

CANDIDATE  
NAME

--

CENTRE  
NUMBER

--	--	--	--	--

CANDIDATE  
NUMBER

--	--	--	--



**MARINE SCIENCE**

**9693/03**

Paper 3 A2 Structured Questions

**October/November 2016**

**1 hour 30 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.**

Answer **all** questions.

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.

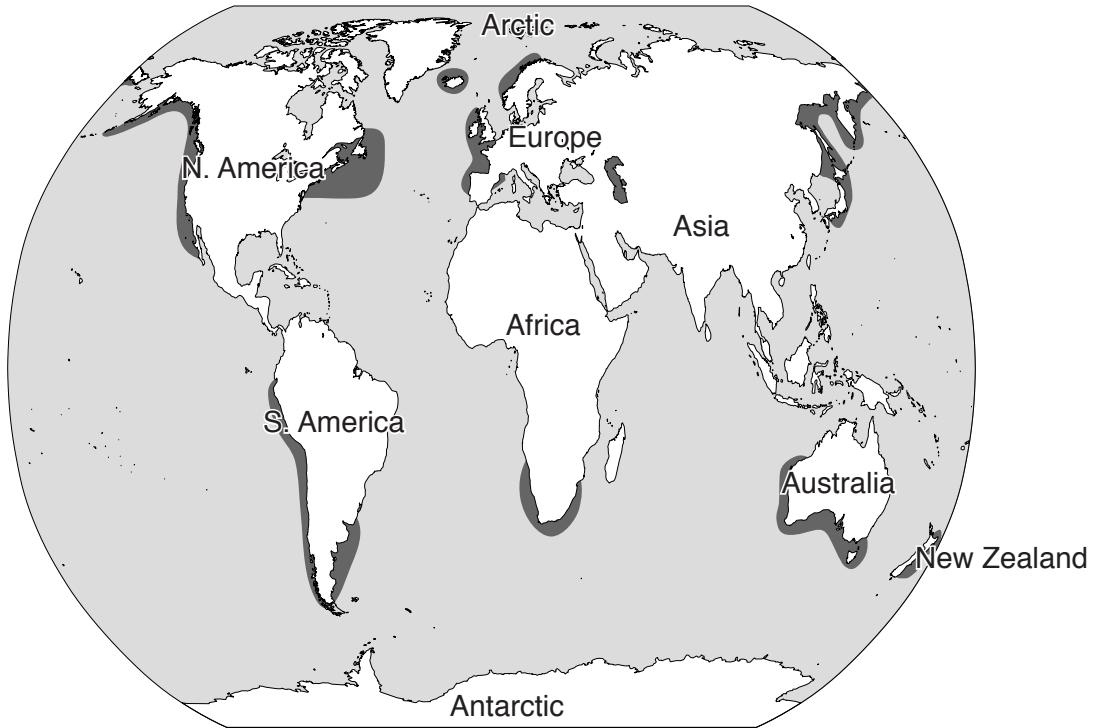
At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [ ] at the end of each question or part question.

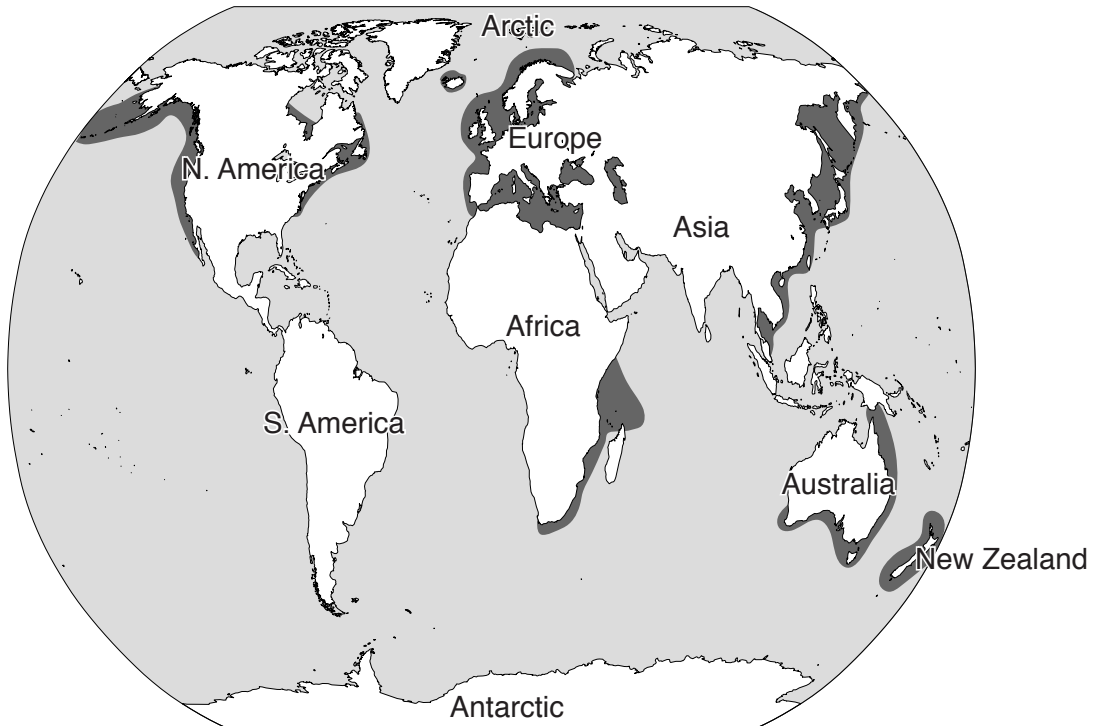
This document consists of **18** printed pages and **2** blank pages.

