UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education
Advanced Subsidiary Level and Advanced Level

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

7269387727

MARINE SCIENCE **9693/04**

Data-Handling and Free-Response **October/November 2012**

Paper 4

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 on both sides of the paper.
You may use a soft pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

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.

Section A
Answer **all** questions.
Write your answers in the spaces provided on the question paper.

Section B
Answer **all** questions.
Write your answers on the lined pages provided.

Electronic calculators may be used.

For Examiner's Use	
1	
2	
3	
4	
Total	

This document consists of **13** printed pages and **3** blank pages.

Section A

For Examiner's Use

Answer **both** questions in this section.

1 *Fucus spiralis* is a brown alga found on rocky shores. An investigation was carried out into the effect of temperature on the rate of photosynthesis of this alga.

A piece of the alga was placed into a boiling tube containing a solution of sodium hydrogencarbonate and illuminated with a constant light intensity (Fig. 1.1).

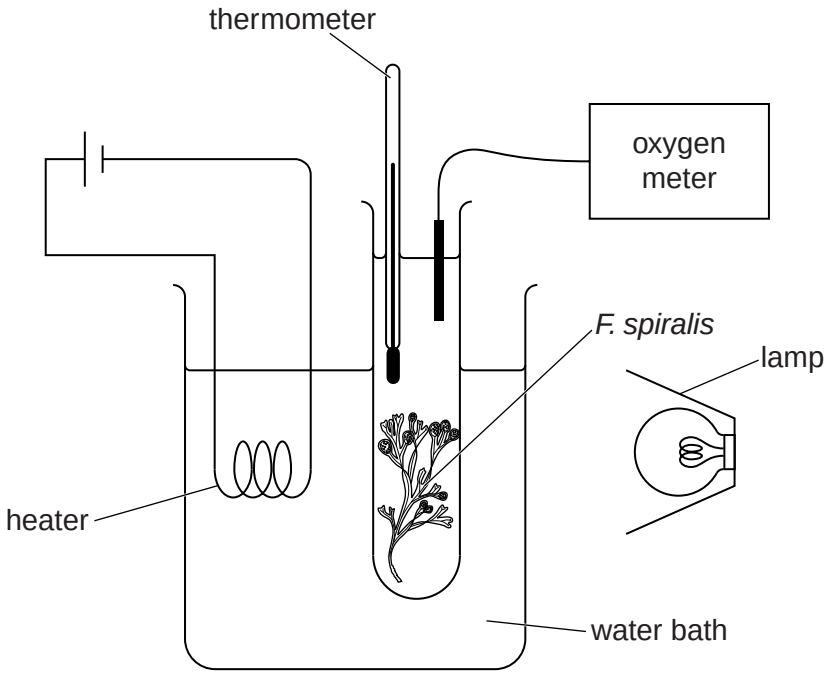

Fig. 1.1

The rate of oxygen production by the alga was measured using an oxygen meter over a period of 24 hours. The investigation was carried out at eight different temperatures between 2 °C and 30 °C.

Table 1.1 shows the results of this investigation.

Table 1.1

temperature / °C	rate of oxygen production / $mm^3 hr^{-1}$
2	4
6	9
10	15
14	19
18	20
22	21
26	21
30	20

(a) (i) Plot a graph of rate of oxygen production against temperature. Draw a curve of best fit.

