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 **May/June 2016**

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.

CAMBRIDGE International Examinations

Section A

Answer **both** questions in this section.

1 Coral bleaching occurs when environmental stress causes coral polyps to release their zooxanthellae into the water. This may lead to the death of the coral.

Many factors have been suggested to cause coral bleaching, including elevated temperature and high exposure to solar radiation.

An experiment was performed to investigate the effects of elevated temperature and increased exposure to solar radiation on the bleaching of coral.

Three approximately equal-sized pieces of a reef-building coral, *Pocillopora damicornis*, were placed into an aquarium tank filled with sea water. The tank was illuminated by a fluorescent lamp that produced radiation similar to solar radiation, with an adjustable light filter placed beneath it. The tank also had a thermostatically-controlled heating element.

Fig. 1.1 shows how the apparatus was assembled.

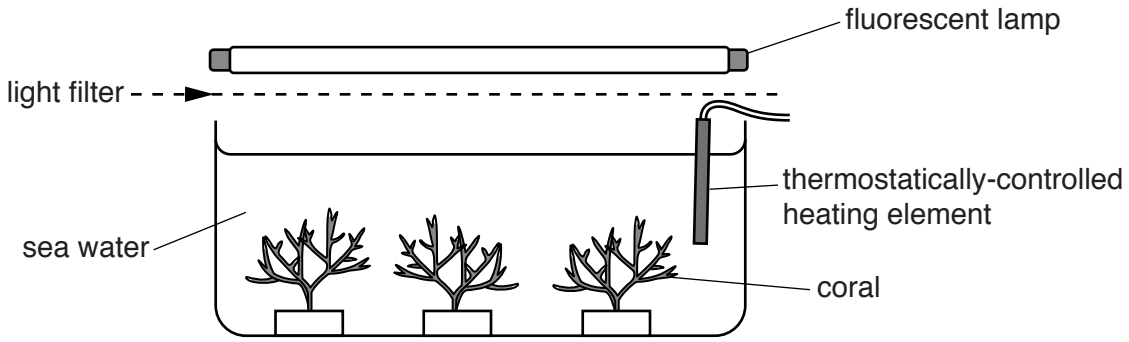

Fig. 1.1

The experiment was carried out as follows:

- The temperature was set to 26 °C.
- A light filter that exposed the coral to low level solar radiation was inserted.
- The corals were left for 15 days and then removed from the water.
- The mean number of zooxanthellae per polyp was then determined by counting them under a microscope.
- The experiment was then repeated with light filters that generated medium and high solar radiation exposures.
- The effects of all three light exposures at 30 °C were then investigated.

The results are shown in Fig. 1.2.