Answer **all** the questions in the spaces provided.

- 1 (a) Fig. 1.1 shows the world distribution of kelp and Fig. 1.2 shows the world distribution of sea grass.



**Fig. 1.1 Kelp**



**Fig. 1.2 Sea grass**

(i) Explain why kelp and sea grass are found next to coastlines.

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

(ii) Compare the world distributions of kelp and sea grass.

.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....[4]

(iii) Describe **two** ways in which kelp forests and sea grasses are important to the marine ecosystem.

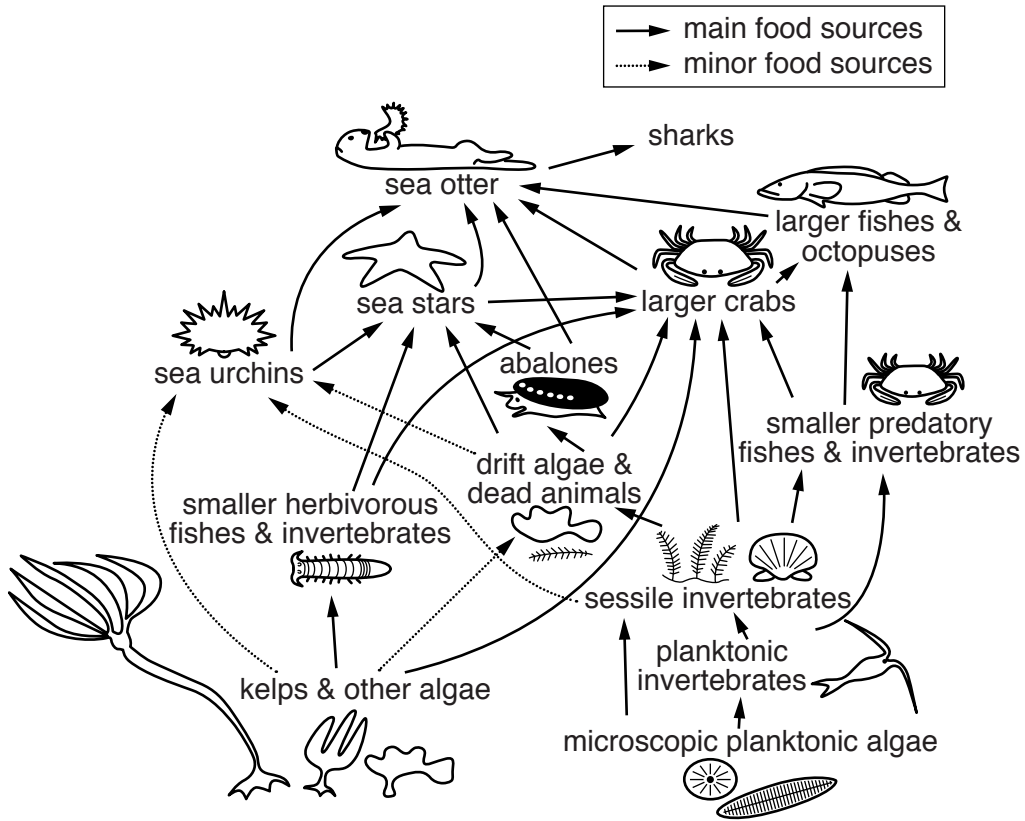
1 .....

.....

