



# Cambridge International AS & A Level

CANDIDATE  
NAME

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CENTRE  
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**MARINE SCIENCE**

**9693/21**

Paper 2 AS Data-Handling and Free-Response

**May/June 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 Fig. 1.1 shows a species of butterfly fish, *Chaetodon austriacus*, which inhabits coral reefs in the Red Sea. These fish feed primarily by biting live coral.



**Fig. 1.1**

Scientists researched the feeding behaviour of *C. austriacus* in areas of one coral reef with different percentage cover of coral.

They measured:

- the feeding rate, as number of bites of live coral per 30 minute period
- the size of the territory of the fish, in  $m^2$
- the percentage of the area covered by coral.

The results are shown in Fig. 1.2 and Fig. 1.3.

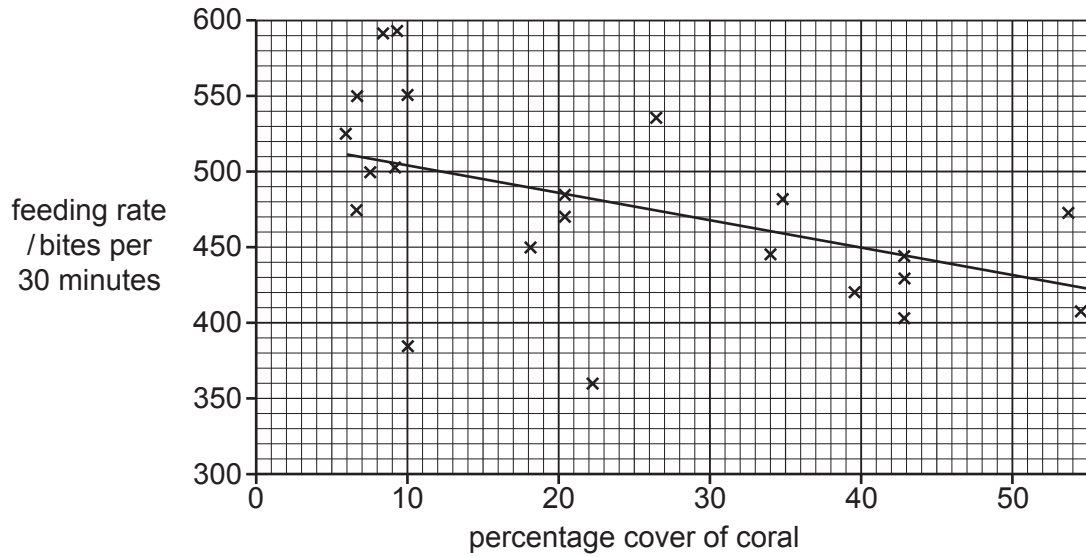


Fig. 1.2

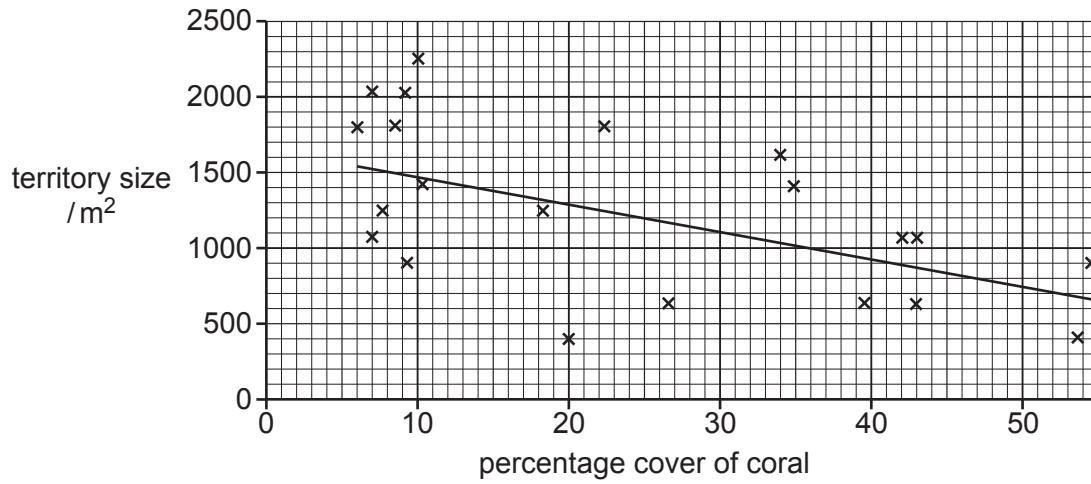


Fig. 1.3

(a) Suggest how the data for percentage cover of coral could be collected.

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..... [2]

(b) Suggest a hypothesis that could be formulated, based on the results shown in Fig. 1.2 and Fig. 1.3.

.....

..... [1]

(c) Suggest explanations for the patterns shown by the data in Fig. 1.2 and Fig. 1.3.

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..... [3]

(d) The scientists suggested that measuring butterfly fish territory size or feeding rate could be used to assess the health of a coral reef.

Discuss the extent to which the data support this suggestion.

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..... [3]

[Total: 9]

- 2 Phytoplankton are small photosynthetic organisms that float in the upper layers of the oceans. They are eaten by zooplankton.

Fig. 2.1 shows the mean number of zooplankton and phytoplankton per  $\text{m}^3$  in Ticao Pass, a stretch of water between two islands of the Philippines, north of the equator. Data was gathered from September 2010 to April 2011.