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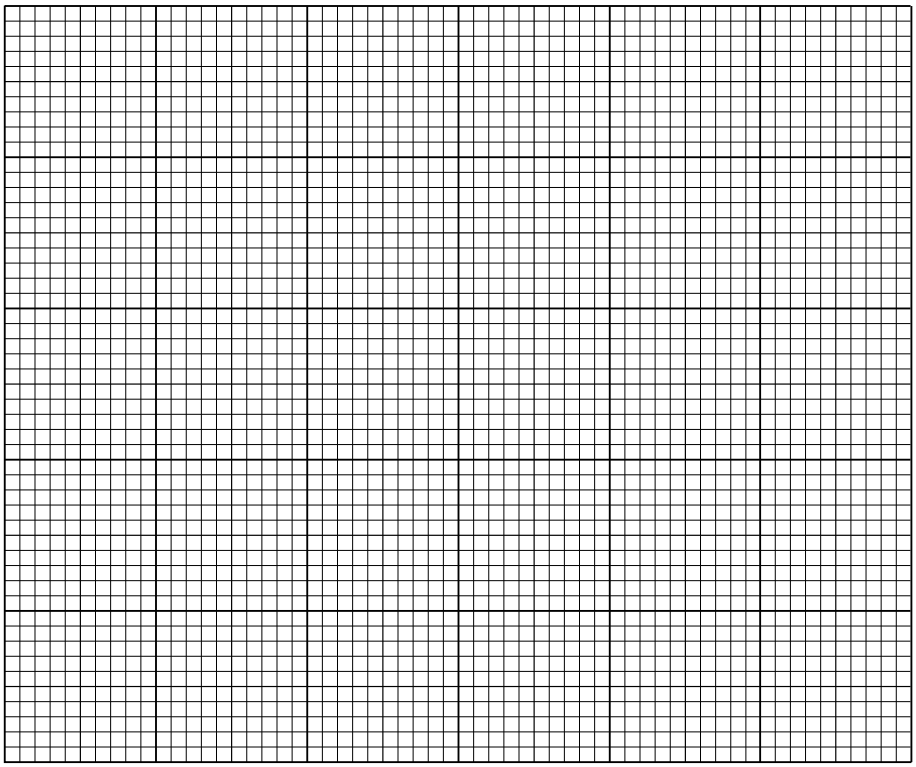

[3]

(ii) Using the information in Table 1.1 and your graph, describe the effect of increasing the temperature on rate of photosynthesis of this alga and suggest an explanation.

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(iii) Sketch a curve on your graph in **1(a)(i)** to predict the effect of repeating the investigation at a reduced light intensity. [1]

A separate investigation was carried out into the effect of temperature on the rate of respiration of the alga.

The alga was kept in the dark and the volume of oxygen removed by the alga from the water over a 24 hour period was measured.

The investigation was carried out at eight different temperatures in equal increments between 2 °C and 30 °C. The results are shown in Table 1.2 and Fig. 1.2.

Table 1.2

temperature / °C	**rate of oxygen consumption / $mm^3 hr^{-1}$**
2	2
6	8
10	9
14	11
18	16
22	17
26	18
30	24

