Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

4750112345

MARINE SCIENCE **9693/04**

Paper 4 A2 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.

DC (CJ/SW) 187558/3

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Section A

Answer **both** questions in this section.

1 Gold mining causes the release of heavy metals, such as mercury, into estuaries. These heavy metals sink to the bed of the estuary.

Some scientists have suggested that dredging of estuaries in areas where gold mining has occurred causes the release of mercury into the water.

In January 2009, dredging was banned in an estuary in North America to reduce the release of mercury.

A mining company objected to the ban on dredging and investigated the effect of the ban on the release of mercury into the water.

They randomly sampled the concentrations of mercury in four species of organisms in the estuary, before and after dredging was stopped.

The results are shown in Table 1.1.

Table 1.1

species	mean concentration of mercury in organism/parts per million		
	2007	**2008**	**2012**
A	42	30	61
B	60	41	50
C	65	50	81
D	190	101	120

(a) (i) State why the organisms were sampled randomly.

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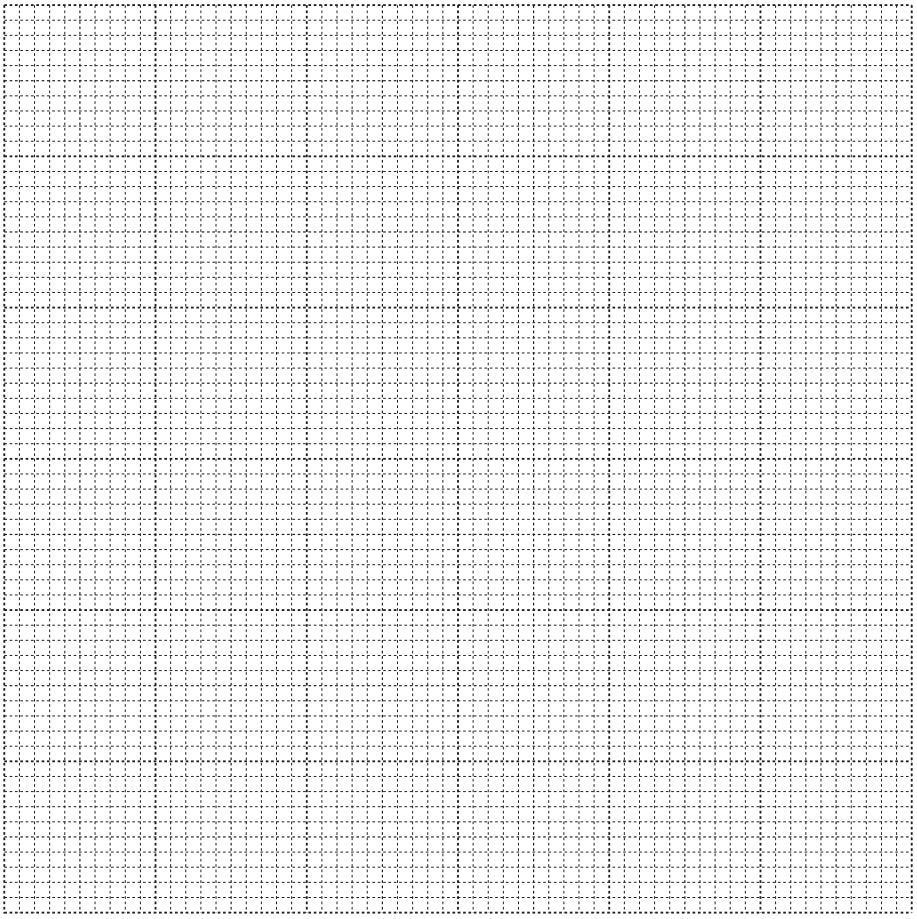
(ii) Plot a line graph to show the changes in concentration of mercury over time for each of the species in Table 1.1. Join your points with ruled, straight lines. Use a separate line for each species.



[5]

(iii) Species **A** consumes plants. Species **D** is a predator.

Use this information to explain the differences between the concentrations of mercury in species **A** and species **D** in 2007.

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(b) The mining company stated that dredging prevents mercury accumulating in the water and that sudden flooding of the estuary causes the release of mercury from the bed of the estuary.

They provided data to show the concentration of mercury in the estuary in 2008 and 2009.

The results are shown in Fig. 1.1.

