

CANDIDATE  
NAME

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CENTRE  
NUMBER

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**MARINE SCIENCE**

**9693/03**

Paper 3 A2 Structured Questions

**May/June 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 **16** printed pages.

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

- 1 (a) Explain what is meant by the term *osmoconformer*.

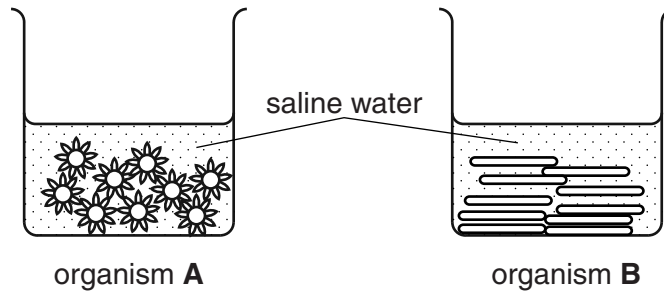
.....  
 .....[1]

- (b) An investigation was carried out using two different types of organism, **A** and **B**, that live in an environment where the salinity of the water surrounding these organisms changes regularly.

- (i) Name a type of habitat where the salinity of the water changes regularly.

.....[1]

In the investigation, several organisms of each type were first weighed and then placed in water of **three** different salinities, 8, 24 and 40 parts per thousand (ppt), as shown in Fig. 1.1.



**Fig. 1.1**

Each organism was weighed at 20 minute intervals for a total of 80 minutes. The mean change in mass for each organism was calculated.

Table 1.1 shows the results of this investigation.

**Table 1.1**

time/minutes	mean change in mass of organisms/arbitrary units					
	8 ppt		24 ppt		40 ppt	
	<b>A</b>	<b>B</b>	<b>A</b>	<b>B</b>	<b>A</b>	<b>B</b>
20	+ 4.2	+ 1.2	+ 1.8	+ 0.5	0.0	+ 0.2
40	+ 5.0	+ 1.0	+ 2.5	+ 0.4	+ 0.5	- 0.3
60	+ 6.2	+ 0.5	+ 2.8	+ 0.8	- 0.5	+ 0.4
80	+ 7.8	+ 0.8	+ 3.0	+ 0.3	- 0.8	+ 0.2

- (ii) Name the process that causes the change in mass of the organisms.

.....[1]

(iii) Describe how the mean changes in mass of organism **A** and organism **B** in a salinity of 8 parts per thousand differ between 20 minutes and 80 minutes.

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

(c) (i) Using the information in Table 1.1, describe the evidence that supports the conclusion that organism **A** is an osmoconformer and organism **B** is an osmoregulator.

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

(ii) Suggest why, in a salinity of 40 parts per thousand, organism **B** secretes chloride ions from its body.

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

[Total: 10]

2 (a) Table 2.1 shows some of the stages of the life cycle of the Atlantic salmon.

**Table 2.1**

stage in life cycle	habitat	time spent in stage
parr	freshwater	1–7 years
smolt	freshwater and seawater	2–3 months
adult	seawater	1–4 years

(i) The time spent in freshwater as parr varies with latitude.

Suggest why the further north the salmon live, the longer the time it takes to reach the next stage in its life cycle.

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

(ii) Outline the changes that occur when parr become smolt.

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

(b) In November 2013, a Canadian company was granted approval to produce GM (genetically modified) salmon eggs for commercial production in Canada.

