



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

CANDIDATE  
 NAME

CENTRE  
 NUMBER

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 NUMBER

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**MARINE SCIENCE**

**9693/04**

Data-Handling and Free-Response

**October/November 2013**

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 in the spaces provided on the question paper.

Electronic calculators may be used.

For Examiner's Use	
1	
2	
3	
4	
<b>Total</b>	

This document consists of **11** printed pages and **1** blank page.



## Section A

Answer **both** questions in this section.

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1. A laboratory investigation into photosynthesis by marine algae was carried out.

A mark was made 20 cm above the base of a 100 cm<sup>3</sup> measuring cylinder. The measuring cylinder was then filled with saline solution, to which sodium hydrogencarbonate was added.

Green algae were trapped in beads of a transparent, jelly-like substance called sodium alginate. Ten of these beads were added to the measuring cylinder. The beads sank to the bottom

A lamp was placed 15 cm from the measuring cylinder, as shown in Fig. 1.1.

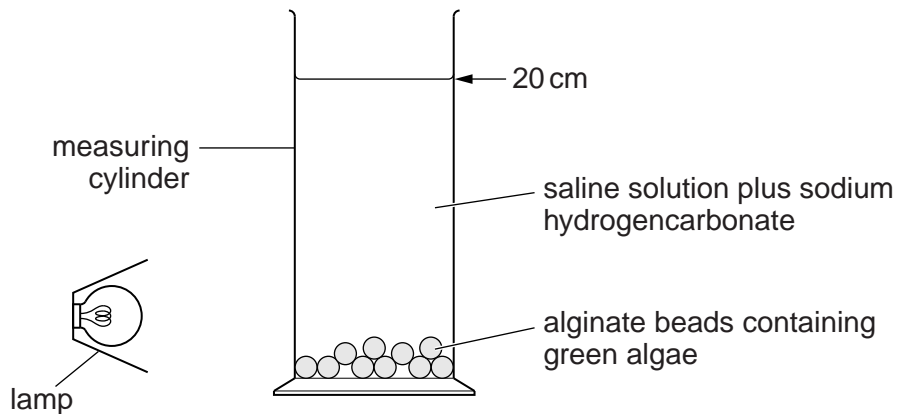


Fig. 1.1

The time taken for each bead to float to the surface was measured. The results are shown in Table 1.1.

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**Table 1.1**

bead number	time taken for bead to rise/s
1	135
2	166
3	174
4	183
5	185
6	185
7	196
8	210
9	292
10	295

- (a) (i) Using your knowledge of photosynthesis, suggest why the beads floated after illumination.

..... [1]

- (ii) Suggest why the sodium hydrogencarbonate was added to the saline solution.

..... [1]

- (iii) The **rate** at which the beads rise can be calculated from the time taken to rise a given distance.

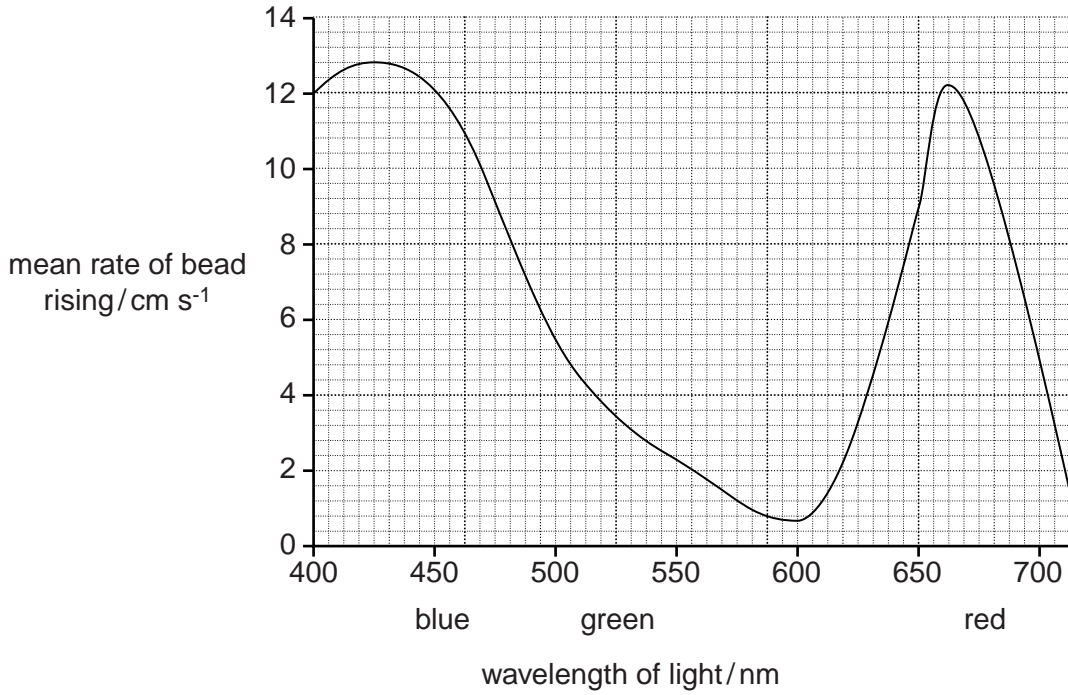
Use the information given in Fig. 1.1 and Table 1.1 to calculate the **mean** rate at which the beads rise.

[2]

(b) The beads were then exposed to different wavelengths of light.

The results are shown in Fig. 1.2.

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**Fig. 1.2**

(i) With reference to Fig. 1.2, describe how changing the wavelength of light affects the rate of photosynthesis.

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..... [3]

(ii) Using your knowledge of photosynthesis, explain the pattern of results shown in Fig. 1.2.

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..... [2]

(c) Fresh alginate beads containing algae were made and allowed to settle to the bottom of the measuring cylinder.