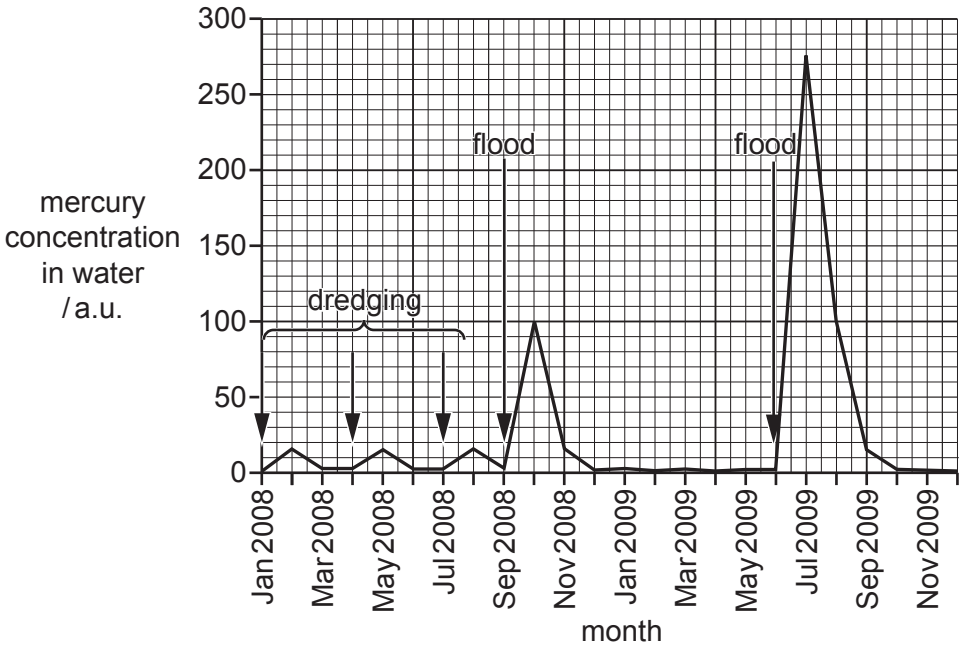

Fig. 1.1

Use the information in Table 1.1 and Fig. 1.1 to discuss the claims of the mining company that banning dredging has led to increased release of mercury from the bed of the estuary.

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[Total: 12]

2 A scientist investigated the effect of changing salinity on a species of estuary crab, *Metacarcinus gracilis*.

They placed crabs into water of different salinities for one hour and then measured the salinity of the body fluid of the crabs.

The results are shown in Fig. 2.1.

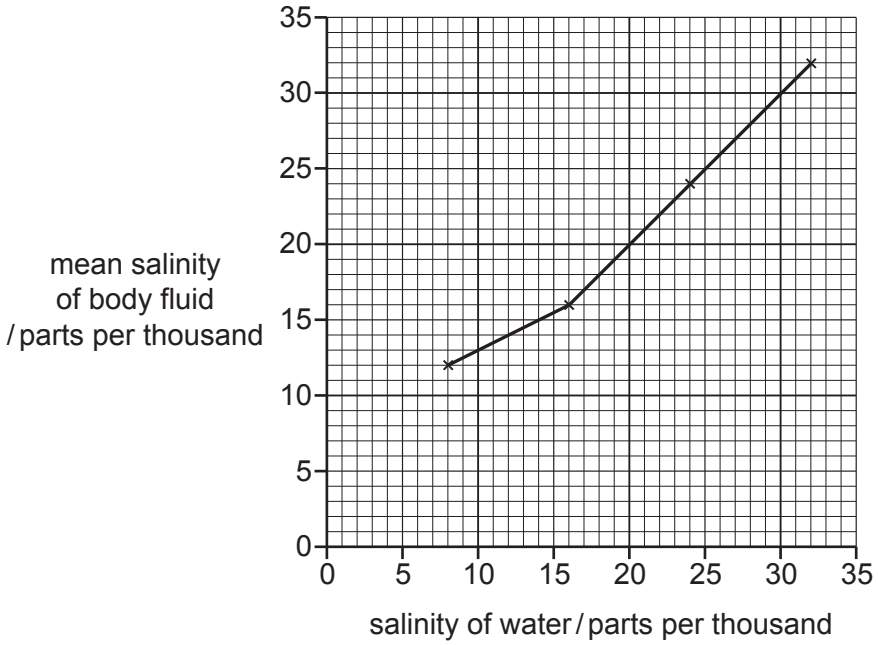

Fig. 2.1

(a) The scientists concluded that this species of crab is an osmoconformer.

Explain whether the results shown in Fig. 2.1 support this conclusion.

