Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

6229647660 8

MARINE SCIENCE **9693/04**

Paper 4 A2 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 Scientists genetically engineered zebrafish for rapid growth. They inserted an additional growth hormone gene into the DNA of zebrafish eggs.

The growth hormone gene was injected into 366 zebrafish eggs. 273 of these eggs survived, but only 2 of these eventually developed into genetically engineered fish with the growth hormone gene switched on.

(a) (i) Calculate the percentage of injected eggs that developed into genetically engineered zebrafish with the growth hormone gene switched on.

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[1]

(ii) Only 2 of the 273 zebrafish were successfully genetically engineered and showed rapid growth.

Suggest why the success rate of genetic engineering is so low.

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..... [1]

(b) The scientists carried out an experiment to investigate whether the genetically engineered zebrafish grew faster than non-genetically engineered zebrafish.

They produced large numbers of genetically engineered zebrafish and calculated their mean mass every week from 4 weeks until 10 weeks.

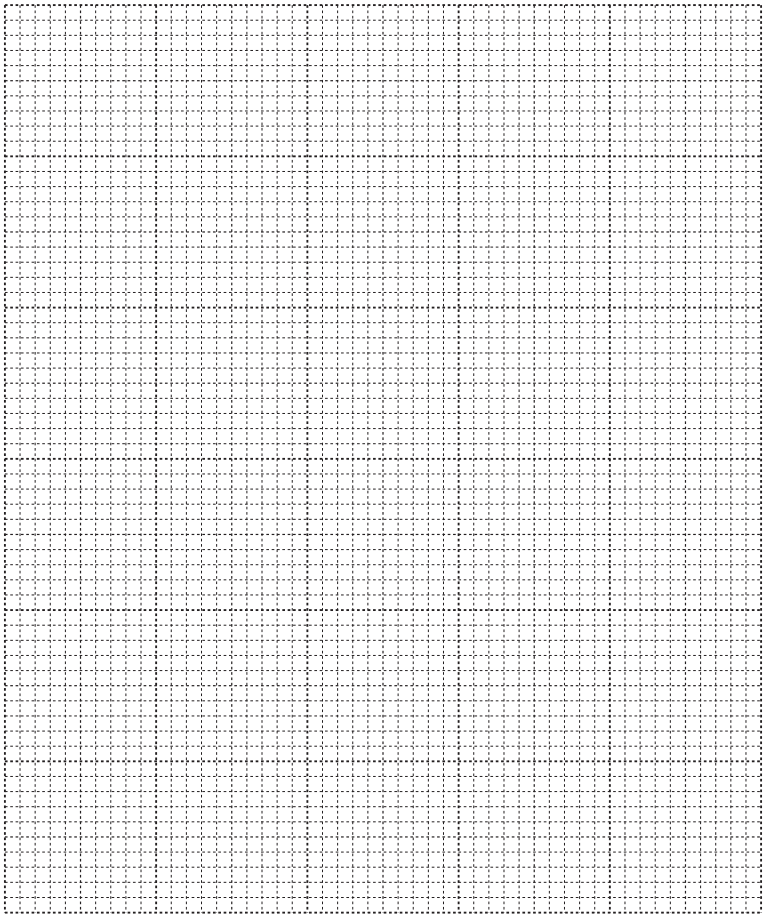
This experiment was repeated with non-genetically engineered zebrafish. The results of the experiment are shown in Table 1.1.

Table 1.1

age of zebrafish / weeks	mean mass of zebrafish / g	
	genetically engineered	non-genetically engineered
4	0.12	0.12
5	0.18	0.15
6	0.21	0.18
7	0.28	0.22
8	0.31	0.25
9	0.33	0.28
10	0.34	0.30

(i) Plot a graph to show the growth of both groups of zebrafish from 4 weeks to 10 weeks.

Join your points with ruled, straight lines.



[5]

(ii) Compare the growth rates of the non-genetically engineered and genetically engineered zebrafish.

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..... [2]

(c) Salmon produced by aquaculture are often fed with pellets made from wild fish such as anchovies and herring.

Genetically engineered salmon have recently been produced that convert food into growth very efficiently.

(i) 1000 kg of wild fish are required to make 250 kg of pellets.

5000 kg of wild fish are required to make the pellets to produce 1000 kg of non-genetically engineered salmon.

1125 kg of pellets are required to produce 1000 kg of genetically engineered salmon.

Calculate the difference in the mass of wild fish used to produce 1000 kg of non-genetically engineered salmon compared to 1000 kg of genetically engineered salmon.