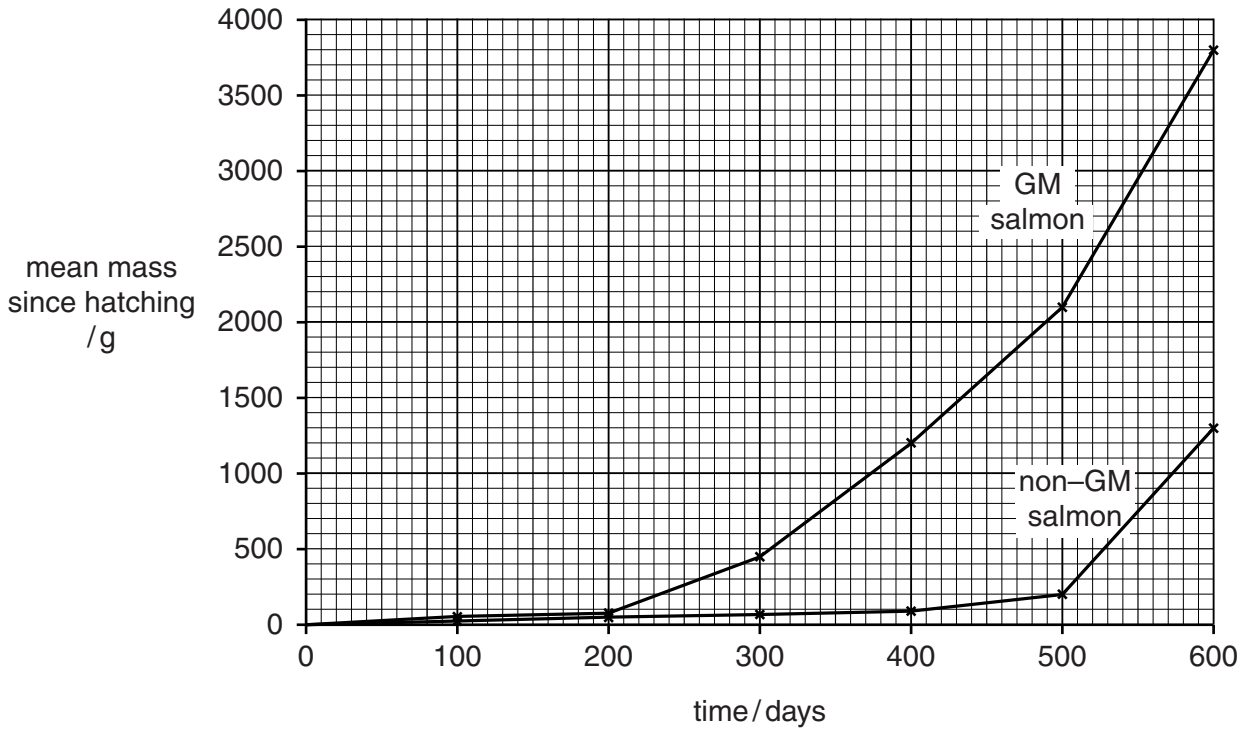
These GM salmon eggs carry a copy of the Chinook salmon gene that controls the production of growth hormone.

These salmon eggs also carry a promoter gene from the ocean pout.

State the purpose of the promoter gene.

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

(c) Fig. 2.1 shows the growth of GM salmon and non-GM salmon for a period of 600 days.



**Fig. 2.1**

(i) Use the information in Fig. 2.1 to calculate the difference in growth rate between GM salmon and non-GM salmon during the 600 day period.  
Show your working.

..... g per day [2]

(ii) The Canadian company claims that to achieve market size, GM salmon consume 25% less food than non-GM salmon.  
Using all the information given and your own knowledge, suggest the economic benefits of GM salmon production.

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



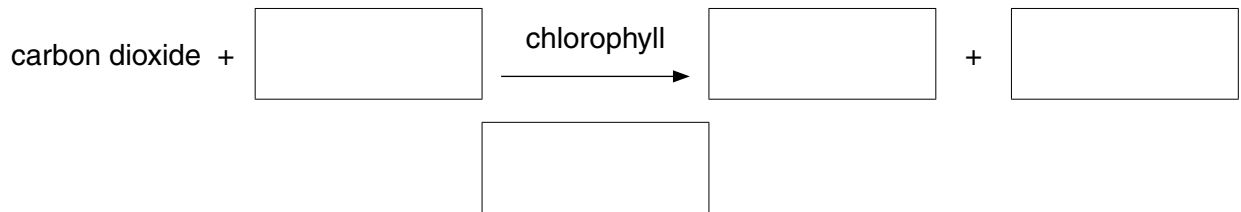
3 (a) Surface waters in the open ocean support many types of phytoplankton.

