Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

2241719689

MARINE SCIENCE **9693/02**

Paper 2 AS Data-Handling and Free-Response **May/June 2017**

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

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 an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Section A
Answer **both** questions in this section.
Write your answers in the spaces provided on the Question Paper.

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

Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.

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.

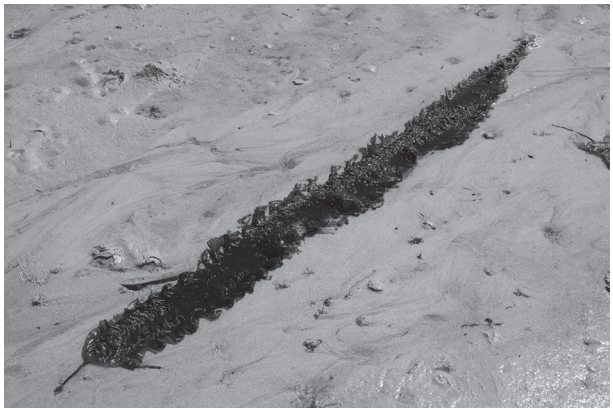
This document consists of **11** printed pages and **1** blank page.

CAMBRIDGE International Examinations

Section A

Answer **both** questions in this section.

1 Fig. 1.1 shows a specimen of *Laminaria longicruris. L. longicruris* is a species of alga and is a producer in marine ecosystems.



magnification × 0.1

Fig. 1.1

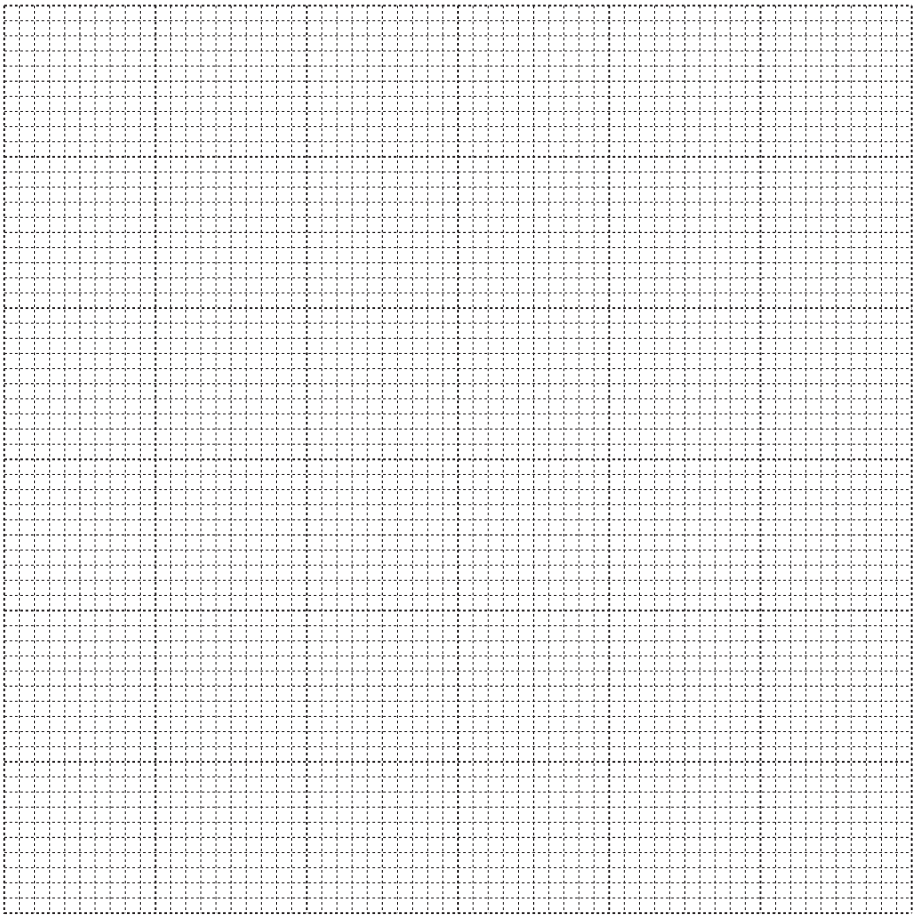
Investigations were carried out to study factors affecting *L. longicruris*.

