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Level 3 Earth and Space Science, 2019

91413 Demonstrate understanding of processes in the ocean system

2.00 p.m. Thursday 28 November 2019
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 and clearly number the question.

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

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

TOTAL

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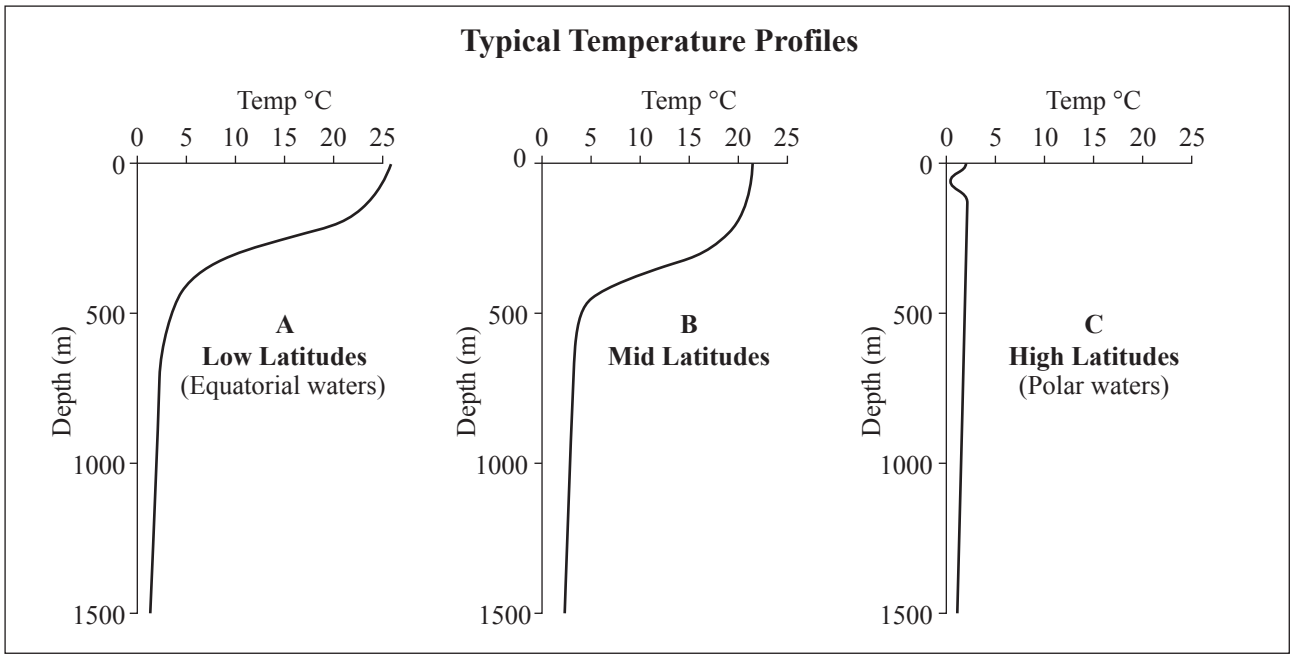
QUESTION ONE: THE THERMOCLINE AND SEASONAL VARIATIONS

The resource below shows three thermoclines that were sampled in one year in March, in the Southern Hemisphere for equatorial, mid, and polar latitudes.



With reference to the above graphs, explain the reason behind the trends shown in the three thermoclines in terms of the thermal energy in the oceans, AND explain the likely consequences on the thermoclines of further global warming.

In your answer you should consider:

- what a thermocline is
- the links between the layers, latitude, and solar heating for each thermocline
- how seasonal heating can affect the thermocline
- the effect of global warming on the ocean layers.

You may use an annotated diagram to assist your answer.

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

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QUESTION TWO: CARBON DIOXIDE AND OCEAN ACIDIFICATION

The photographs below show the development and thickness of the shell structure of 13-day-old green-lipped mussel larvae raised in different ocean water acidity conditions.

pH and Acidity Level	**Shell**	**Shell Cross Section Structure** (Taken from the area shown by the red square – thickness is shown in micrometres)
pH level 8.0 Normal ambient levels of ocean acidity		
pH level 7.7 Moderate level of ocean acidity		
pH level 7.3 Extreme level of ocean acidity		

Source: J. Ericson, *Effects of ocean acidification on fertilisation and early development in polar and temperate marine invertebrates*, MSc thesis (Dunedin, University of Otago, 2010), p. 117

As more carbon dioxide dissolves in the oceans, ocean water is becoming more acidic.

Using the above resource to assist you, explain how the increasing levels of carbon dioxide in the oceans will impact ocean life.

In your answer you should consider:

- the reasons for increasing carbon dioxide in the oceans
- what happens to the carbon dioxide when it enters the ocean; this should include the appropriate chemical equations
- how changes to the ocean's carbonate levels will affect marine life.

You may use an annotated diagram to assist your answer.

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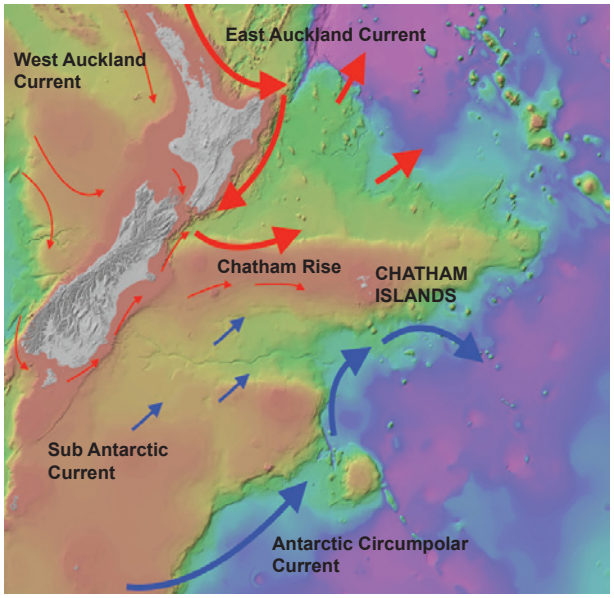
QUESTION THREE: FISHING AND THE CHATHAM RISE

The resources below show the sea floor and ocean currents that circulate off the east coast of New Zealand, and a satellite image of a phytoplankton bloom in 2010 taken by a NASA satellite over the Chatham Islands and Rise.



Key

Depth below the sea surface	Colour
500 m	
2000 m	
5000 m	

Adapted from: https://www.niwa.co.nz/our-science/oceans/bathymetry/download-the-data and https://teara.govt.nz/en/map/5912/ocean-currents-around-new-zealand

Source: NASA Aqua satellite 5 December 2010. https://earthobservatory.nasa.gov/images/47621/bloom-around-the-chatham-islands-new-zealand

The Chatham Rise is an underwater mountain range that extends from the east coast of the South Island to beyond the Chatham Islands. It is the meeting point of surface and deep-water ocean currents.

Explain how this region of the ocean will have an influence on marine life and human activity.

In your answer you should consider:

- current formation and origin
- reasons for the different temperatures of the currents
- the reason why the two currents meet at the Chatham Rise.

You may use an annotated diagram to assist your answer.

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

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Extra paper if required.
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