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(b) In a further experiment, the behavioural response of the crabs to different salinities was investigated.

A rectangular tank was divided up into five chambers, each with a different salinity, as shown in Fig. 2.2. A passageway between the chambers was provided for crabs to move between chambers.

The salinities used ranged between 60% and 100% of the salinity of normal sea water.

Fig. 2.2 shows the chambers as viewed from above.

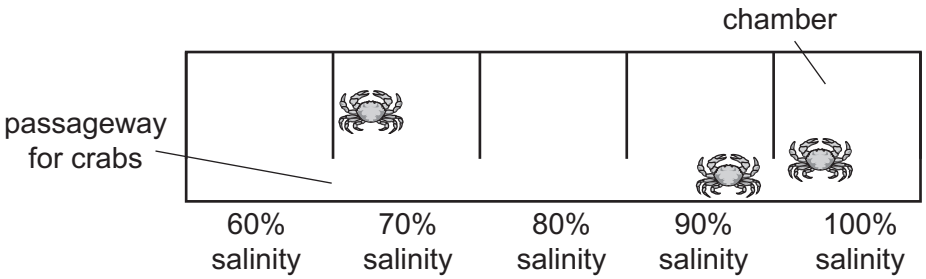

Fig. 2.2

Crabs of the same age, mass, sex and species were placed randomly into different salinities in the tank and the times spent in each salinity recorded.

The mean time that the crabs spent in each salinity was calculated.

The results are shown in Fig. 2.3.

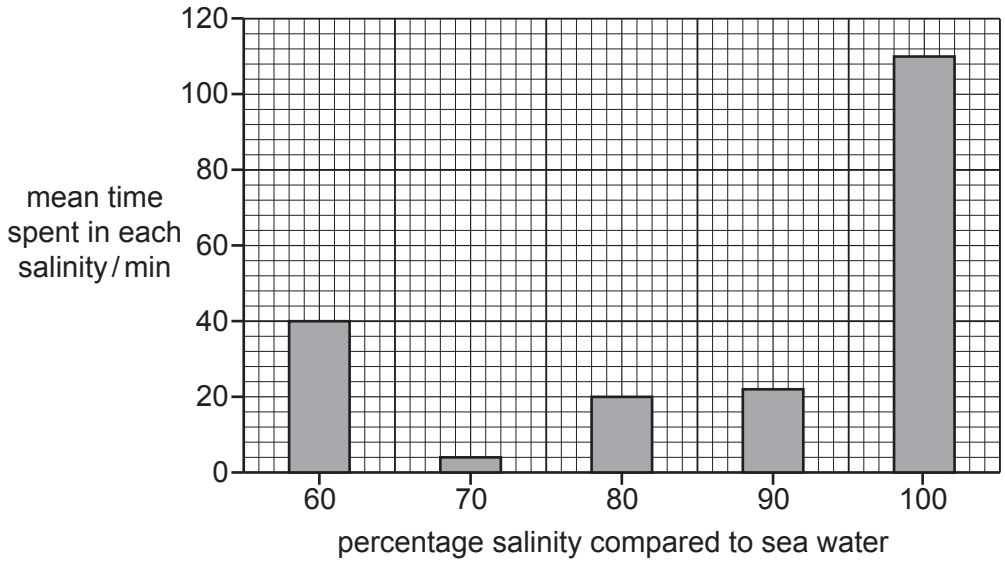

Fig. 2.3

(i) Describe the effect of increasing salinity on the mean time the crabs spent in each salinity.

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(ii) Crabs of the same age, mass, sex and species were used.

Suggest **two** other variables that would need to be kept constant in this experiment.

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(iii) Use your knowledge of marine animal physiology to explain the response of the crabs to the different salinities.

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[Total: 8]

Section B

Answer **both** questions in this section.

3 Government ministries often place restrictions on fishing to ensure sustainable exploitation of fish stocks.

(a) Describe the long-term **and** short-term sociological impacts of restrictions on fishing.

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(b) Discuss the information that government ministries may use to decide how to best exploit fish stocks on a sustainable basis.

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(c) Discuss the advantages **and** disadvantages of building artificial reefs to rehabilitate depleted fish stocks.

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4 (a) (i) Outline how salmon have been genetically engineered for rapid growth.

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(ii) Genetically engineered salmon are grown in aquaculture systems.

Explain how a new aquaculture venture could affect the tourist industry in a coastal area.

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(b) Discuss the evidence that emissions of carbon dioxide and other greenhouse gases from human activities are causing global warming.

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[Total: 15]

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