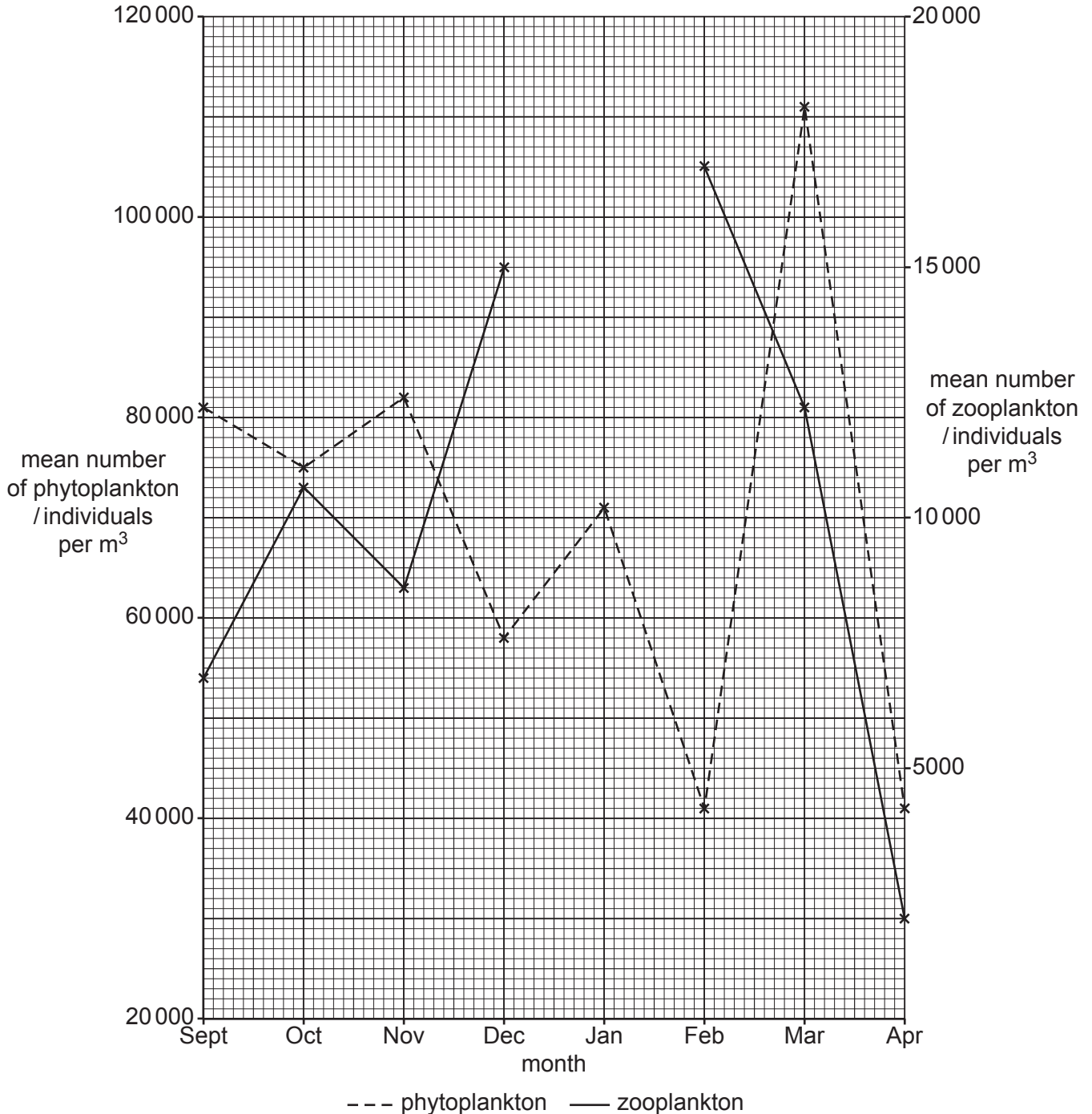


Fig. 2.1

Each data point is the mean from six randomly selected sample sites in Ticao Pass. Table 2.1 shows the numbers of zooplankton from each of the six sample sites in January.

**Table 2.1**

January zooplankton numbers/individuals per m <sup>3</sup>						
site 1	site 2	site 3	site 4	site 5	site 6	mean
3820	4179	4285	3220	4105	3359	

(a) (i) Calculate the mean value for the six sample sites in January.

..... individuals per m<sup>3</sup> [1]

(ii) Use your answer from part (a)(i) to complete the graph in Fig. 2.1. [2]

(b) Explain the relationship between the numbers of phytoplankton and the numbers of zooplankton:

(i) from November to December .....

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 ..... [2]

(ii) from February to March. ....

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 ..... [2]

(c) (i) State the trophic level of the phytoplankton.

..... [1]

(ii) Suggest reasons for the change in the number of phytoplankton that occurs from March to April.

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 ..... [3]

[Total: 11]

**[Turn over**

**Section B**

Answer **both** questions in this section.

**3** A research boat spent six months, from July to January, monitoring the currents and conditions off the Indian coastline, where the ocean had a depth of 1000 m.

**(a)** Describe **and** explain how the wind patterns would differ in this area in summer (July and August) from in winter (December and January).

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**(b)** Water temperature, salinity and oxygen concentration were measured at different depths. Describe **and** explain how each factor would change with increasing depth.

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salinity .....

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oxygen concentration .....

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[8]

(c) Outline the factors that produce ocean currents.

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[3]

[Total: 15]

4 (a) Explain why the biodiversity on sandy shores is usually lower than that of rocky shores.

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(b) Two rocky shores on the same coastline are found to have different levels of biodiversity.

Discuss how environmental factors, including the morphology of the shore, could cause this difference.

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