Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME

CENTRE NUMBER | | | | | |

CANDIDATE NUMBER | | | | |

2370902726

MARINE SCIENCE **9693/04**

Paper 4 A2 Data-Handling and Free-Response **October/November 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 (a) An investigation was carried out into the effect of freezing on photosynthesis in algae.

Three different algal species were collected from a rocky shore in Maine, USA.

Fig. 1.1 shows the parts of the shore from which the algal species were collected.

One species was collected from each area, **A**, **B** and **C**.

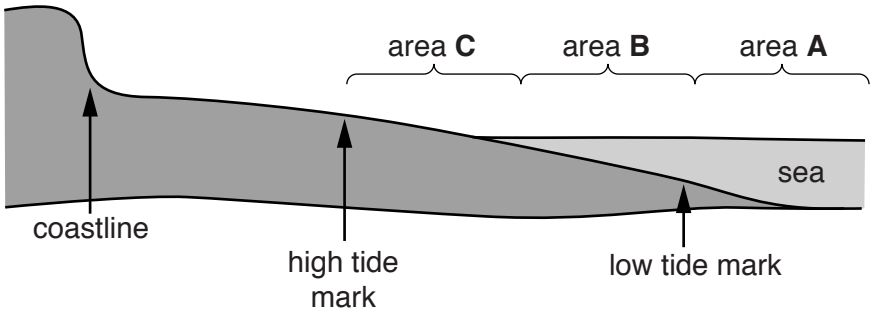

Fig. 1.1

All of the algae were placed into sea water at 15 °C. The algae in each species were then split into three samples, and exposed to different temperatures:

- 3 hours at 5 °C in sea water
- 3 hours at 5 °C in the air
- 3 hours at –20 °C in the air.

After exposure, the algae were placed into beakers containing sea water at 15 °C and illuminated for 20 minutes. The rates of photosynthesis were measured by observing the mean change in concentration of oxygen in the sea water.

The mean changes in oxygen concentration, along with the standard deviations, are shown in Table 1.1.

Table 1.1

		mean change in concentration of oxygen after 20 minutes illumination in sea water/μg dm^{-3}		
area of shore	**species**	**5 °C in sea water**	**5 °C in air**	**–20 °C in air**
A	*Dumontia contorta*	20.2 ± 4.0	16.4 ± 8.4	–3.6 ± 1.7
B	*Palmaria palmata*	12.2 ± 5.1	14.1 ± 5.8	–1.1 ± 4.7
C	*Fucus spiralis*	14.0 ± 4.6	12.2 ± 5.0	14.0 ± 5.2

(i) Suggest the purpose of the experiment carried out at 5 °C in sea water.

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(ii) Describe and explain the effect of the different treatments on the mean changes in oxygen concentration for the different species of algae.

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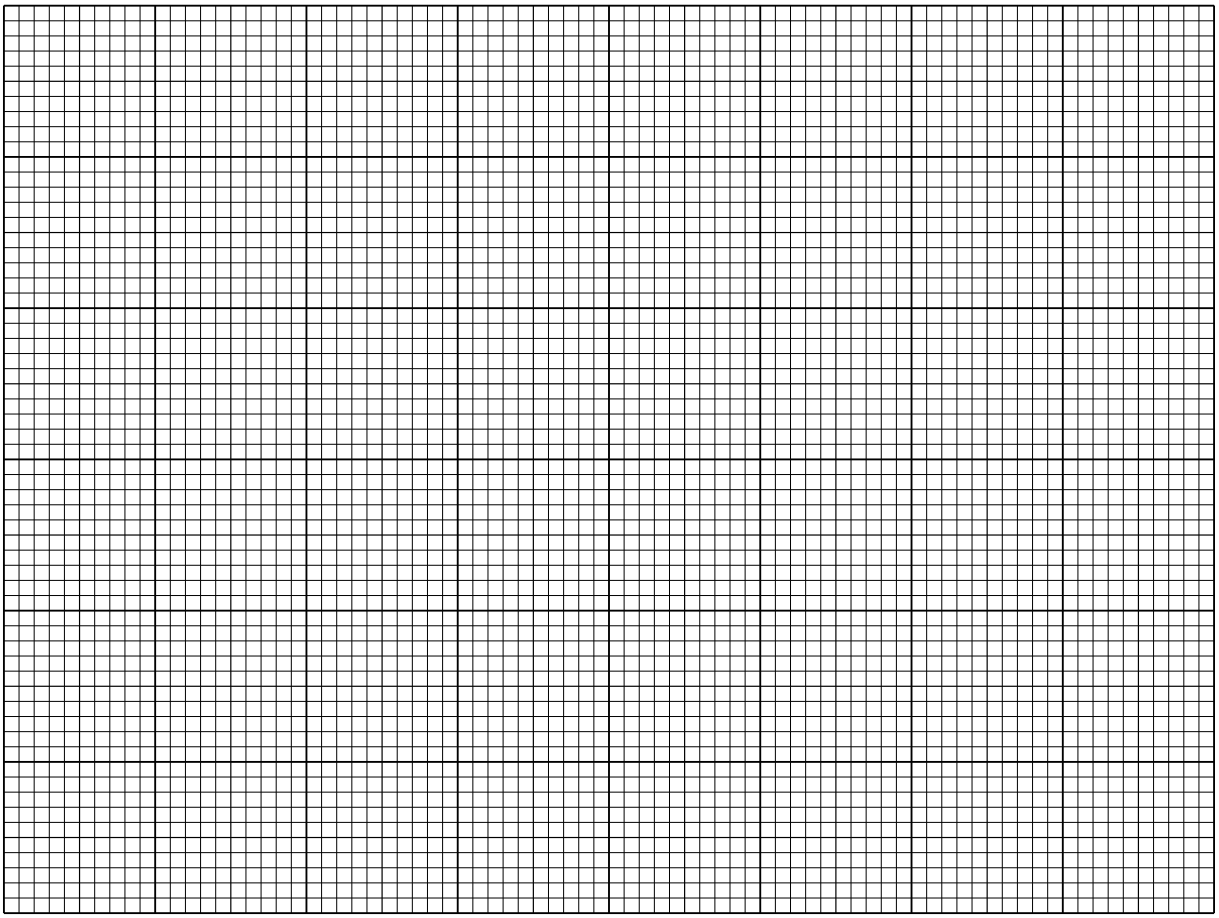
(b) In a further experiment, the effect of the exposure to a temperature of –20 °C on the release of amino acids from the algae was determined. Samples of each species were exposed to either –20 °C or 5 °C for 3 hours and the concentration of amino acids released into the water measured.