..... kg
[1]

(ii) Suggest **and** explain the environmental benefits of using the genetically engineered salmon.

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..... [3]

[Total: 13]

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2 The ratio of the gill surface area : body mass of fish is calculated using the following formula.

$$\text{gill surface area : body mass ratio} = \frac{\text{gill surface area}}{\text{body mass}}$$

Fig. 2.1 shows how the gill surface area : body mass ratio changes with increasing body mass of a species of marine fish.

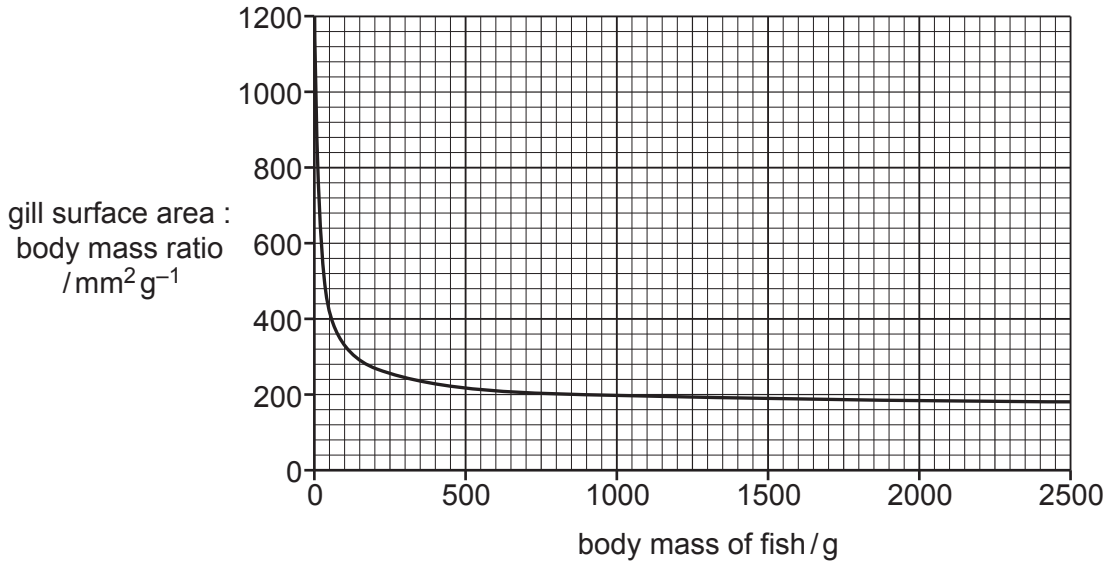

Fig. 2.1

(a) (i) Describe the change in gill surface area : body mass ratio as the body mass of the fish increases.

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..... [1]

(ii) Use Fig. 2.1 to calculate the gill surface area of a fish with a body mass of 500 g.

..... mm^2
[2]

(b) Fig. 2.2 shows the effect of temperature on the oxygen concentration of salt water.

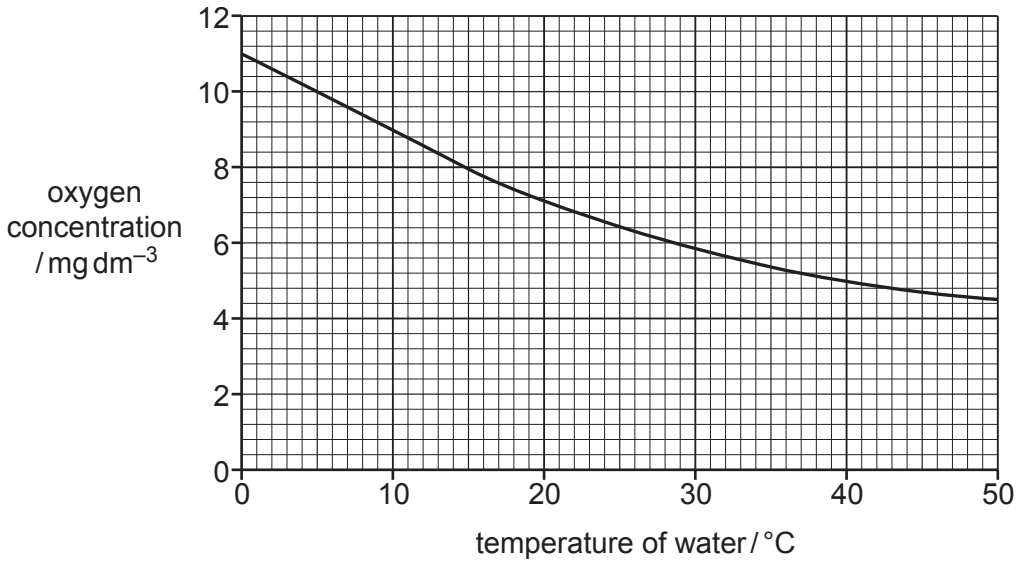

Fig. 2.2

Some scientists suggest that global warming may result in fish not growing as large.