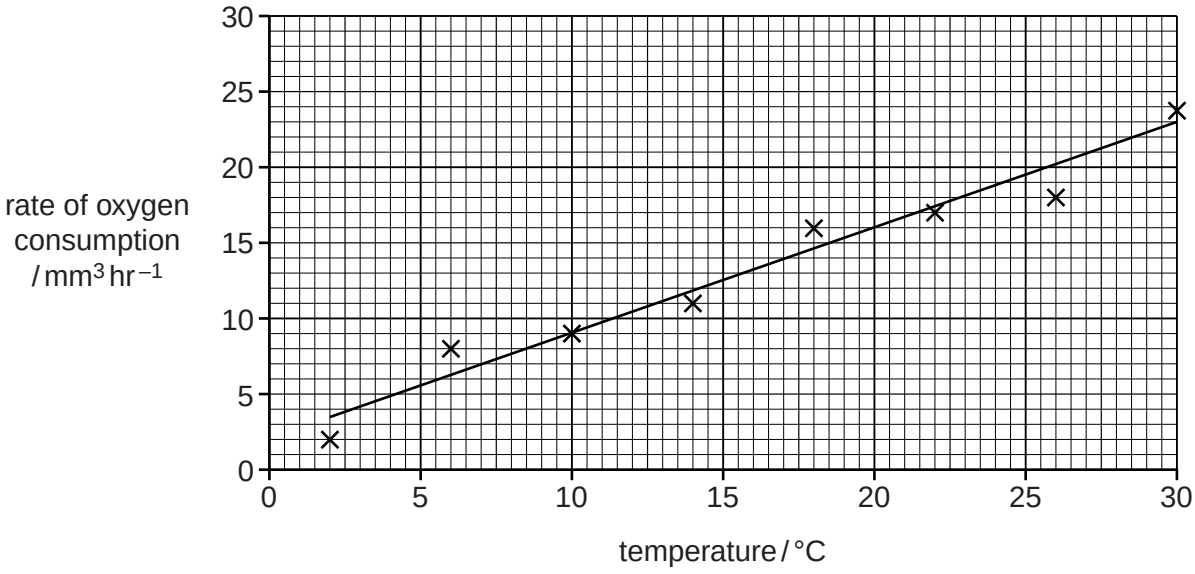

Fig. 1.2

(b) It is predicted that the mean global temperature could rise over the next 50 years. Use your graph in **1(a)(i)** and Fig. 1.2 to suggest why a temperature rise could lead to the alga failing to survive in certain areas.

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[Total: 11]

2 **(a)** Coral polyps use their body surface to undergo gas exchange. Fig. 2.1 shows a single coral polyp from a coral colony.

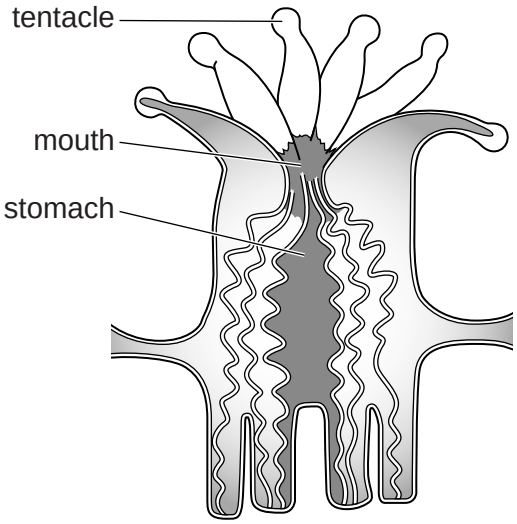

Fig. 2.1

(i) Each tentacle approximates in shape to a cylinder with length 20 mm and radius 5 mm.

Calculate the surface area of one of these tentacles using the following formula.

surface area of a cylinder = $\pi r^2 l$ (r = radius, l = length of the cylinder, π = 3.14)

[1]

(ii) Fick's Law states that the rate of diffusion is proportional to

$$\frac{\text{surface area} \times \text{concentration gradient}}{\text{thickness of exchange surface}}$$

Use Fick's Law to suggest how the coral polyp is adapted to maximise the rate of diffusion of oxygen into its body, other than by having a large surface area.

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(b) Larger, more active organisms such as the grouper have respiratory exchange structures which increase the rate of gas exchange.

Suggest why the grouper requires a specialised exchange system rather than relying on simple diffusion of gases through the skin.

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[Turn over

(c) An experiment into the pump ventilation method of the grouper was carried out. The pressure of the water was measured in both the buccal cavity and opercular cavity. Fig. 2.2 shows the flow of water through the gills and the pressure changes during one breathing cycle.