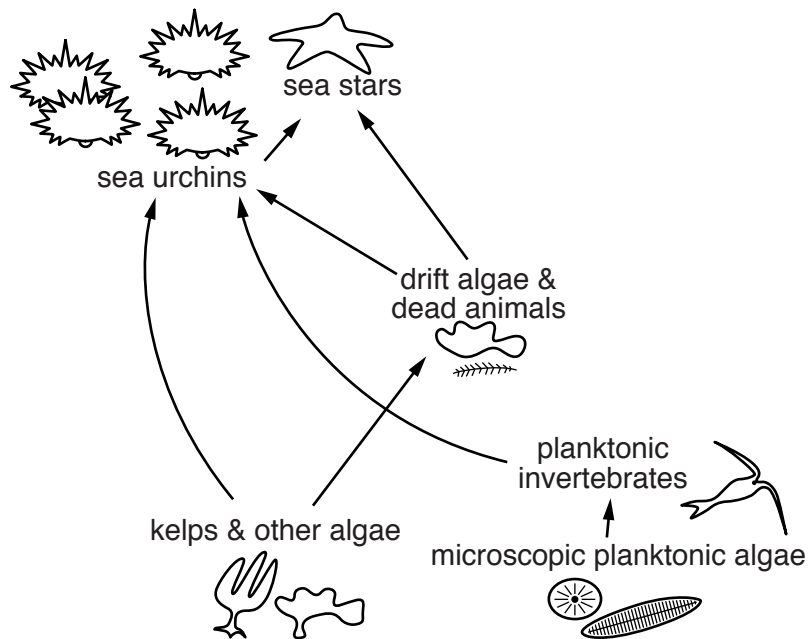
2 .....

.....[2]

- (b) Kelp forests have shown a progressive decrease in size due to human activities. Fig. 1.3 shows a food web of an undisturbed kelp forest. Fig. 1.4 shows the food web after overfishing and the hunting of sea otters for the fur trade.



**Fig. 1.3 Food web of an undisturbed kelp forest**



**Fig. 1.4 Food web of a kelp forest after sea otter hunting and overfishing**

Explain how overfishing and hunting of the sea otters for the fur trade have led to these changes in the food web.

.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....[4]

[Total: 13]

- 2 (a) The diffusion coefficient is a measure of how long it takes molecules to diffuse. It is calculated using the formula:

$$\text{diffusion coefficient} = \frac{\text{distance}^2}{\text{time}}$$

Oxygen diffusing in water takes about 10 milliseconds (ms) to diffuse 6 μm, which is approximately the radius of a fish red blood cell.

- (i) Calculate the diffusion coefficient for oxygen in water.

..... μm<sup>2</sup>ms<sup>-1</sup> [1]

- (ii) The eggs of Chinook salmon are 6000 μm in diameter, so the distance to the centre is 3000 μm.

Assume that the diffusion coefficient for oxygen is the same in a fish egg as in water. Use your answer to (i) to calculate the time taken for oxygen to diffuse to the centre of an egg. Show your working.

.....[2]

- (iii) The eggs of salmon depend on direct diffusion across their surface for their oxygen supply. After hatching, fish use gills to obtain their oxygen and a circulatory system to distribute it to cells.

Explain why young fish cannot depend on direct diffusion across their body surface to supply sufficient oxygen to their cells.

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

**(b) (i)** Salmon swimming at low speeds use pumped ventilation. Describe how pumped ventilation causes water to move across the gills.

.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....[4]

**(ii)** When swimming at high speed salmon change from pumped ventilation to ram ventilation. Describe how this increases the rate of oxygen uptake by the salmon.

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

[Total: 11]

3 (a) Fig. 3.1 shows the life cycle of an oyster.