The quantity of amino acids released was expressed as a percentage of the total cellular amino acid content. The results are shown in Table 1.2.

Table 1.2

		percentage amino acid release	
area of shore	**species**	**5 °C**	**–20 °C**
A	*Dumontia contorta*	2.44	100.00
B	*Palmaria palmata*	0.16	47.40
C	*Fucus spiralis*	1.82	0.32

(i) Draw a graph to display the data in Table 1.2.



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(ii) Suggest a reason for the effect of temperature on amino acid release for the algae from areas **A** and **B**.

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(c) Using Table 1.1, Table 1.2 and your graph, suggest an explanation for the zonal distribution of the algae on the shore.

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[Total: 13]

2 Aquaculture is frequently used to grow large numbers of tilapia fish. Fish farmers often prefer to grow the fish in tanks that contain exclusively male fish.

Exposure of fish fry to the steroid hormone methyltestosterone causes female fry to undergo sex reversal into male fry. This hormone is often included in the food given to tilapia fry in order to generate tanks of male fish.

Temperature is also thought to affect the sex reversal process.

Researchers investigated the effect of temperature and addition of different concentrations of methyltestosterone on sex reversal of tilapia.

Tilapia fry were raised in tanks in a range of temperatures and methyltestosterone concentrations for 28 days. The percentage that were male were determined after the 28 day period.

The results are shown in Table 2.1.

Table 2.1

concentration of methyltestosterone / mg dm^{-3}	% male			
	26 °C	**28 °C**	**30 °C**	**32 °C**
0	55	51	45	57
20	77	80	74	79
40	92	78	91	82
60	92	81	87	82

(a) (i) Suggest **one** reason why it is more desirable to grow exclusively male tilapia.

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(ii) Suggest why consumer and environmental groups have objected to the use of methyltestosterone in aquaculture.

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(b) With reference to Table 2.1, discuss the relative effects of temperature and addition of methyltestosterone on sex reversal in tilapia.

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(c) It has been suggested that a more environmentally friendly method of ensuring more male tilapia would be to insert the gene for male sex determination into tilapia eggs to create GM tilapia. Evaluate this suggestion.

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Section B

Answer **both** questions in this section.

3 **(a)** Describe the causes of variations in salinity in coastal areas. Explain how organisms are affected by this and how they are adapted to tolerate it.

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(b) Carbon dioxide is another abiotic factor that affects marine organisms both directly and indirectly. Suggest why atmospheric carbon dioxide concentrations may change and how this may affect marine organisms.

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4 **(a)** State **three** of the principal methods that can be used to ensure that fish stocks are exploited on a sustainable basis.

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(b) Human activities in marine areas have had major impacts on marine biodiversity and many pressure groups have called for conservation measures to be put in place. One suggestion is the generation of marine nature reserves where no fishing and only very limited development may occur.

Explain the arguments for and against the setting up of such marine nature reserves.

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(c) In an effort to increase bluefin tuna populations, it has been suggested that young bluefin tuna could be grown in culture and then released into certain areas of the Pacific and Indian Oceans.

Suggest what factors should be considered before embarking on such a project.

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