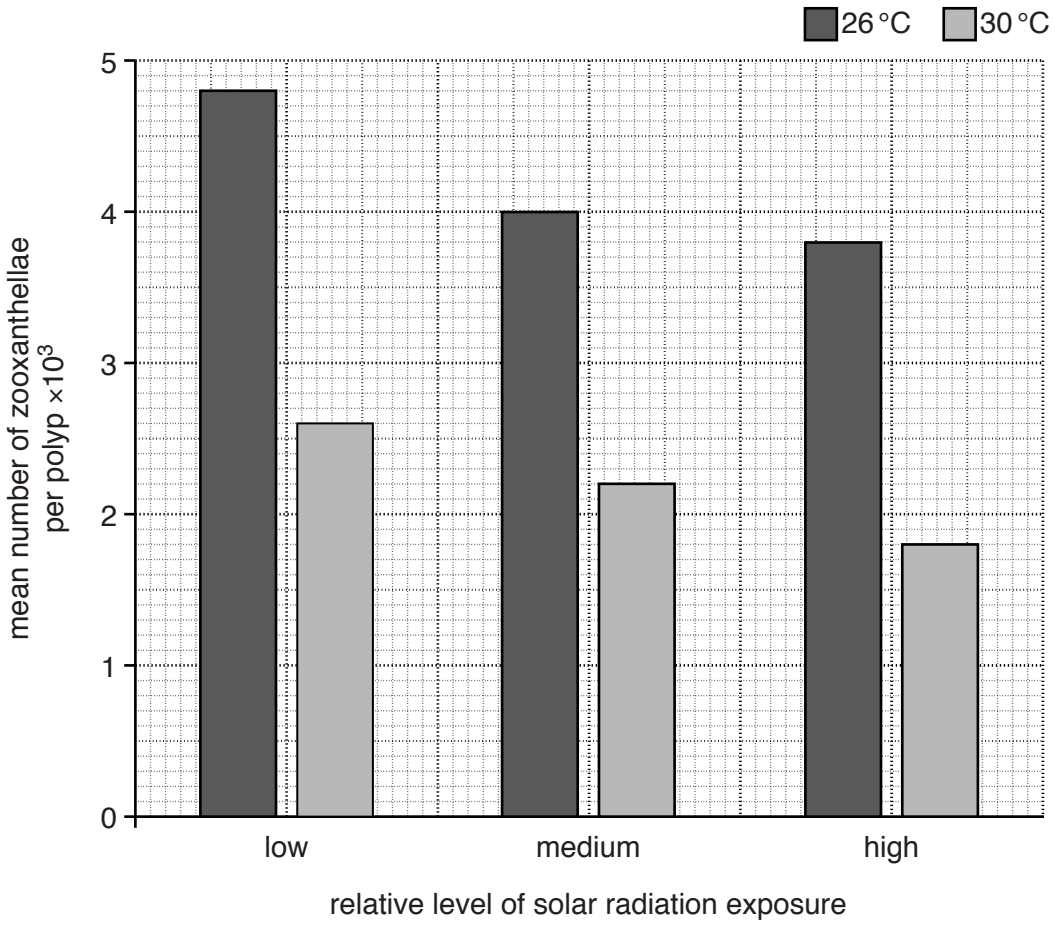

Fig. 1.2

(a) Describe the effects of solar radiation exposure and temperature on the mean number of zooxanthellae per polyp.

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(b) Changes in salinity are also thought to cause coral bleaching.

Describe a laboratory experiment that could be carried out to investigate how changing salinity affects coral bleaching.

Your answer should include reference to the control of variables and the collection of quantitative results.

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(c) During the El Niño event of 1997–1998, changes in temperature in the Indian Ocean caused massive coral reef bleaching in the Seychelles. Fisheries reported reduced catches of several species of fish up to ten years later.

Suggest an explanation for the reduced catches of different fish species.

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[Total: 10]

2 In intensive aquaculture projects, the high density of fish populations often encourages the growth of parasites and pathogenic bacteria. The presence of both of these factors contributes to the development of gill lamellae hypertrophy.

Gill lamellae hypertrophy is a condition where the gill lamellae cells enlarge, eventually causing the secondary and primary gill lamellae to shorten, fuse together and thicken. The gills also produce large quantities of mucus.

Fig. 2.1 shows a fish gill with both normal and hypertrophic lamellae.

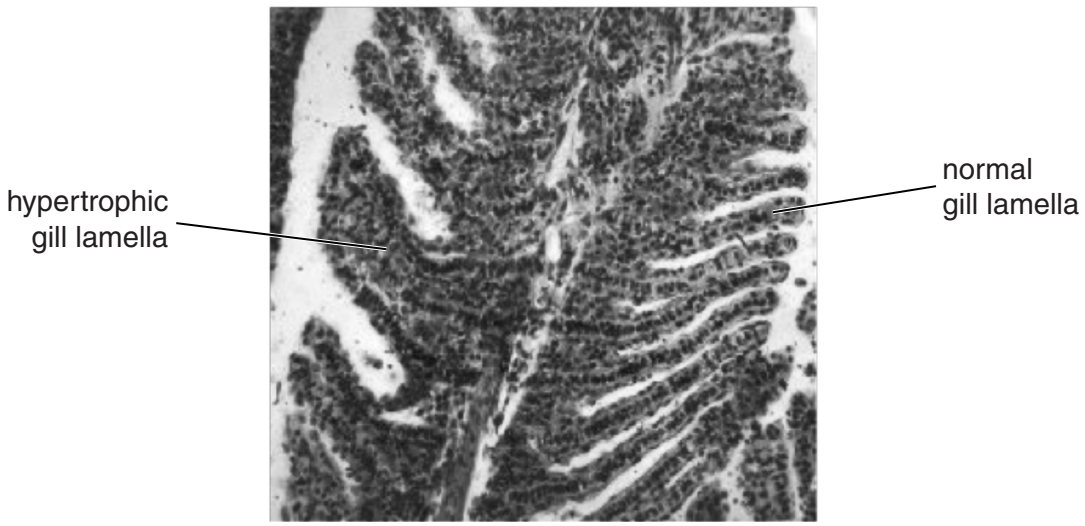

Fig. 2.1

(a) Suggest and explain how gill hypertrophy would reduce the growth of a fish.

