

CANDIDATE  
NAME

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**MARINE SCIENCE**

**9693/21**

Paper 2 AS Data-Handling and Free-Response

**May/June 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 **11** printed pages and **5** blank pages.



## Section A

Answer **both** questions in this section.

- 1 Fig. 1.1 shows the common limpet, *Patella vulgata*, a mollusc that inhabits rocky shores across Northern Europe.

When submerged, limpets feed by moving across the rock surface, scraping off algae. During low tide they attach themselves securely to the rock surface. Repeated use of the same position on the rock by limpets over many years can lead to a home scar forming, also visible in Fig. 1.1.



**Fig. 1.1**

Individual limpets repeatedly return to the same home scar, and are therefore said to have a homing instinct.

A researcher investigated this homing instinct to test the following hypothesis.

**‘The further a limpet moves from its home scar, the less likely it is to return there.’**

At low tide, a sample of similar sized limpets was carefully removed from their home scar and placed 10cm away, ensuring they reattached securely to the rock surface. The limpets and their original home scars were marked with numbers.

The limpets were left until the next low tide. The researcher then counted how many limpets had returned to their home scar. This process was repeated in five different areas, but with limpets moved different distances each time.

(a) Suggest **two** variables that the researcher was unable to control.

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2 .....

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[2]

Table 1.1 shows the results.

**Table 1.1**

distance moved /cm	number of limpets moved	number returning to home scar	percentage returning to home scar
10	16	15	93.8
20	15	10	66.7
30	14	11	78.6
40	15	11	73.3
50	15	9	

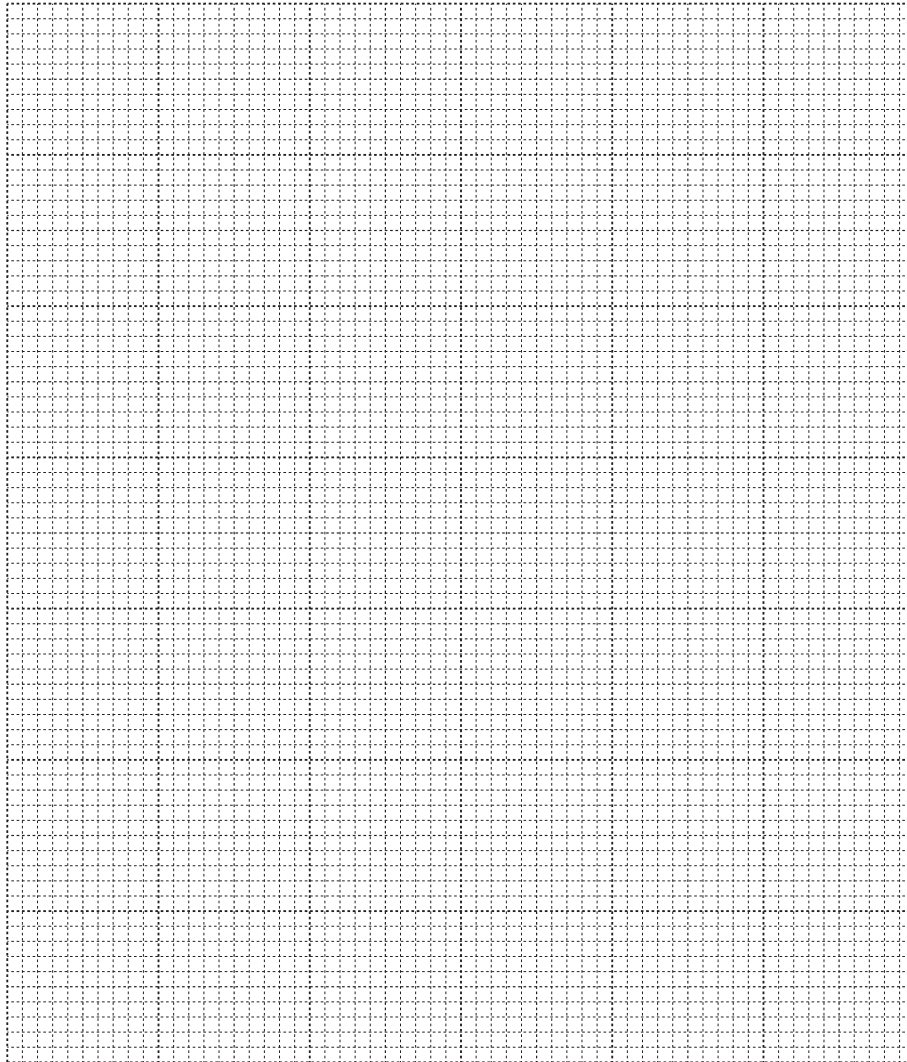
(b) (i) Calculate the percentage of limpets returning to their home scar after being moved 50 cm.

Show your working.

.....  
[2]

- (ii) Plot a line graph to show the relationship between the distance the limpets were moved and the percentage returning to their home scar. Include a point for your calculated value for limpets that were moved 50 cm.

Join the points with ruled, straight lines.



[4]

- (iii) Use the data in Table 1.1 and your graph to discuss the extent to which the data support the hypothesis.

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[3]

(c) Suggest **and** explain how the homing instinct may increase the chance of survival of limpets.

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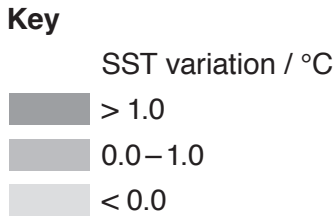
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..... [2]

[Total: 13]



- 2 Fig. 2.1 shows how the sea surface temperature (SST) of the Pacific Ocean in December 1997 varied from the long-term mean.



**Fig. 2.1**

- (a) (i) State the name that is given to the event shown in Fig. 2.1 in the eastern tropical Pacific Ocean.

..... [1]

- (ii) Peruvian anchoveta, *Engraulis ringens*, are fish that are caught in large numbers in the eastern tropical Pacific Ocean.

Describe **and** explain the probable impact of conditions like those in 1997 on the size of the anchoveta catch.

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- (b) Table 2.1 shows the mean SST variation at point X on Fig. 2.1, for three three-month periods during 2009 to 2015.

Table 2.1

year	mean SST variation in three-month period/°C		
	September to November	October to December	November to January
2009	1.0	1.2	1.3
2010	-1.4	-1.3	-1.4
2011	-0.9	-0.9	-0.8
2012	0.4	0.2	-0.2
2013	-0.2	-0.2	-0.3
2014	0.4	0.6	0.6
2015	2.0	2.2	2.3

- (i) Describe how the mean SST variation for each three-month period would have been calculated.

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- (ii) State the **two** years in which conditions were most similar to those in 1997.

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[Total: 7]

Section B

Answer **both** questions in this section.

3 (a) (i) Define the term *ecological niche*.

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(ii) With reference to **one** named example, explain why some marine habitats contain narrow ecological niches.

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(b) (i) Describe **two** ways in which energy is made available to food chains.

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- (ii) As energy is passed along a food chain, only about 10% of the energy is transferred to the next trophic level.

Explain why energy is lost as it is passed along a food chain.

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[Total: 15]

4 (a) Explain how tectonic processes can lead to a tsunami.

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(b) Outline the Darwin-Dana-Daly theory of atoll formation.

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