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The beads were left in **complete darkness** for 24 hours.

During this period, these beads also rose to the surface.

Suggest why these beads rose.

.....

.....

.....

..... [2]

**[Total: 11]**

2. An ecological investigation was carried out into the effects of an extensive aquaculture system located in an estuary. The aquaculture was designed to produce large quantities of shrimps.

Samples of water were taken at 10m intervals downstream from the aquaculture site. The turbidity, nitrate concentration and oxygen concentration of the samples were determined. Turbidity is a measure of cloudiness which is affected by the quantity of sediment suspended in the water.

The results are shown in Fig. 2.1.

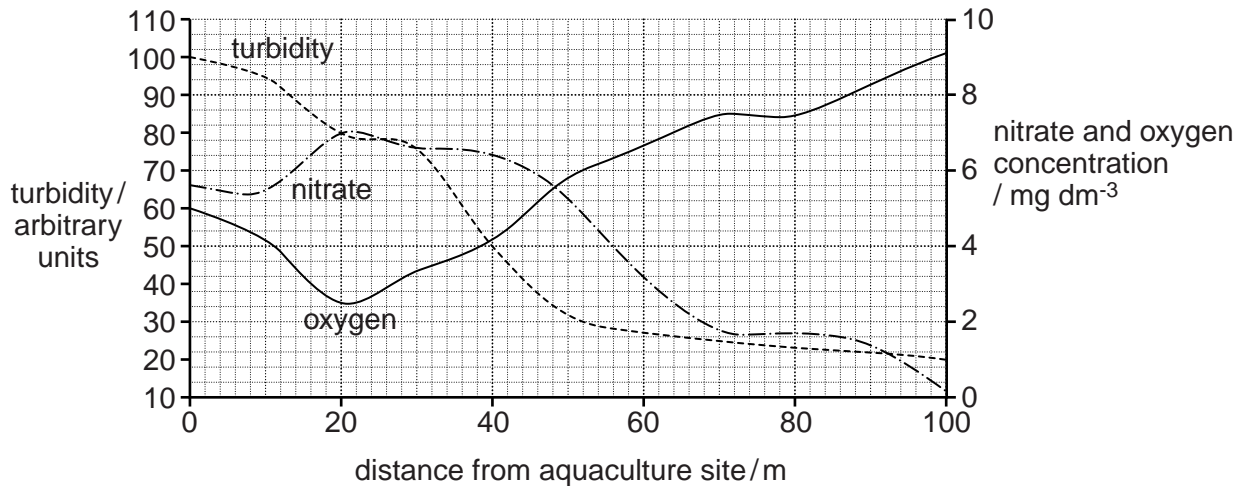


Fig. 2.1

Fish were netted at 10m intervals downstream from the aquaculture site. The numbers of salmon and carp (a freshwater fish) are shown in Fig. 2.2.

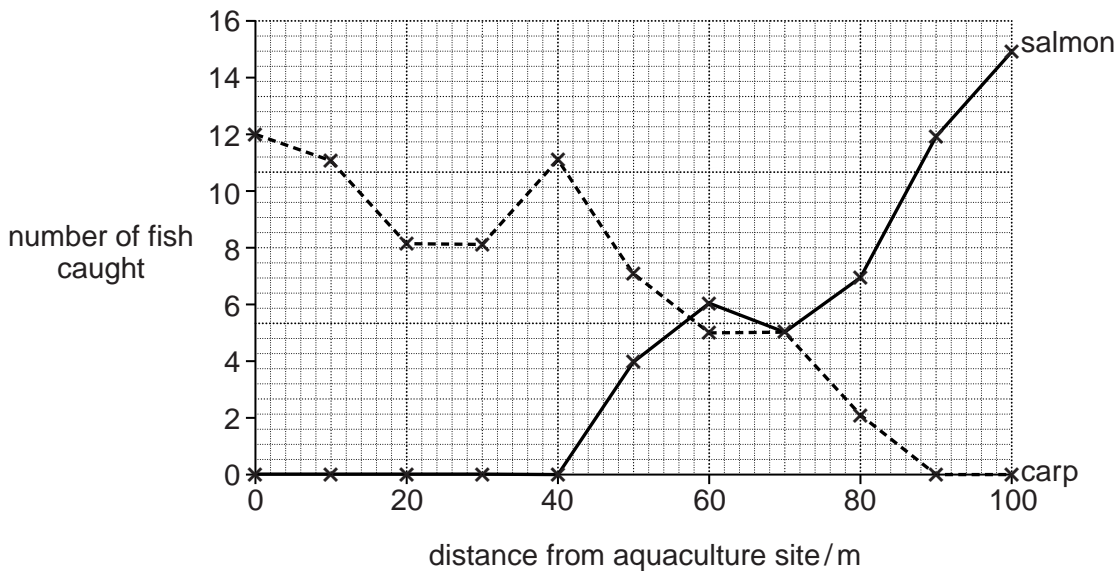


Fig. 2.2

(a) Explain the pattern shown by the nitrate concentration in Fig. 2.1.

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..... [3]

(b) Explain the pattern shown by the oxygen concentration in Fig. 2.1.

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..... [3]

(c) Suggest explanations for the distributions of the salmon and carp shown in Fig. 2.2.

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.....  
..... [3]

**[Total: 9]**

**Section B**

Answer **all** questions in this section.

Write your answers on the lined pages provided.

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**3 (a)** Define the following terms.

**(i)** *gene*

..... [1]

**(ii)** *genetic engineering*

..... [1]

**(iii)** *gene promoter*

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..... [2]

**(b)** Suggest how biotechnology could be used to reduce oil pollution on beaches and in the sea after a crude oil spillage.

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..... [3]









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