(i) State **one** example of a type of phytoplankton.

.....[1]

(ii) Phytoplankton fix carbon by photosynthesis.

Complete the word equation for photosynthesis.



[2]

(b) Phytoplankton are found in a water column that varies in depth from less than 50m to around 200m. The phytoplankton in the water column are continually mixed.

Phytoplankton growth and reproduction are affected by:

- the depth to which mixing of water takes place
- the critical depth, at which the quantity of carbon fixed by photosynthesis is equal to the quantity of carbon lost in respiration.

Fig. 3.1 shows phytoplankton numbers, depth of mixing and critical depth for March, June and November in the North Sea.

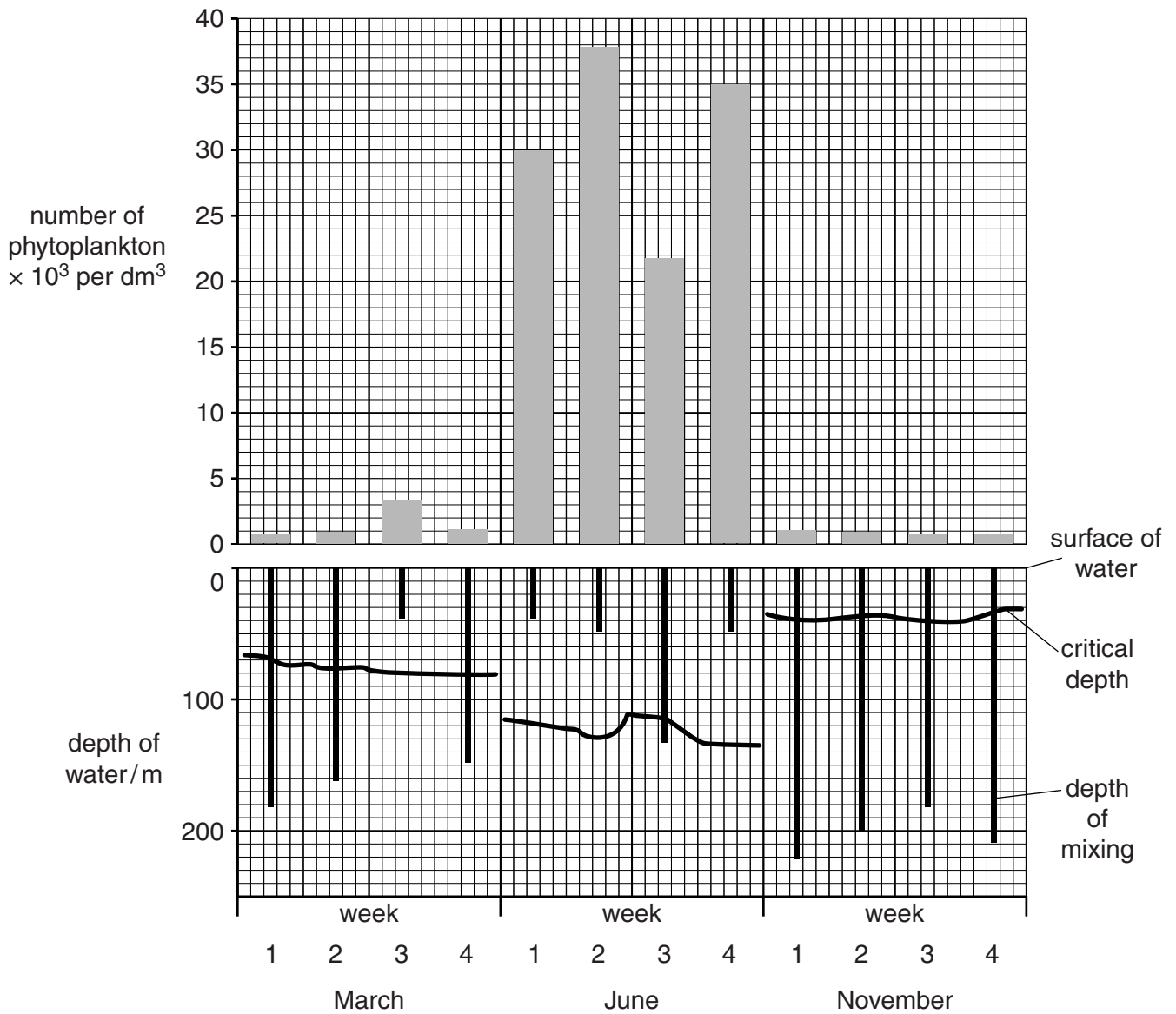


Fig. 3.1

(i) Suggest **one** reason why the depth of mixing is greater in November than in June.

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



(ii) Suggest **two** environmental changes between March and June that could cause the critical depth to be deeper during June.

- 1 .....
- .....
- 2 .....
- .....[2]

(c) Growth and reproduction of phytoplankton can only occur if the depth of mixing is **above** the critical depth.