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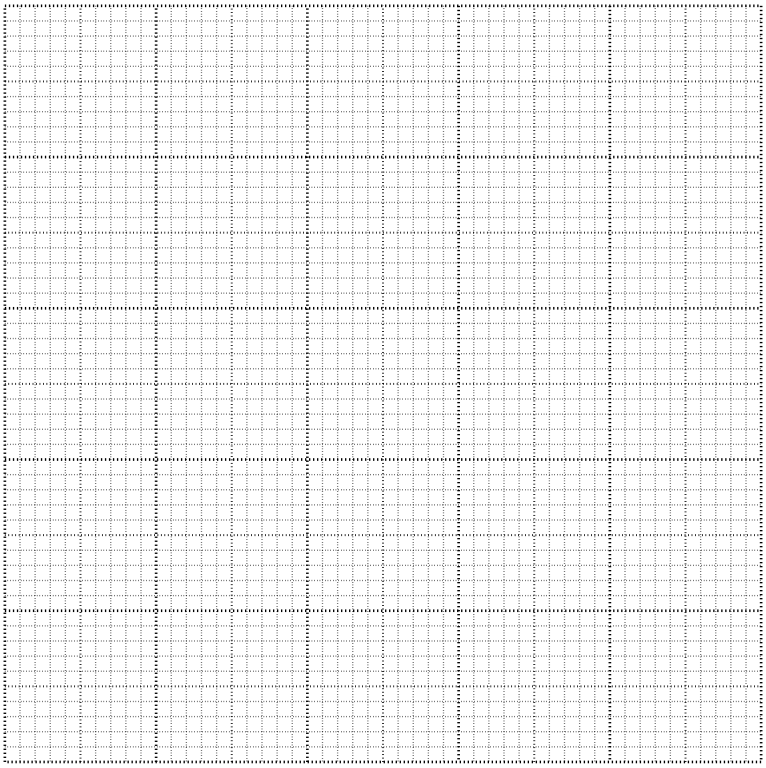
(b) The oxygen concentration of water is affected by temperature. Table 2.1 shows the concentration of oxygen in water at a range of temperatures.

Table 2.1

temperature / °C	oxygen concentration / mg dm^{-3}
0	14.6
5	12.8
10	11.4
15	10.2
20	9.2

(i) Using the data in Table 2.1, plot a graph to show how temperature affects the concentration of oxygen in water. You should read question **2(b)(ii)** before plotting your graph.



[3]

(ii) Use your graph to predict the oxygen concentration at a temperature of 25 °C.

oxygen concentration ..... mg dm^{-3} [2]

(c) Suggest why fish with gill hypertrophy are more likely to suffer higher mortality in warmer conditions.

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[Total: 10]

Section B

Answer **both** questions in this section.

3 **(a)** State **two** differences between *extensive* and *intensive* aquaculture systems.

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(b) Outline the processes used for the sustainable aquaculture of the grouper.

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(c) In Costa Rica there are areas of outstanding natural coastal beauty which attract many tourists. The demand for shrimps has also led to the government encouraging aquaculture projects.

Discuss how these two industries could come into conflict.

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[Total: 15]

4 Oil and other pollutants have a significant impact on marine ecosystems.

(a) Compare and contrast the ecological impacts of the wreck of an oil-filled tanker and a vessel deliberately sunk as a wreck dive.

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(b) In an effort to reduce the effects of mercury pollution, the Environmental Protection Agency in the United States of America published dietary advice for pregnant women.

Pregnant women are advised that it is safe to consume fish from lower trophic levels, such as cod, without restriction. Top predators, such as shark and swordfish, should be consumed no more than once a month.

Explain the scientific reasoning behind this advice.

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[Total: 15]

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