

CANDIDATE  
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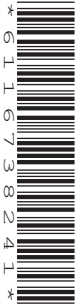
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**MARINE SCIENCE**

**9693/04**

Paper 4 A2 Data-Handling and Free-Response

**October/November 2019**

**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**

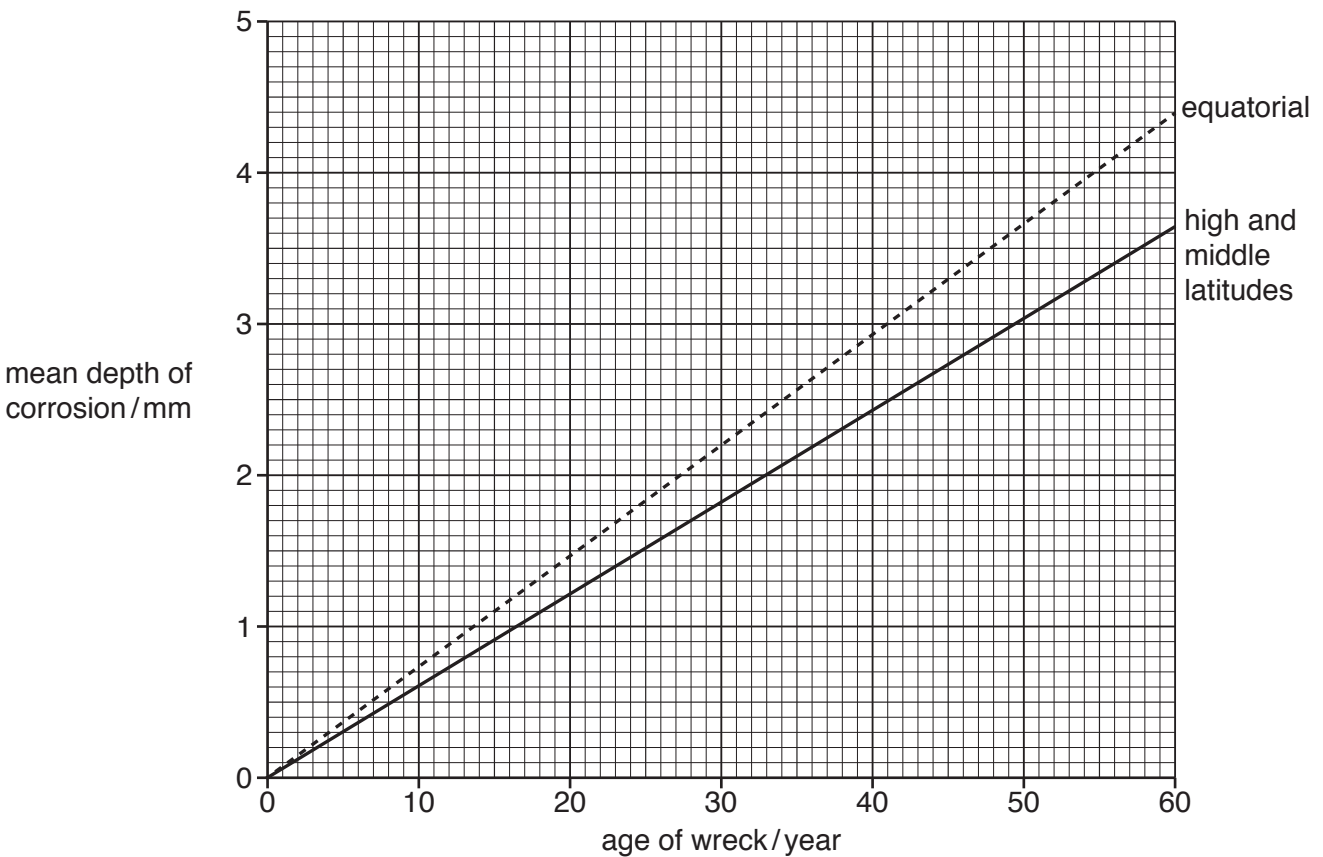
Answer **both** questions in this section.