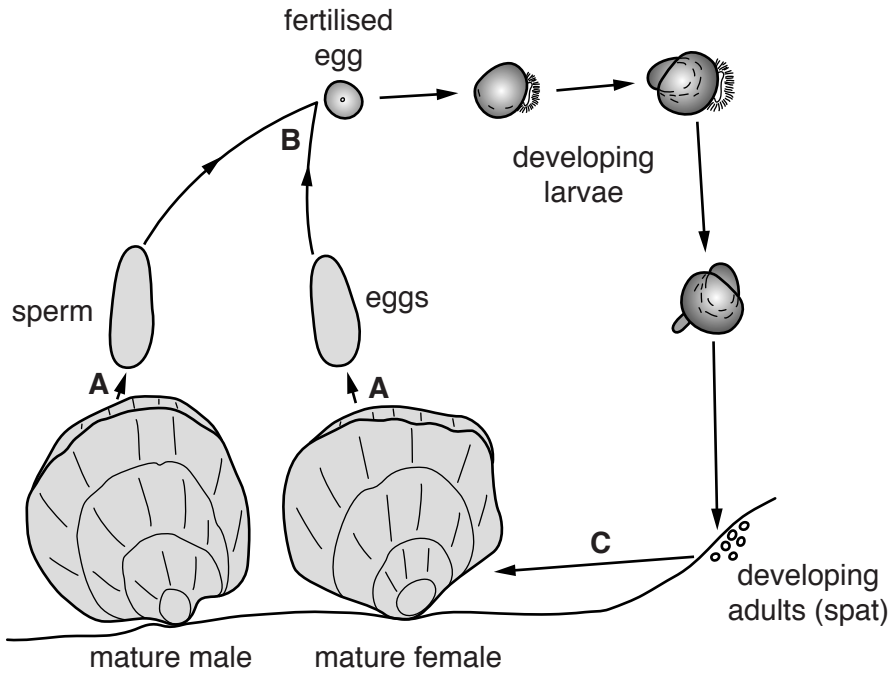


Fig. 3.1

(i) Name the process occurring at each of the stages **A**, **B** and **C**.

- A** .....
- B** .....
- C** .....[3]

(ii) A single female oyster can produce 100 million eggs per year. Suggest **one** reason why so many eggs are produced.

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

(iii) The final larval stages of an oyster and a giant clam are similar in that they both develop a foot. Suggest the purpose of the foot.

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



(b) Table 3.1 describes the habitats of larvae and adults of oysters, shrimp and giant clams.

**Table 3.1**

stage in life cycle	habitat		
	oyster	shrimp	giant clam
larvae		ocean surface then move to estuaries	ocean surface
adults	tidal areas/estuaries		

Complete Table 3.1 by writing in the information about the habitats of oysters, shrimp and giant clams. [3]

(c) Carbon dioxide concentration increased in the sea water around the western coast of Canada between 2010 and 2014, causing the pH to fall from pH 8.1 to pH 7.3. The increase in carbon dioxide concentration in the sea water has been blamed on human activity.

(i) Name **one** human activity that causes an increase in carbon dioxide in the air.

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

(ii) Explain how an increase in carbon dioxide in the air can cause the pH of sea water to fall.

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

(iii) Oysters reared in hatcheries on land are then transferred to the sea for several years before harvesting. In 2014, most of the oysters along the western coast of Canada died as a result of the fall in pH of the sea water.

Explain why a fall in the pH of sea water caused the death of oysters.

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

[Total: 13]

**[Turn over**

- 4 (a) Table 4.1 shows the total catch of fish for the Maldives from 1960 to 2006. This includes fish caught commercially and recreationally.

Table 4.1

year	1960	1970	1980	1990	2000	2006
total catch/tonnes	13000	37273	38624	78733	118963	184158

Explain **two** ways in which modern fishing technology could account for the increase in fish catch.

1 .....

.....

.....

.....

.....

.....

.....

2 .....

.....

.....

.....

.....

.....

.....[4]

- (b) Since 2006 the fish catch has decreased from 184 158 tonnes, reaching 83 100 tonnes in 2011.

(i) Explain how fishing practices could have caused this decrease.

.....

.....

.....

.....

.....

.....[2]

- (ii) About 5000 tonnes of the fish caught each year are consumed locally. The rest of the catch is the main export commodity of the Maldives.

Calculate the decrease in fish exports between 2006 and 2011.  
Show your working.

..... tonnes [1]

- (iii) Suggest how the fishing effort might be affected if the fish catch continues to decrease.

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

[Total: 9]

- 5 Most giant clams produced by aquaculture are harvested for the aquarium industry due to their colourful mantle. The colour is due to dinoflagellates which live in the mantle.

Fig. 5.1 shows the position of the mantle in a giant clam.

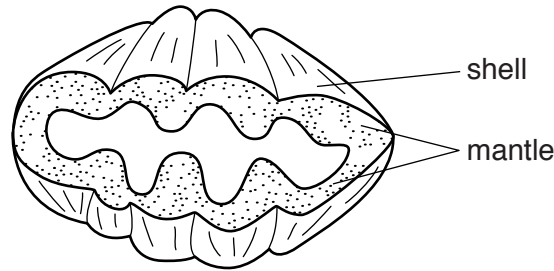


Fig. 5.1

- (a) Describe the mutualistic relationship between giant clams and dinoflagellates.

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

- (b) Aquaculture of giant clams takes place in land-based hatcheries. Filtered sea water is pumped through a series of tanks containing high densities of breeding adults, larvae or juveniles. The tanks are aerated and nutrients added if required.

