



Cambridge International AS & A Level

CANDIDATE
NAME

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MARINE SCIENCE

9693/23

Paper 2 AS Data-Handling and Free-Response

May/June 2021

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 **16** pages. Any blank pages are indicated.

Section A

Answer **both** questions in this section.

- 1 Scientists investigated the effect of red grouper and lionfish on the numbers of juvenile fish in an area of sea bed.

Red grouper feed mainly on marine invertebrates. They often live in natural hollows in the sea bed which also act as nurseries for juvenile fish.

Lionfish have been introduced into this area by humans and feed mainly on juvenile fish.

Red grouper and lionfish do not consume each other.

The scientists randomly assigned sixteen natural hollows of equal size to one of four treatments:

- no red grouper or lionfish present
- one lionfish present
- one red grouper present
- one red grouper and one lionfish present.

The percentage change in the numbers of juvenile fish in each hollow was calculated every week for 6 weeks.

Fig. 1.1 shows the results of this investigation.

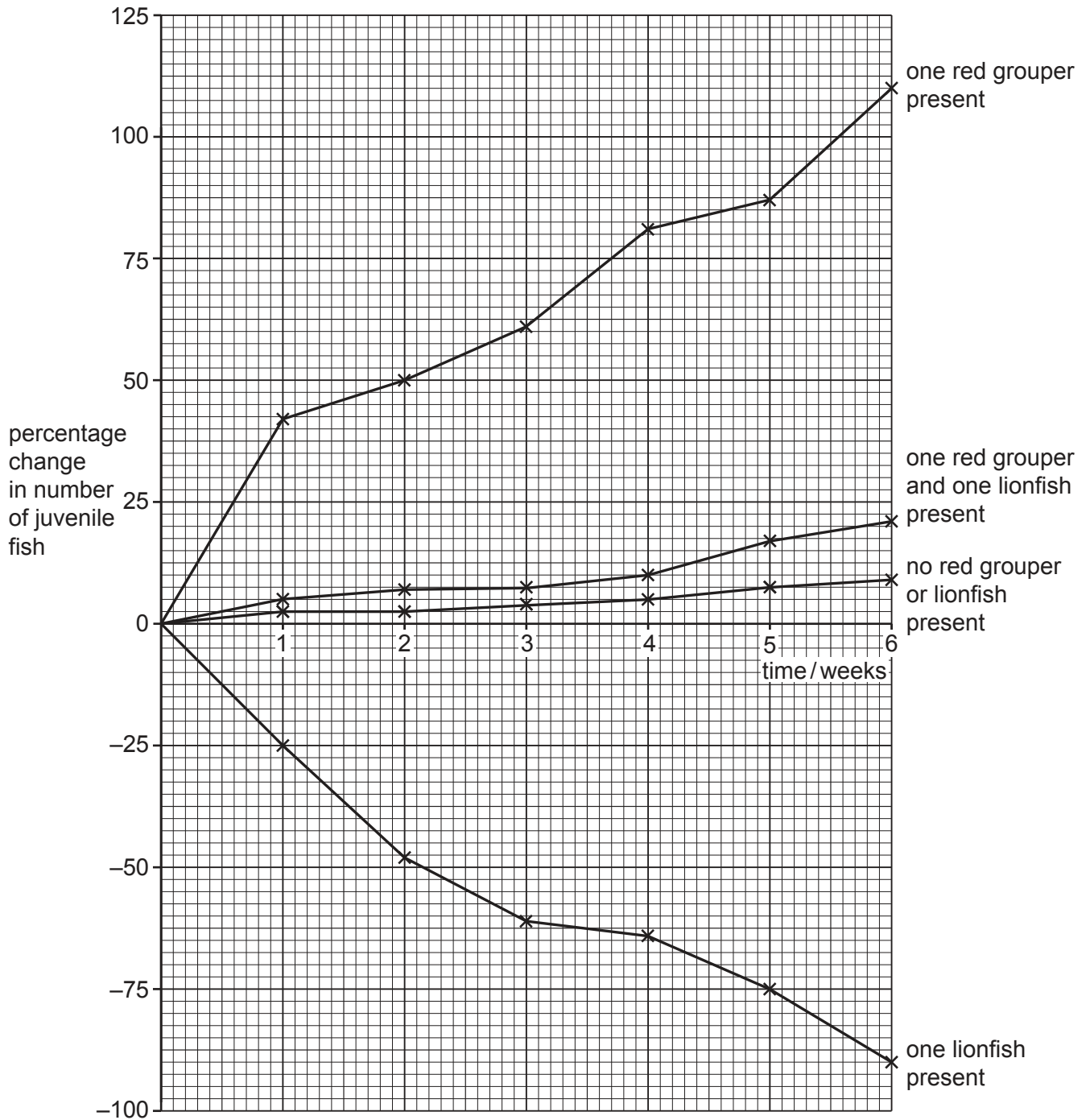


Fig. 1.1

(a) Describe the effect of the following on the percentage change of juvenile fish numbers. Use the data in Fig. 1.1 to support your answer.

one lionfish present

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one red grouper present

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[4]

(b) The scientists concluded that the presence of red grouper reduces the effect of lionfish on the numbers of juvenile fish.

Explain whether the results in Fig. 1.1 support this conclusion.

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..... [1]

- (c) The scientists calculated the percentage of juvenile fish and shrimp in the diet of the lionfish when red grouper were present and absent.

Table 1.1 shows the composition of the diet of the lionfish.

Table 1.1

red grouper	percentage composition of lionfish diet	
	juvenile fish	shrimp
present	43	57
absent	78	22

(i) Plot a bar graph of the data shown in Table 1.1.



[4]

(ii) Use the results to suggest the type of niche occupied by lionfish.

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..... [1]

(d) Discuss the extent to which the whole investigation supports the idea that red grouper presence increases biodiversity.

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[Total: 13]

(b) Suggest why dinoflagellates may benefit from their ability to migrate to the surface waters.

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..... [2]

[Total: 7]

Section B

Answer **both** questions in this section.

3 (a) Describe the factors needed for tropical coral reef growth.

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(b) Describe the scientific methods that can be used to reconstruct the history of a coral reef.

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..... [5]

4 (a) Describe how abyssal plains form on the sea bed.

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(b) Marine snow is the remains of dead organisms and faeces that sink to the abyssal plain from above.

(i) Explain why most food chains on the abyssal plain depend on marine snow as a source of **energy**.

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..... [4]

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