Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME	
CENTRE NUMBER	
CANDIDATE NUMBER	

2078330907

MARINE SCIENCE **9693/02**

Paper 2 AS Data-Handling and Free-Response **May/June 2016**

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 **10** printed pages and **2** blank pages.

Section A

Answer **both** questions in this section.

1 Nitrogen is an essential nutrient in marine ecosystems. In the form of nitrogen gas, N_2, nitrogen is unavailable to most organisms. Nitrogen fixation converts nitrogen gas into a form that can be used by plants.

In an investigation, the rate of fixation of nitrogen was determined in the sediment of six marine environments. The rate was measured as grams of nitrogen per square metre per year ($g\,m^{-2}\ year^{-1}$).

The results are shown in Table 1.1.

Table 1.1

location	rate of nitrogen fixation / g m^{-2} $year^{-1}$
Vostok Bay, Russia	0.002
Rhode River Estuary, Maryland	0.13
Lune Estuary, England	0.14
Waccasassa Estuary, Florida	0.37
Kāne'ohe Bay, Hawaii	0.60
Flax Pond mud flats, New York	0.65
mean rate of nitrogen fixation =	

(a) Complete Table 1.1 by calculating the mean rate of nitrogen fixation. [1]

(b) The mean rate of nitrogen fixation was also determined for six other locations, in which there were significant numbers of bacteria present.
The mean rate of nitrogen fixation for these locations was found to be 17.37 $g\,m^{-2}\ year^{-1}$.

Compare the mean rate of nitrogen fixation in locations with bacteria present with the mean rate for the locations shown in Table 1.1. Suggest an explanation for the difference.

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(c) The productivity of producers is higher in locations with high rates of nitrogen fixation. Suggest an explanation for this.

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(d) Suggest **two** factors, other than the rate of nitrogen fixation, that may affect the availability of nitrogen in marine ecosystems.

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[Total: 9]

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2 Fig. 2.1 shows a shell of a common cockle, *Cerastoderma edule*.

magnification ×2

Fig. 2.1

Cockles are found in intertidal areas around the coasts of most European countries. A cockle has a muscular foot which enables it to burrow in the sediment.

Cockles can occur in large populations, with up to thousands of individuals per square metre.

(a) (i) Explain how you would make an accurate estimate of the population of cockles on a coastal location.

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(ii) Suggest why burrowing might be an advantage to cockles.

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(b) An investigation was carried out into the burrowing ability of cockles.

A total of 139 cockles were collected from the surface of a habitat (Group **A**) and 127 cockles were collected from under the surface of the same habitat (Group **B**).

These cockles were placed in a tank of sea water that had five centimetres of sediment at the bottom. All the cockles were placed on the surface of the sediment. After two hours, the numbers of cockles that had burrowed into the sediment were counted.

The results are shown in Table 2.1.

Table 2.1

group	position from which cockles were collected	number of cockles placed on the surface of the sediment in the tank	number of cockles that had burrowed into the sediment after 2 hours
A	surface of habitat	139	7
B	under the surface of the habitat	127	79

(i) Using the data in Table 2.1, calculate the percentage of cockles that had burrowed in each group.

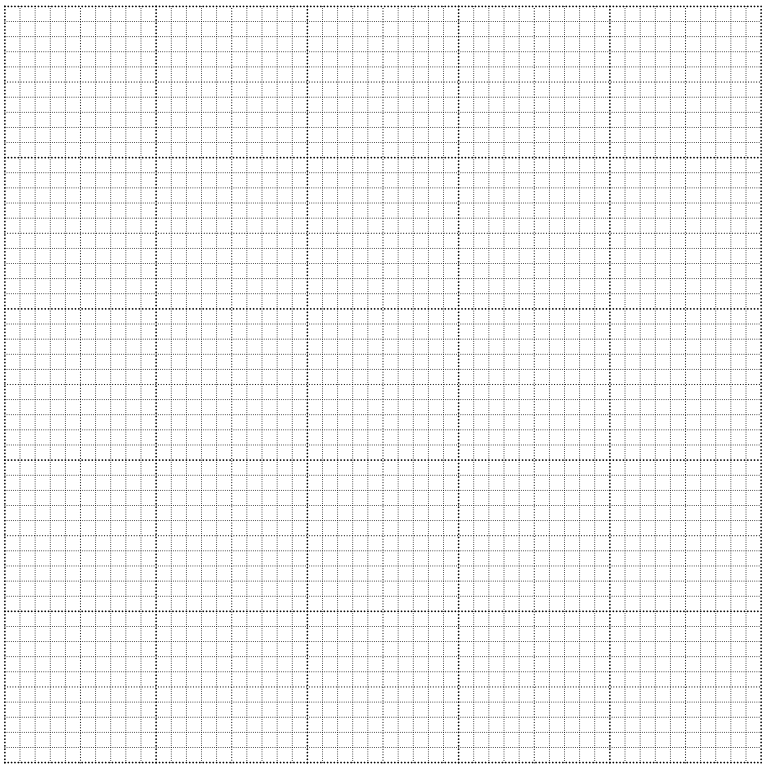
Write your answers in Table 2.2.

Table 2.2

percentage of cockles that burrowed in Group A	percentage of cockles that burrowed in Group B

[2]

(ii) On the grid below, plot a bar graph to show the data in Table 2.2.



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(iii) Formulate a hypothesis based on the results of this investigation.

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[Total: 11]

Section B

Answer **both** questions in this section.

3 **(a)** Explain the meaning of each of the following terms used in ecology.
Give **one** example of each from the marine environment.

(i) *succession*

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(ii) *niche*

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(b) Explain how environmental factors influence the ecological communities on a rocky shore.

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(c) Suggest why sandy shores usually have a lower biodiversity than rocky shores.

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[Total: 15]

4 **(a)** Explain what is meant by the term *thermocline*.

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(b) **(i)** Outline the effects of evaporation and precipitation on salinity.

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(ii) Suggest why the salinity of sea water is often lower near to the coast than it is in the open ocean.

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(c) Describe how salinity gradients form to produce ocean layers and explain how mixing of these layers may occur.

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