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MARINE SCIENCE

9693/04

Paper 4 A2 Data-Handling and Free-Response

October/November 2018

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

DO **NOT** WRITE IN ANY BARCODES.

Section A

Answer **both** questions in this section.

Write your answers in the spaces provided on the Question Paper.

Section B

Answer **both** questions in this section.

Write your answers in the spaces provided on the Question Paper.

Electronic calculators may be used.

You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

This document consists of **10** printed pages and **2** blank pages.

Section A

Answer **both** questions in this section.

- 1 Surface longline fishing is a fishing method in which trawlers tow long fishing lines with baited hooks along the surface of the water. It is used to catch albacore tuna.

The catch of albacore tuna from an area of the Indian Ocean around Mauritius was recorded each month, every year, from 2005 to 2011. This information was used to calculate the mean catch of albacore tuna per month.

In order to determine fishing effort each month, the total number of hooks used to catch fish was recorded. This was used to calculate the mean number of hooks used for each month over the time period.

The results are shown in Table 1.1.

Table 1.1

| month | mean albacore tuna catch/kg | standard deviation of mean albacore tuna catch/kg | mean number of hooks used | catch per unit effort /kg hook ⁻¹ |
|-------|-----------------------------|---|---------------------------|--|
| Jan | 6200 | 600 | 720 | 8.6 |
| Feb | 9000 | 2700 | 1100 | 8.2 |
| Mar | 5800 | 500 | 680 | 8.5 |
| Apr | 6200 | 600 | 700 | 8.9 |
| May | 5800 | 300 | 680 | 8.5 |
| Jun | 4000 | 300 | 550 | |
| Jul | 3200 | 500 | 400 | 8.0 |
| Aug | 4000 | 800 | 500 | 8.0 |
| Sep | 5000 | 700 | 600 | 8.3 |
| Oct | 4500 | 600 | 550 | 8.2 |
| Nov | 9500 | 3000 | 1100 | 8.6 |
| Dec | 8500 | 1500 | 1000 | 8.5 |

- (a) (i) Explain what is shown by the standard deviation of the mean albacore tuna catch.

.....

.....

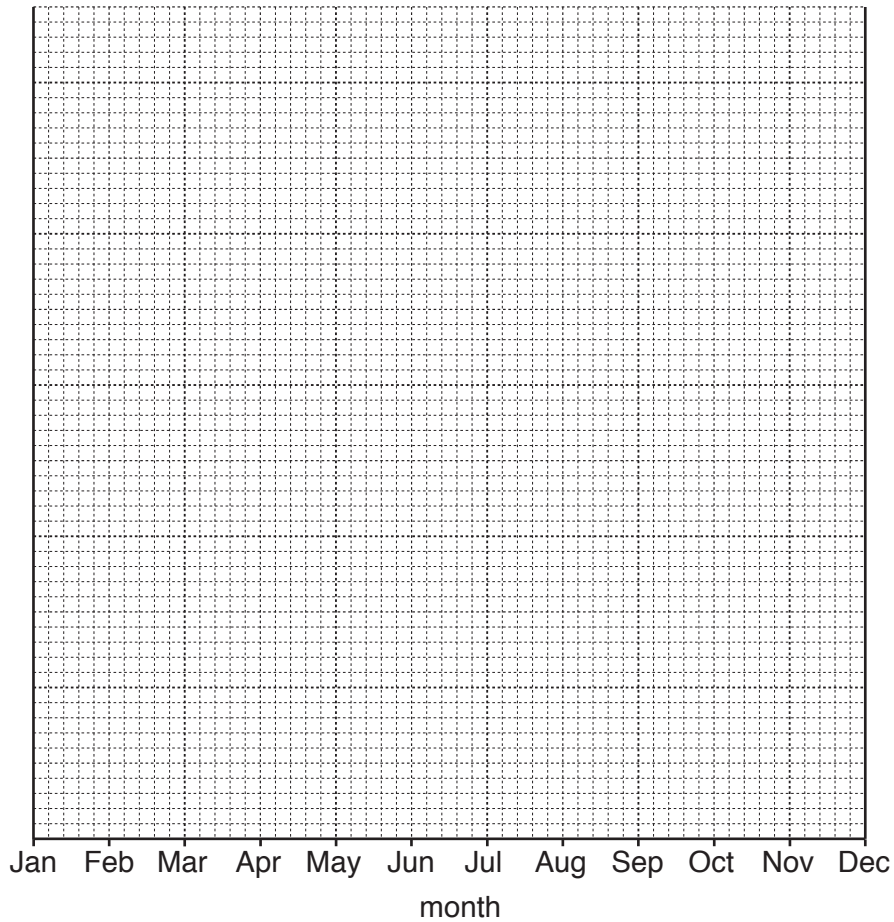
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.....[2]

- (ii) Plot a graph to show how the mean albacore tuna catch and mean number of hooks used changes. Label both y-axes fully and include the units.



[5]

- (b) Catch per unit effort is considered to be a better comparative measure of the health of fish stocks than mean catch alone.

$$\text{catch per unit effort} = \frac{\text{mean albacore tuna catch}}{\text{mean number of hooks used}}$$

Calculate the catch per unit effort for June.

..... kg hook⁻¹
[1]

2 A student investigated the effect of water temperature on the ventilation rate of tilapia.

Three tilapia were placed into separate tanks of water. The number of times each fish opened its mouth within a period of thirty seconds was recorded.

The water temperature was maintained at 10 °C using a thermostatically controlled water bath.

The experiment was repeated at different temperatures.

The results are shown in Table 2.1.

Table 2.1

| temperature /°C | number of times mouth opened in 30 s | | | | mean ventilation rate /mouth openings min ⁻¹ |
|-----------------|--------------------------------------|--------|--------|------|---|
| | fish 1 | fish 2 | fish 3 | mean | |
| 10 | 3 | 5 | 2 | 3 | 6 |
| 15 | 5 | 9 | 6 | 7 | 14 |
| 20 | 9 | 12 | 13 | | |
| 25 | 11 | 18 | 11 | 13 | 26 |

(a) (i) Calculate the mean ventilation rate, to the nearest whole number, for fish placed in water at 20 °C.

..... mouth openings min⁻¹
[1]

(ii) The student concluded that increasing the temperature increases the rate of ventilation.

Discuss the extent to which the data support this conclusion.

.....

 [3]

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