



Cambridge International AS & A Level

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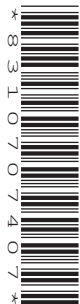
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MARINE SCIENCE

9693/02

Paper 2 AS Data-Handling and Free-Response

October/November 2020

1 hour 15 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 50.
- The number of marks for each question or part question is shown in brackets [].

This document has **12** pages. Blank pages are indicated.

Section A

Answer **both** questions in this section.

- 1 Green shore crabs are predators of the common periwinkle, a herbivorous intertidal snail.

A scientist investigated the effect of the presence of a green shore crab on shell length and shell thickness of the common periwinkle.

The scientist used ten equal-sized tanks, each filled with the same volume of sea water. The scientist added actively growing brown algae. Each tank was stocked with two common periwinkles as shown in Fig. 1.1.



Fig. 1.1

One male green shore crab, living inside a cage, was placed in each of five of the tanks as shown in Fig. 1.2. The crabs were fed each day.

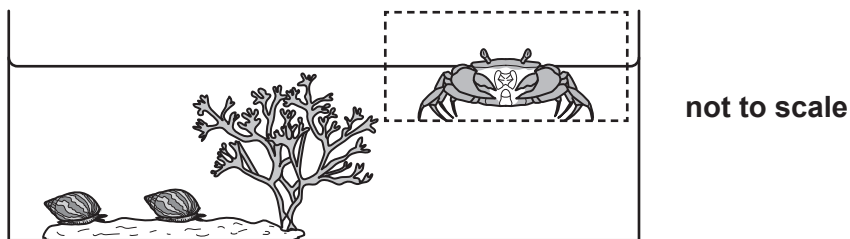


Fig. 1.2

The length and thickness of the shell of each periwinkle were measured at the start of the investigation, and again after 60 days.

- (a) (i) Suggest why growing, brown algae were placed in each tank.

.....
..... [1]

- (ii) Suggest **one** variable that should be controlled when selecting the periwinkles to use in this investigation.

.....
..... [1]

(iii) Explain why five replicates of the set-up shown in Fig. 1.2 were used.

.....
 [1]

(iv) Suggest why the investigation was not continued for more than 60 days.

.....

 [2]

(b) The results of the investigation are shown in Table 1.1.

Table 1.1

predatory green shore crab presence	mean periwinkle shell length /mm	mean periwinkle shell thickness /mm	ratio of mean shell length to mean shell thickness
without crab	11.10	1.26	8.81 : 1
with crab	10.20	1.50

(i) Calculate the percentage difference in shell thickness of the periwinkles in the tanks with a green shore crab, compared to those in tanks without a crab.

.....% [2]

(ii) Suggest **one** advantage to the periwinkles of the change in shell thickness in the presence of a green shore crab.

.....
 [1]

(iii) Complete Table 1.1 by calculating the ratio of mean shell length to mean shell thickness with a green shore crab present. [1]

(iv) Referring to Table 1.1, suggest a reason for the difference between the ratios of mean shell length to mean shell thickness in the presence and absence of a green shore crab.

.....
 [1]

[Total: 10]

[Turn over

- 2 *Zostera marina* is a species of seagrass. Macroalgae are seaweeds. *Z. marina* and macroalgae are producers that can grow in the same habitat.

A scientist noticed that the distribution of *Z. marina* and macroalgae varied greatly within a single large estuary.

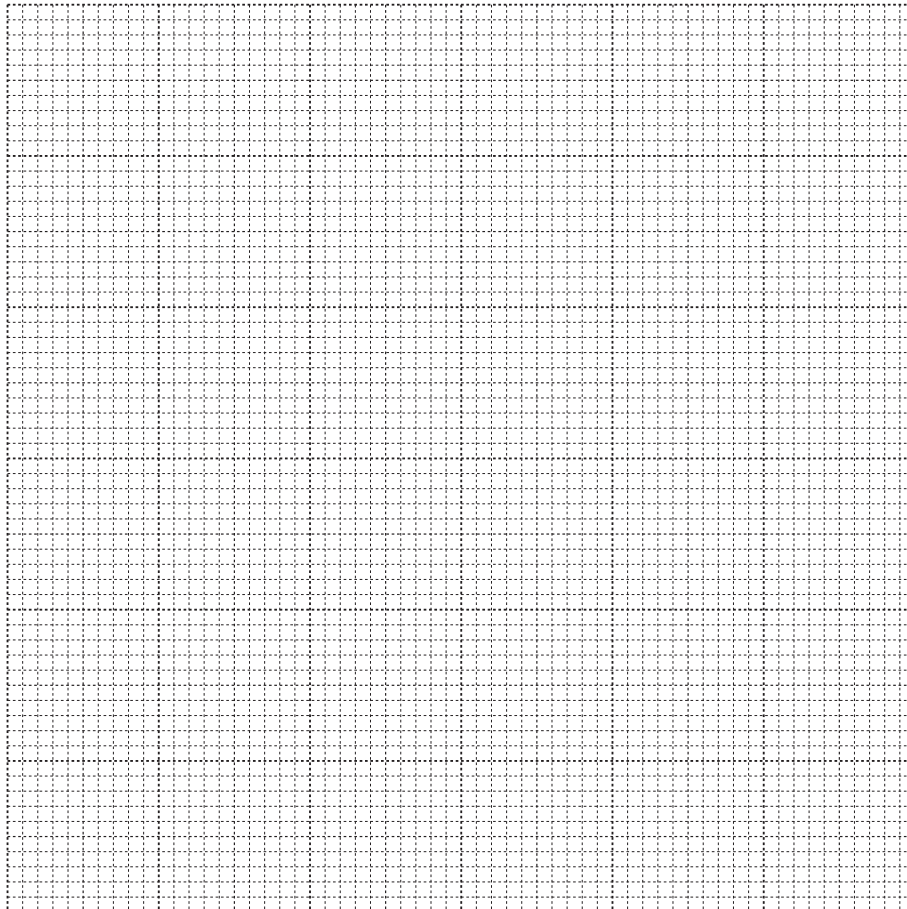
Different areas of the estuary varied in their nitrogen input levels. The scientist measured the biomass of each producer and the nitrogen inputs in each area.

Table 2.1 shows the biomass of the two producers for different nitrogen input levels.

Table 2.1

nitrogen input /kg per hectare per year	biomass of <i>Z. marina</i> /g per m ²	biomass of macroalgae /g per m ²
0	48	53
300	2	116
400	2	174

- (a) Plot a bar chart to show the effect of nitrogen input on the biomass of *Z. marina* and macroalgae.



[5]

(b) A student developed the following hypothesis.

Nitrogen input decreases the growth of *Z. marina* in the presence of macroalgae.

Discuss the extent to which the data in Table 2.1 supports this hypothesis.

.....
.....
.....
.....
.....
..... [3]

(c) Macroalgae and *Z. marina* are photosynthetic. *Z. marina* can grow to a height of 15 cm. Macroalgae can grow to a height of 175 cm.

Use this information to explain why the biomass of *Z. marina* decreases in conditions of high nitrogen input, when growing in the presence of macroalgae.

.....
.....
.....
..... [2]

[Total: 10]

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