

CANDIDATE
NAME

--

CENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--



MARINE SCIENCE

9693/02

Paper 2 AS 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 **10** printed pages and **2** blank pages.

Section A

Answer **both** questions in this section.

- 1 Fig. 1.1 shows a mussel (*Mytilus edulis*), a mollusc found in intertidal areas. Mussels are filter-feeders, feeding on small producers such as phytoplankton.



magnification $\times 1$

Fig. 1.1

- (a) State the trophic level occupied by mussels.

.....[1]

- (b) Fig. 1.2 shows part of a food web, including four predators of mussels. The figures show energy in kJ per m² per year.

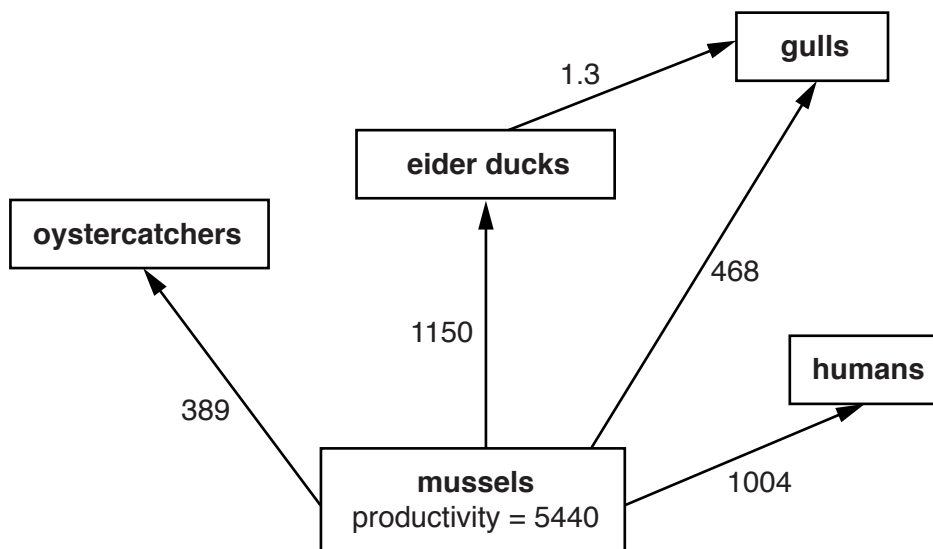


Fig. 1.2

- (i) Using the information in Fig. 1.2, calculate the total energy transferred to predators from mussels.

..... [2]

- (ii) Express your answer to (i) as a percentage of the productivity of mussels.
Show your working.

..... % [2]

- (iii) It has been estimated that mussels in this food web lose a further 2500kJ per m² per year as a result of their metabolism.

Suggest what effect the total energy losses have on the size of the mussel population.

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

[Total: 8]

- 2 (a) Atmospheric carbon dioxide dissolves in sea water and forms carbonic acid.

Table 2.1 shows the annual mean atmospheric concentration of carbon dioxide for five years.

Table 2.1

year	annual mean atmospheric concentration of carbon dioxide/parts per million
1959	315.97
1987	349.16
1992	356.38
1997	363.71
2012	393.82

Suggest how these changes in atmospheric carbon dioxide could affect the chemical composition of sea water.

.....

.....

.....

.....

.....

.....

.....

.....[3]

- (b) Changes in the chemical composition of sea water can affect the growth of corals.

In one study, researchers determined the growth rate of coral in two sites, **A** and **B**, in the Mesoamerican Barrier Reef System in the western Caribbean Sea.

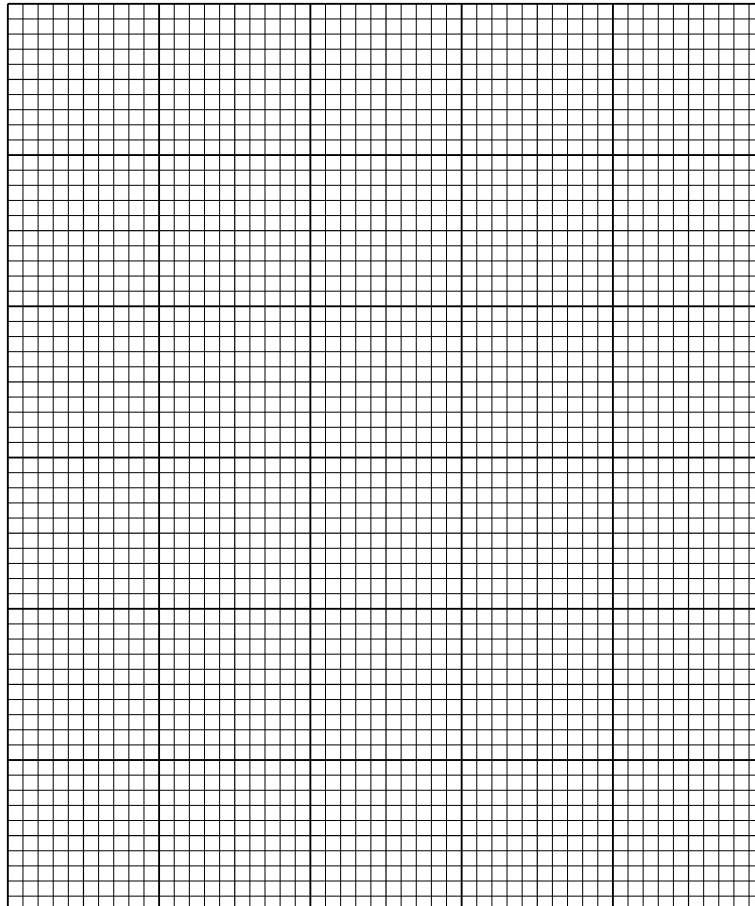
Cores of coral were extracted and growth rates were determined from X-ray images.

The results are shown in Table 2.2.

Table 2.2

years	mean annual growth rate /mm yr ⁻¹	
	site A	site B
1935 to 1949	5.7	4.3
1950 to 1964	4.7	4.6
1965 to 1979	4.6	4.3
1980 to 1994	4.3	4.3
1995 to 2008	3.3	4.5

- (i) On the grid below, plot line graphs of the two sets of data in Table 2.2. Join the points on your graph with ruled, straight lines.



[4]

(ii) Compare the changes in growth rate for the corals from these two sites.

.....
.....
.....
.....
.....[2]

(iii) Researchers proposed the following hypothesis:

As the concentration of carbon dioxide in the atmosphere increases, the growth rate of corals decreases.

Do the results of this investigation support or refute this hypothesis?
Give an explanation for your answer.

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

[Total: 12]

Section B

Answer **both** questions in this section.

3 (a) Explain the meaning of each of the following terms used in ecology.

(i) *habitat*

.....
.....[1]

(ii) *species*

.....
.....
.....
.....[2]

(b) With reference to an example from the marine environment, explain how populations of predator and prey may be interrelated.

.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....[6]

(c) Suggest why the concentration of dissolved oxygen may be lower in a tropical lagoon than in the open ocean.

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 15]

BLANK PAGE

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge International Examinations Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cie.org.uk after the live examination series.

Cambridge International Examinations is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.