(i) With reference to Fig. 3.1, state the changes that occurred in phytoplankton numbers:

- between weeks 3 and 4 in March  
.....  
.....
- between weeks 3 and 4 in June.  
.....  
.....[2]

(ii) Use the information provided to explain these changes.

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

[Total: 11]

4 A survey in an area showed a 20% decline in fish stocks during a three year period. Local fishing companies were advised to change their fishing methods to become more sustainable.

The changes made were:

- using rod-and-line instead of purse seine nets to reduce by-catch
- using mid-water trawling instead of benthic trawling.

(a) (i) State the meaning of the term *by-catch*.

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

(ii) Explain why there is more by-catch from using purse seine nets compared to using rod-and-line.

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

(iii) Suggest **one** way rod-and-line fishing could be modified to reduce by-catch even further.

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

(b) Describe **three** environmental benefits of replacing benthic trawling with mid-water trawling.

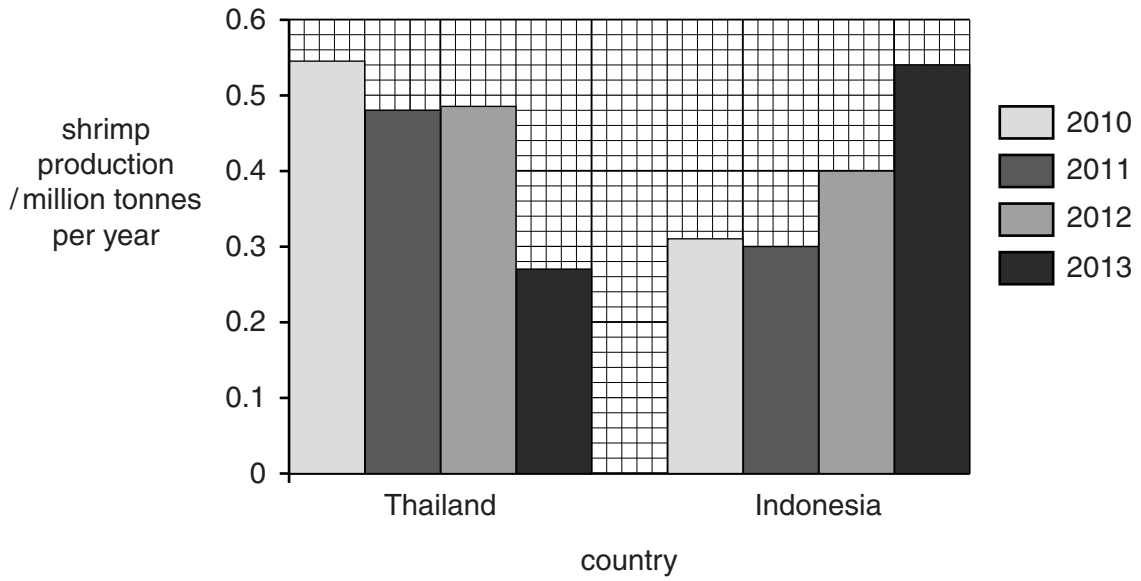
1 .....  
.....  
2 .....  
.....  
3 .....  
.....[3]