Use Fig. 2.1 and Fig. 2.2 to explain why some scientists think that fish may not be able to grow as large if global warming occurs.

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[Total: 7]

Section B

Answer **both** questions in this section.

3 **(a)** Outline how the techniques of intensive aquaculture differ from those of extensive aquaculture.

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(b) Describe the process used for the aquaculture of shrimp.

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(c) Fig. 3.1 shows an aquaculture method called integrated multitrophic level aquaculture.

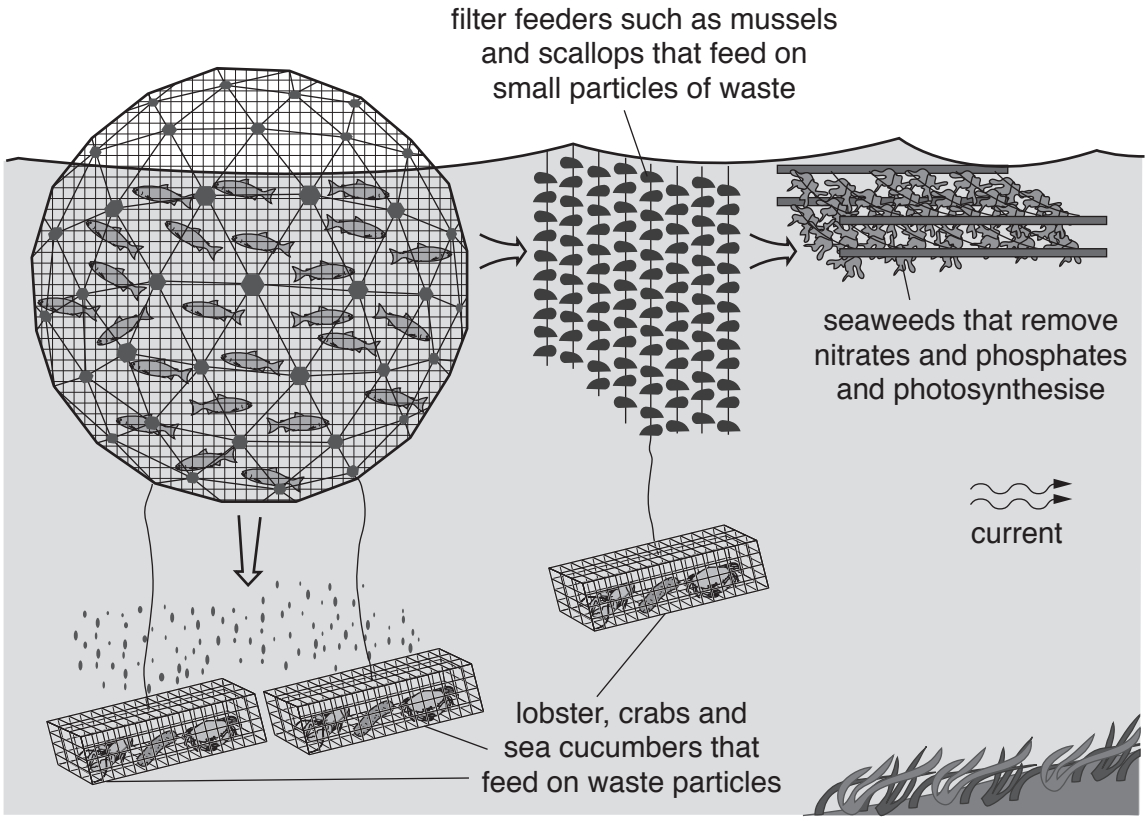

Fig. 3.1

Discuss how this method of aquaculture meets the requirements of sustainable aquaculture and minimises its impacts on the environment.

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..... [6]

[Total: 15]

4 The conservation of primary producers is essential for the health of the marine environment and for ensuring sustainable fish stocks.

(a) (i) Outline the ecological importance of primary producers.

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..... [3]

(ii) Explain why different types of primary producers are found in the open ocean and intertidal zones.

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(b) Discuss the advantages **and** disadvantages of the principal methods used to monitor fisheries to ensure sustainable fishing.

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[Total: 15]

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