

Fig. 4.1

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

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..... [2]

(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.

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The students' results are shown in Table 4.1.

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.

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..... [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%.

(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

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

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[Total: 12]

3 The enzyme urease is a catalyst of the hydrolysis of urea in solution, forming ammonia and carbon dioxide, for example in the breakdown of urea in soils by microorganisms.

You are required to plan an investigation to compare the activity of urease free in solution and urease immobilised in alginate beads.

As the reaction proceeds, the ammonia released dissolves, causing the pH to increase.

You are provided with the following equipment which you may use or not in your plan, as you wish. You may **not** use any additional equipment in your plan.

- an unlimited supply of calcium alginate beads all of uniform size prepared with a 50 g dm^{-3} urease solution (you may call this immobilised urease)
- an unlimited volume of 50 g dm^{-3} urease solution (you may call this free urease)
- an unlimited volume of 1.0 mol dm^{-3} urea solution
- an unlimited volume of distilled water
- beakers and flasks of different sizes
- stop watch or electronic timer
- broad and narrow range pH papers and liquids with appropriate colour charts, pH probes and meters
- colorimeter and tubes/cuvettes
- thermometer
- thermostatically-controlled water baths
- graduated pipettes and pipette fillers
- filter funnels
- syringes
- glass rods for stirring
- test-tubes and boiling tubes
- test-tube racks

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
- show how you would present and analyse your results
- include a brief risk assessment
- be written in clear scientific language.

You may include a diagram or diagrams in your plan.

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