- 1 There are thousands of wrecked ships around the world. Many of these ships were sunk in the 1940s and so are now over 70 years old. They often still contain large quantities of oil and fuel.

As shipwrecks age, the steel corrodes and becomes thinner. Scientists are worried that the steel in many old shipwrecks is now so thin that oil will begin to leak into the surrounding water.

Scientists measured the depth of corrosion in shipwrecks of different ages. They made measurements on shipwrecks in oceans and seas from high and middle latitudes and from close to the equator.

The results are shown in Fig. 1.1.



**Fig. 1.1**

- (a) (i) Use Fig. 1.1 to determine the mean depth of corrosion of steel from shipwrecks in equatorial oceans and seas after 15 years.

..... mm  
[1]

- (ii) The corrosion rate was calculated for shipwrecks in equatorial oceans and seas by measuring the gradient (slope) of the line on the graph. This was found to be  $0.08 \text{ mm year}^{-1}$ .

Calculate the gradient of the line for shipwrecks in high and middle latitudes to determine the rate of corrosion.

Show your working and state the unit.

..... [3]

- (iii) Many of the shipwrecks sunk in the 1940s (over 70 years ago) were made of steel with a thickness of between 5 mm and 12 mm.

Use the information in part (a)(ii) to suggest why there is now major concern about shipwrecks in equatorial oceans and seas.

..... [2]

- (iv) Describe **two** ecological problems that oil leakage from the shipwrecks could cause.

1 .....

2 .....

..... [2]

- (b) Ships are sometimes deliberately sunk for wreck diving or to act as artificial reefs. It is thought that the shipwrecks create areas of high biodiversity.

To investigate the effect of age of the shipwrecks on biodiversity, scientists compared the percentage cover of different types of organisms on five different shipwrecks in the Indian Ocean.

The results are shown in Table 1.1.

**Table 1.1**

		shipwreck				
		Peel	Vember	North Bay	Zuiss	Japan
<b>age of shipwreck/years</b>		10	25	30	40	50
<b>depth of shipwreck/m</b>		10	9	10	11	28
<b>use of shipwreck</b>		diving	fishing	fishing and diving	diving	fishing
<b>percentage cover of shipwrecks</b>	<b>by coral</b>	12	26	36	48	31
	<b>by sponges</b>	18	10	9	4	11
	<b>by barnacles</b>	11	12	10	9	12
	<b>by molluscs</b>	13	15	10	11	12
	<b>by no organisms</b>	46	37	35	28	34

Use the information in Table 1.1 to discuss whether the investigation supports the hypothesis that biodiversity increases with the age of the shipwrecks.

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..... [4]

[Total: 12]



- 2 An investigation was carried out to measure the effect of adding shrimp to aquaculture tanks of tilapia fish.

Tilapia were placed into tanks and grown with shrimp added at different population densities. The yields of tilapia and shrimp were then determined.

The results are shown in Table 2.1.

**Table 2.1**

combination of species	yield/g m <sup>-2</sup>	
	shrimp	tilapia
tilapia alone	–	483.5
tilapia and low-density shrimp	23.3	499.2
tilapia and medium-density shrimp	30.6	455.8
tilapia and high-density shrimp	61.1	401.6

- (a) (i) Calculate the percentage change in yield between tilapia grown alone and with shrimp at high density.

Show your working.

..... [2]

- (ii) Describe the effect of using different population densities of shrimp on the yield of tilapia.

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

- (iii) Suggest **two** variables that should be controlled in this investigation.

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

(b) Shrimp feed on waste food and the wastes produced by tilapia.

Suggest the benefits of growing tilapia with shrimp rather than growing tilapia alone.

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..... [3]

[Total: 8]







- 4 (a) With reference to named examples, explain the advantages of internal fertilisation compared to external fertilisation.

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..... [3]

- (b) Oysters use external fertilisation.

Outline the life cycle of oysters.

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..... [4]



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