(c) State **two** changes in fishing practice, other than using rod-and-line and mid-water trawling, which could be introduced to help fish stocks to recover.

1 .....  
.....  
2 .....  
.....[2]



5 (a) Fig. 5.1 shows shrimp production by aquaculture in two Asian countries from 2010 to 2013.



**Fig. 5.1**

(i) Use the information in Fig. 5.1 to compare shrimp production in Thailand with shrimp production in Indonesia from 2010 to 2013.

.....

.....

.....

..... [2]

(ii) Calculate the percentage change in shrimp production in Thailand from 2012 to 2013. Show your working.

..... % [2]

(b) Most aquaculture businesses buy juvenile shrimp from specialist hatcheries to restock their ponds. Early Mortality in Shrimp (EMS) is a disease which kills juvenile shrimp in the first 30 days after restocking. EMS is caused by a virus which is found in the intestines of shrimp. Infection with this virus kills up to 90% of juvenile shrimp in the aquaculture ponds.

EMS has spread throughout most of Asia, where shrimp aquaculture using very high stocking densities is common. There were no cases of EMS in South America between 2009 and 2013, where shrimp aquaculture using low stocking density is common.

(i) Suggest how EMS could explain the difference in shrimp production in Thailand and Indonesia after 2012.

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

(ii) Use the information about EMS to suggest **two** ways in which EMS can be reduced when buying juveniles to restock aquaculture ponds.

1 .....  
.....  
2 .....  
.....[2]

(iii) Shrimp are cannibalistic. Explain how this can increase the spread of EMS.

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

(iv) To reduce the spread of EMS, juvenile shrimp can be placed into small nursery tanks for about 30 days before being transferred to the main aquaculture pond.

Suggest **two** ways a nursery tank may prevent the spread of EMS.

1 .....  
.....  
2 .....  
.....[2]

[Total: 12]

- 6 Cruise ships are floating cities that produce and discharge large volumes of sewage and other harmful wastes. In 2010 the total number of passengers on cruise ships was 18 500 000 and is predicted to reach 24 000 000 by 2018. Most cruise ships carry almost the same number of crew as passengers.

Fig. 6.1 is a flow diagram of part of the waste disposal system of a cruise ship and the quantity of waste water produced per day in each part of the disposal system.