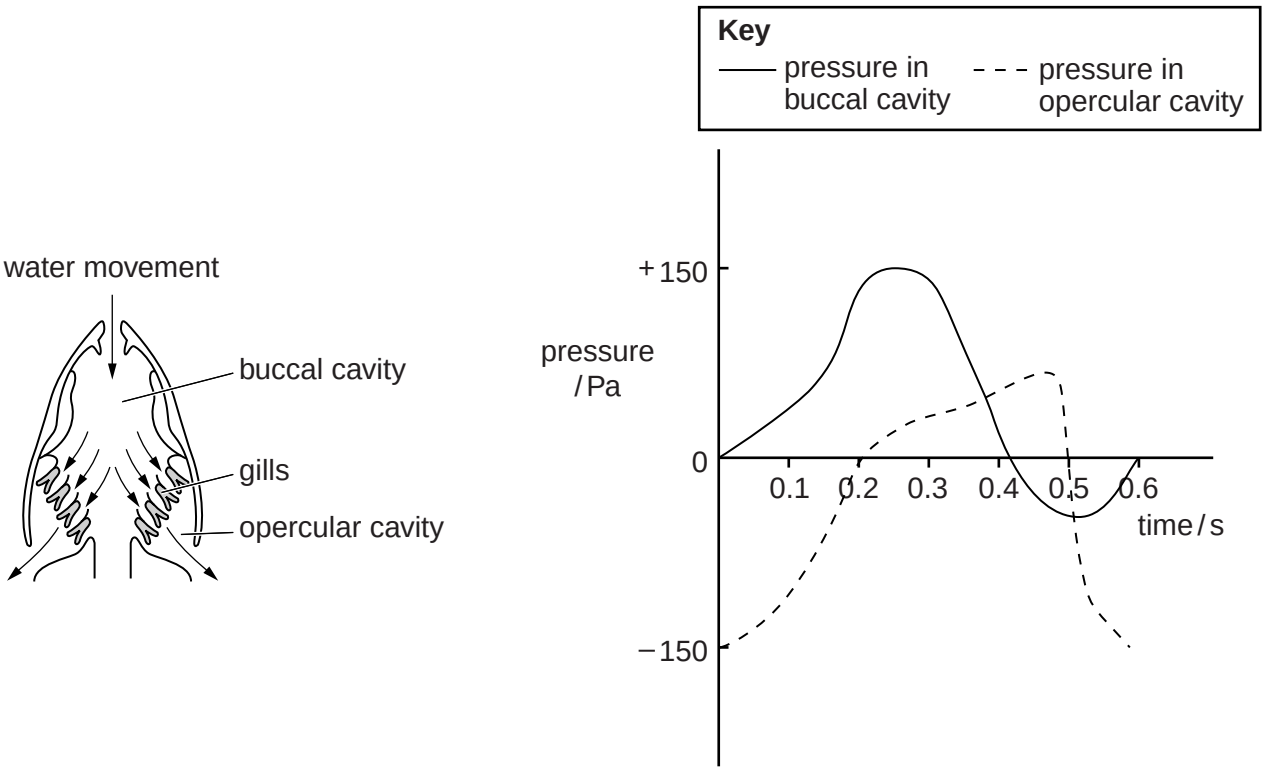

Fig. 2.2

(i) Use the information in Fig. 2.2 to calculate the number of times that water is pumped over the gills in one minute.

..... [1]

(ii) Use the letter **F** to clearly label on the graph in Fig. 2.2 the **two** periods where water is flowing from the buccal cavity to the opercular cavity. [1]

(iii) Use the letter **C** to clearly label on the graph in Fig. 2.2 the point at which the operculum closes. [1]

[Total: 9]

Section B

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Answer **all** questions in this section.

Write your answers on the lined pages provided.

3 **(a)** Describe the life cycle of the oyster. State the principal habitats for each stage and explain why these habitats are advantageous to the oyster. [6]

(b) Shellfish such as oysters are now often produced by aquaculture businesses. Identify the possible major impacts of such an aquaculture business on the ecology and economy of a coastal area. [6]

(c) Suggest **three** ways in which the negative effects of an aquaculture business on the environment could be minimised. [3]

[Total: 15]

4 **(a)** Describe the information that would be needed in order to assess how best to exploit fish stocks on a sustainable basis. [5]

(b) State **two** principals that a fisheries regulating body may use to ensure that fish stocks are maintained at a sustainable level. In each case discuss the advantages and disadvantages. [6]

(c) Suggest and explain the conflicts of interest that may exist between the fisheries industry and tourist industry of a coastal area. [4]

[Total: 15]

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