SUPERVISOR'S USE ONLY

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91413



Draw a cross through the box (\boxtimes) if you have NOT written in this booklet



Mana Tohu Mātauranga o Aotearoa New Zealand Qualifications Authority

Level 3 Earth & Space Science 2023

91413 Demonstrate understanding of processes in the ocean system

Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of processes in the ocean system.	Demonstrate in-depth understanding of processes in the ocean system.	Demonstrate comprehensive understanding of processes in the ocean system.

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should attempt ALL the questions in this booklet.

If you need more room for any answer, use the extra space provided at the back of this booklet.

Check that this booklet has pages 2–16 in the correct order and that none of these pages is blank.

Do not write in any cross-hatched area (continue of the cut off when the booklet is marked.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

QUESTION ONE: CARBON DIOXIDE ABSORPTION AT THE POLES



Figure 1: Global ice area since 1979

Source: https://tamino.wordpress.com/2011/01/14/monckton-skewers-truth/

Deep ocean currents store carbon dioxide and reduce its concentration in the atmosphere. However, polar ice has been reducing as a result of climate change, and melting polar ice may disrupt the ocean currents that enable this removal of carbon dioxide.

Explain the significance of melting polar ice in the removal of atmospheric carbon dioxide.

In your answer, you should consider:

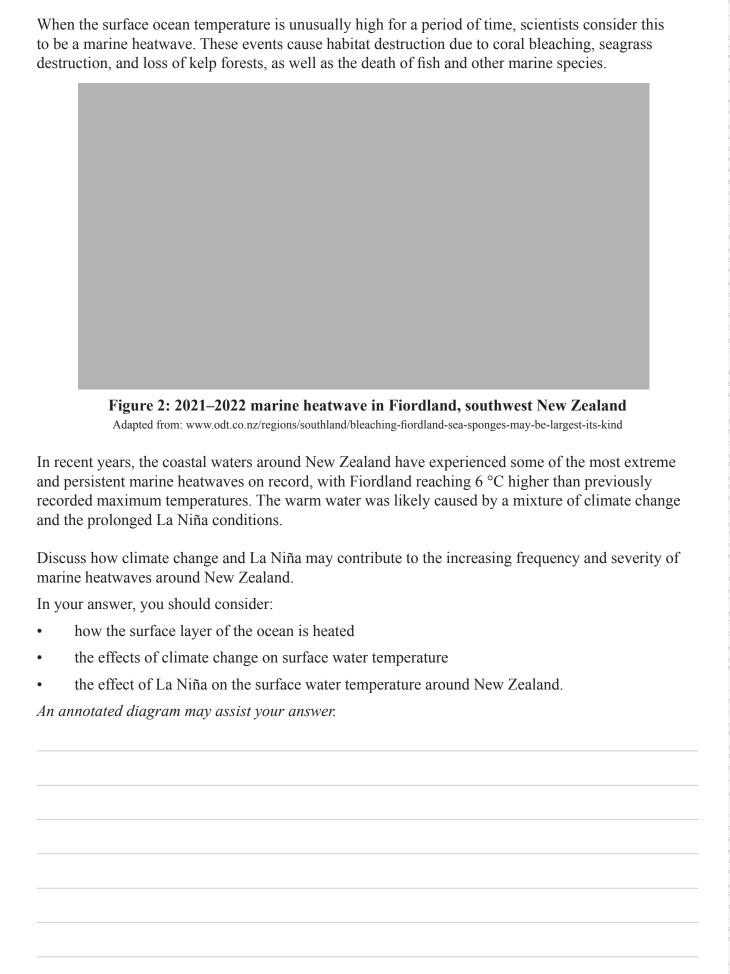
- the causes of downwelling at the poles
- the physical ocean carbon pump at high latitudes
- the significance of melting ice to the polar ocean surface.

You do not need to discuss carbon chemistry or thermohaline circulation.

An annotated diagram may assist your answer.				

There is more space for
There is more space for your answer to this question on the following pages.

QUESTION TWO: MARINE HEATWAVES



There is more space for your answer to this question on the following pages.

QUESTION THREE: THE MOST PLASTIC-POLLUTED ISLAND ON EARTH

Gyre	derson Island is a tiny uninhabited island in the Pitcairn Islands, and lies within the South Pacific e. Beaches on Henderson Island contain an estimated 38 million items of plastic debris. On the id, researchers have found plastic rubbish from South America, Australia, and even as far away as ope.
	Figure 3: Ocean currents around Henderson Island and plastic rubbish on its beaches
	Source: www.weforum.org/agenda/2017/05/the-untouched-south-pacific-island-choking-on-38-million-bits-of-plastic/source. When the source is a simple of the contraction of the contract
	euss how surface ocean circulation has led to such a large accumulation of plastic debris on derson Island.
In ye	our answer, you should consider:
•	how the South Pacific Gyre is formed
•	how the Antarctic Circumpolar Current is formed
•	how plastic debris travels thousands of kilometres from around the globe to accumulate on Henderson Island.
An a	nnotated diagram may assist your answer.

There is more space for your answer to this question on the following pages.

Extra space if required. Write the question number(s) if applicable.

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