- (i) Suggest why the sea water is filtered.  
.....  
.....  
.....[1]

- (ii) Identify **one** feature, other than filtration, of this aquaculture system that is typical of an intensive system.  
.....  
.....[1]

(c) The supply of giant clams to use for aquaculture does not meet demand. One of the main problems is the shortage of clams that are able to breed.

(i) With reference to your knowledge of the life-cycle of the giant clam, state why only clams over 2 years old are suitable for breeding.

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

(ii) To produce new individuals, hatcheries often use artificial methods to cause clams to spawn more often than usual. These include:

Method 1: A sex hormone is injected into the sex organs, deep inside the clam.

Method 2: The sex organs from a mature clam are removed, crushed and then added to the tank containing the adult clams to cause gamete release.

Method 3: An adult clam is subjected to heat shock, by being removed and placed on its side in the sun for a few hours.

Suggest **one** problem that might occur for each of the methods described.

Method 1 .....  
.....

Method 2 .....  
.....

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



**Question 6 starts on Page 16**

6 Read the information about a serious problem caused by dredging.

During 2013, dredging was carried out in the port of Mao on the Mediterranean island of Menorca. The sediment removed was dumped one mile offshore in an area where both recreational and commercial fishing occurs.

This sediment contained high concentrations of mercury. Bacteria in the sediment converted the mercury into a toxic methylmercury compound which can be absorbed by phytoplankton.

In January 2014, excessive concentrations of methylmercury were found in the muscle of some fish species caught around the island.

In samples of monkfish and scorpion fish the quantity was higher than the maximum concentration permitted by European regulations. In red mullet the quantity of methylmercury was below the permitted concentration.

(a) Explain why the sediment removed by dredging contained a high concentration of mercury.

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

(b) Fig. 6.1 shows a small part of the food web from this area.

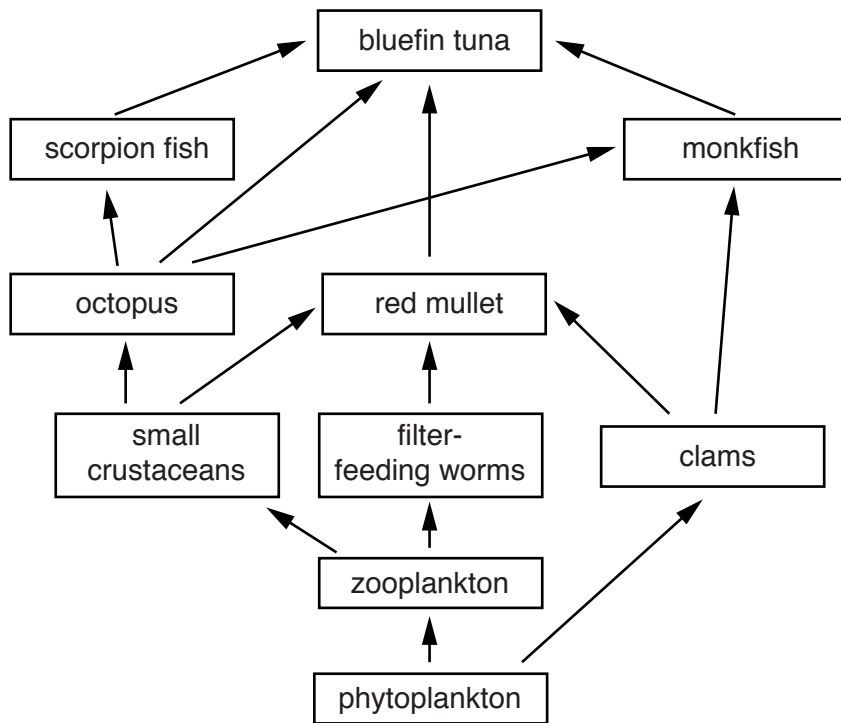


Fig. 6.1



- (i) With reference to Fig. 6.1, explain why monkfish and scorpion fish contain a higher concentration of methylmercury than red mullet.

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

- (ii) Identify a consumer in Fig. 6.1 that you would expect to have a similar concentration of methylmercury to the small crustaceans. Give a reason for your answer.

name of consumer .....

reason .....

.....[2]

- (iii) Explain why pregnant women should avoid eating too much bluefin tuna caught from this area.

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

- (c) The dumped material from dredging contains small particles of silt which become suspended in the sea water.

Explain how the suspended silt in sea water could affect the population of zooplankton.

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

- (d) Suggest **one** way in which the dredged material could be disposed of without harming the environment.

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

[Total: 11]





**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](http://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.