(a) Table 1.1 shows the relationship between the depth of sea water and the population density of *L. longicruris*. Density is expressed as the number of plants per square metre.

Table 1.1

depth/m	population density /number m^{-2}
2	3.8
4	5.2
6	3.5
8	2.2
10	1.0
12	1.5

(i) On the grid, plot a graph to show the relationship between depth and the population density of *L. longicruris*. Join the points on your graph with ruled, straight lines.



[4]

(ii) Use your graph to estimate the population density at a depth of 5 m.

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[2]

(b) Table 1.2 shows the mean rate of uptake of nitrate ions (NO_3^-) by *L. longicruris* at a range of concentrations of nitrate ions.

Concentrations are expressed as micromoles per dm^3 ($\mu mol\,dm^{-3}$).

Table 1.2

nitrate ion concentration / $\mu mol\,dm^{-3}$	mean rate of uptake per hour / $\mu mol\,dm^{-3}\,hr^{-1}$
1.2	2.1
2.9	4.0
6.8	6.7
10.1	8.0
11.7	8.1
14.9	8.2

(i) Use the data in Table 1.2 to describe the relationship between the concentration of nitrate ions and the mean rate of uptake.

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(ii) To determine the mean rate of uptake at a concentration of $1.2\,\mu mol\,dm^{-3}$, seven replicates were used.

Explain how the mean rate would be calculated.

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(iii) Suggest why nitrate ions are needed for the growth of *L. longicruris*.

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[Total: 12]

2 Fig. 2.1 shows a group of nine periwinkles, small molluscs found in the intertidal region of many rocky shores. Periwinkles feed on algae growing on the surface of rocks.

Fig. 2.1

(a) State the trophic level occupied by periwinkles.

.....[1]

(b) The mark-release-recapture technique can be used to estimate population densities of animals such as molluscs.

In this technique, a sample of animals is collected and each one marked with a small dot of paint. These marked animals are then released. After a suitable time, a second sample is collected from the same area and the number of marked individuals in this sample is counted.

The data can then be used to estimate the total number of individuals in the population, using the formula below.

$$\text{Estimated size of population} = \frac{N_1 \times N_2}{N_3}$$

where

N_1 is the number of individuals captured and marked
N_2 is the total number of individuals in the second sample
N_3 is the number of marked individuals in the second sample.

(i) In an investigation, **204** periwinkles were marked and then returned to their habitat. Two days later, a random sample of **936** periwinkles was collected from the same area. Of these, **72** were marked.

Use the formula above to determine the total number of periwinkles in this population.

Show your working.

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[2]

(ii) In this investigation, the area of rocky shore measured 20 m × 20 m.

Use your answer from **(b)(i)** to calculate the mean number of periwinkles per square metre.

Show your working.

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(iii) Suggest **three** reasons why the mark-release-recapture technique may not give an accurate measure of the population density of the periwinkles.

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[3]

[Total: 8]

Section B

Answer **both** questions in this section.

3 **(a)** Explain what is meant by the term *succession* and give **one** example from the marine environment.

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(b) Explain how the processes of erosion and sedimentation give rise to the formation of muddy shores and rocky shores.

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(c) Discuss the factors that can lead to a transition from the growth of a coral reef to reef erosion.

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[Total: 15]

4 **(a)** Explain how volcanic activity affects the chemical composition of sea water.

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(b) Describe how temperature gradients form in water columns to produce ocean layers and how mixing of these layers may occur.

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(c) The concentration of dissolved oxygen in the surface water of open oceans ranges from 4 mg dm^{-3} to 9 mg dm^{-3}. The concentration of dissolved oxygen in a tropical lagoon was measured and found to be 2.9 mg dm^{-3}.

Suggest explanations for this difference.

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[Total: 15]

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