Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME	
CENTRE NUMBER	
CANDIDATE NUMBER	

MARINE SCIENCE **9693/04**

Paper 4 A2 Data-Handling and Free-Response **October/November 2015**

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 **11** printed pages and **1** blank page.

Section A

Answer **both** questions in this section.

1 **(a)** Many fishing ministries regulate catches of fishing fleets in an effort to achieve sustainable fishing.

Explain what is meant by the term *sustainable fishing*.

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.....[1]

(b) In order to set fish harvesting quotas, it is important to determine accurate population sizes.

An attempt to estimate the yellowfin tuna population in an area of the southwest Indian Ocean was carried out by a group of scientists using the mark – release – recapture method.

- Tuna were captured by pole and line for six hours at the same time of day at four sites.
- The tuna were marked by placing a microchip under the skin on the back.
- Tuna were then released back into the sea.
- Four weeks later tuna were caught at the same four sites.

The results are shown in Table 1.1.

Table 1.1

number of yellowfin tuna caught		
first capture	second capture	marked yellowfin tuna caught on second capture
127	174	12

The population of tuna was estimated using the formula below.

$$\text{population} = \frac{\text{number of fish caught on first capture} \times \text{number of fish caught on second capture}}{\text{number of marked fish caught on second capture}}$$

(i) Using the formula, calculate the population of yellowfin tuna in the area.

Show your working.

total population = ... [1]

(ii) Suggest why a small microchip was used to mark the yellowfin tuna.

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(iii) Explain why it was important to use the same method to capture the tuna on both occasions.

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(c) The following formula can be used to calculate future populations of fish.

future population = initial population + recruitment – mortality

where: **recruitment** is the number of new fish entering the population

mortality is the number of fish leaving the population due to death or harvesting.

(i) For the population of yellowfin tuna in part **(b)**, recruitment is estimated to be 400 fish per year. Death due to all factors other than harvesting is estimated to be 15% of the existing stock per year.

Use this information, and your answer to **(b)(i)**, to calculate the maximum number of tuna that could be harvested in one year without reducing the population below current levels.

Show your working.

..... [2]

(ii) Suggest **two** factors, other than harvesting by humans, that will affect the mortality rate of the population of yellowfin tuna.

1 .....

2 .....[2]

(d) Scientific researchers generated data that showed that the yellowfin tuna populations are undergoing a decline. They suggested that a ban should be enforced on fishing yellowfin tuna less than two years old.

Suggest what methods could be used to monitor the fishing and enforce this ban.

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[Total: 12]

Question 2 starts on page 6

2 Tilapia is a fish of high economic value in the aquaculture industry. One of the advantages of farming tilapia is that it can tolerate a broad range of salinities.

An investigation was carried out into osmoregulation by tilapia in different salinities.

Tilapia were kept in solutions of different salinities. An oxygen meter was placed into each solution and the change in oxygen concentration measured.

The initial oxygen concentration, temperature, and feeding were kept constant.

The mean rate of oxygen consumption per fish, determined from the reduction of oxygen content in the water, was calculated at each salinity. The results are shown in Table 2.1.

Table 2.1

salinity / parts per thousand	mean rate of oxygen consumption / $cm^3\ hr^{-1}$
0	0.713
10	0.234
20	0.477
30	0.473

(a) Describe the effect of salinity on the mean rate of oxygen consumption.

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(b) Suggest and explain reasons for the effect of salinity on the mean rate of oxygen consumption.

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(c) When raising fish by aquaculture it is important to supply the correct amount of food.

Explain how the data in Table 2.1 could be used to determine the amount of food needed for tilapia in different salinities.

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[Total: 8]

Section B

Answer **both** questions in this section.

3 **(a)** Define the term *ecotourism*.

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(b) The island of Nauru in the South Pacific traditionally relied upon phosphate mining and fishing as its main source of income. In recent years, the phosphate reserves have almost run out and the government has proposed the development of tourist resorts in an effort to boost the economy.

Explain the possible conflicts of interest that may occur between the fishing and tourist industries if resorts are developed, and describe how the resort should be built in order to minimise environmental damage.

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(c) Sport diving is an economically beneficial aspect of the tourist industry. In order to attract divers, many countries sink old ships around coastal areas.

Describe the possible positive and negative effects of this on the marine environment.

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[Total:15]

4 **(a)** Discuss and evaluate the evidence that global warming is occurring and that human activity is contributing to this process.

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(b) Suggest and explain how the productivity of a marine ecosystem could be affected by global warming.

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.....[6]

[Total:15]

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