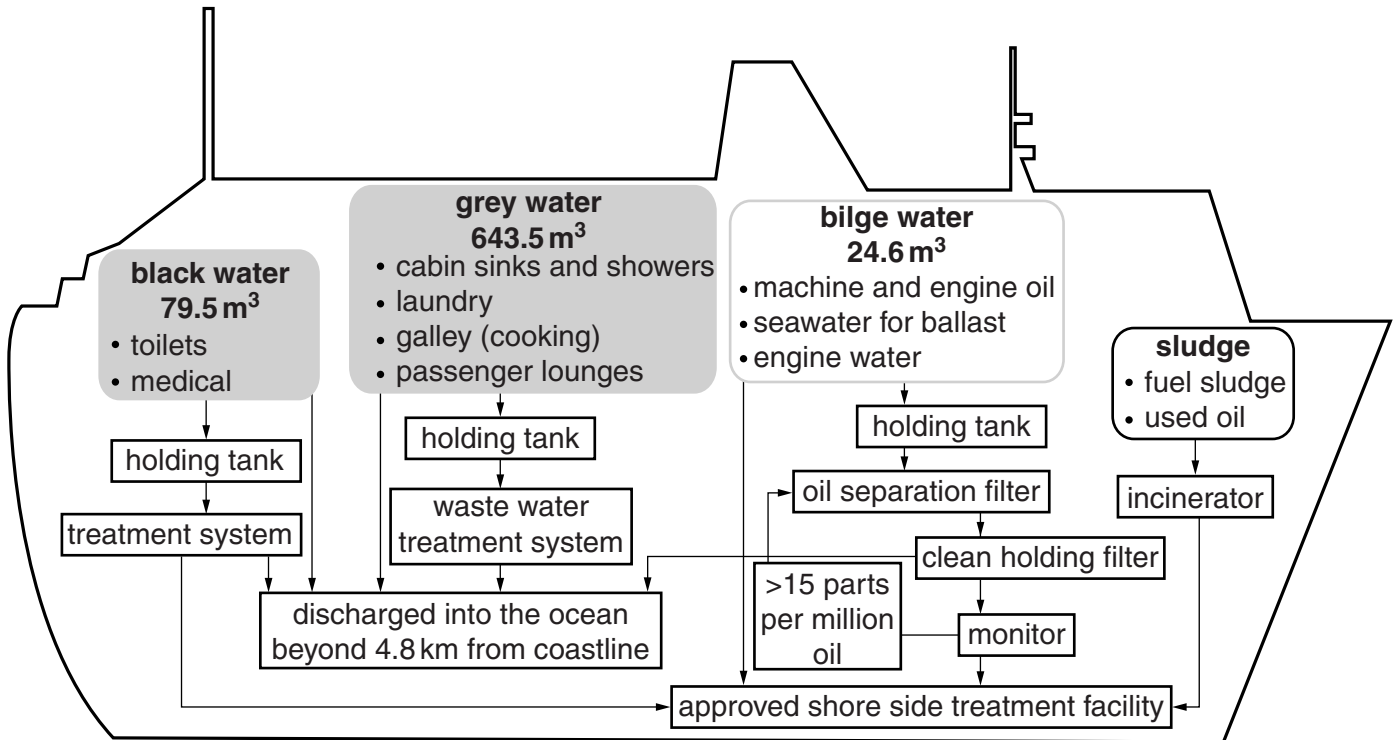


Fig. 6.1

The Clean Water Act of the United States of America requires cities and industries to obtain a permit to treat and discharge wastes, and to report on the quantity of waste water discharged. Treatment systems are monitored regularly.

Cruise ships are not required to have a permit or to report the quantity or quality of the waste discharged. There is no requirement for the cruise ship industry to monitor its ships.

- (a) Suggest why untreated black water and grey water should be released beyond 4.8 km from the coastline.

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.....[2]

(b) Using all the information provided, suggest **two** reasons why some marine protection organisations are concerned about the waste water disposal systems of cruise ships.

1 .....

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2 .....

.....[2]

(c) Suggest **one** way the waste water disposal systems already in use could be modified to reduce the pollution from cruise ship waste water.

.....

.....[1]

(d) Seawater is used as ballast in the bilge of ships to help stability at sea. Most ships discharge the ballast water when they enter ports and take on new ballast water before they leave port.

(i) Explain how this practice has led to the spread of invasive alien species from one part of the world to another.

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.....

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.....[2]

(ii) Suggest **one** way in which spread of alien species by this method could be reduced.

.....

.....[1]

[Total: 8]

7 (a) (i) State the meaning of the term *conservation*.

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

(ii) State **one** reason why marine conservation is necessary.

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

(b) Outline why, to be successful, marine conservation must retain ecological linkages.

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.....[3]

[Total: 6]

**END OF PAPER**

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