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## Level 3 Earth and Space Science 2021

### 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 (XXXX). This area may be cut off when the booklet is marked.

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

**QUESTION ONE: IMPACT OF EL NIÑO**

Every few years El Niño events occur, which cause distinctive weather patterns across the Pacific. A strong El Niño event was recorded from 2014 to 2016.



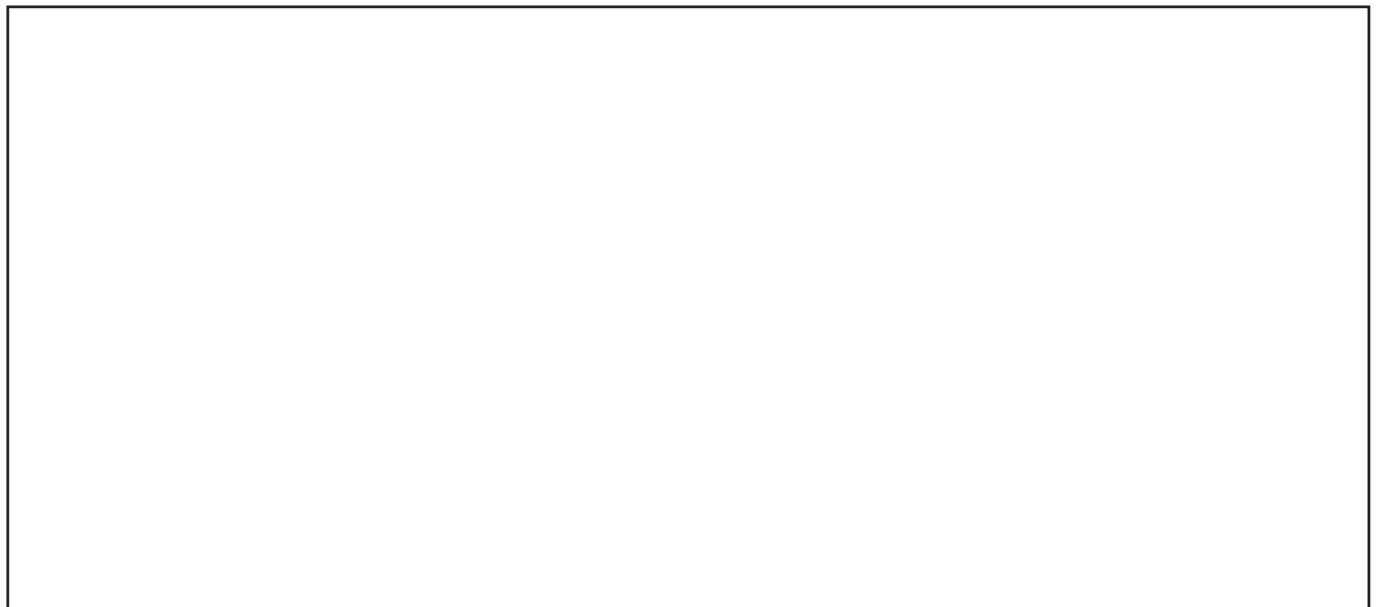
Adapted from: <https://wasatchweatherweenies.blogspot.com/2015/06/el-nino-likely-for-2015-16-winter.html>

Explain in detail the formation and impacts of an El Niño event on surface ocean currents and the thermocline at the Equator.

Your answer should include:

- conditions of an El Niño event (winds, surface temperature, and sea level)
- an explanation of the relationships between trade winds, ocean surface temperature, and sea level at the Equator
- a detailed explanation of how the conditions impact the thermocline along the Equator in the Pacific
- an explanation of how El Niño events may be affected by climate change.

*An annotated diagram may assist your explanation.*



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





**QUESTION TWO: EASTERN BOUNDARY CURRENTS**

Source: <https://quizlet.com/103502698/ocn-exam-2-flash-cards/>

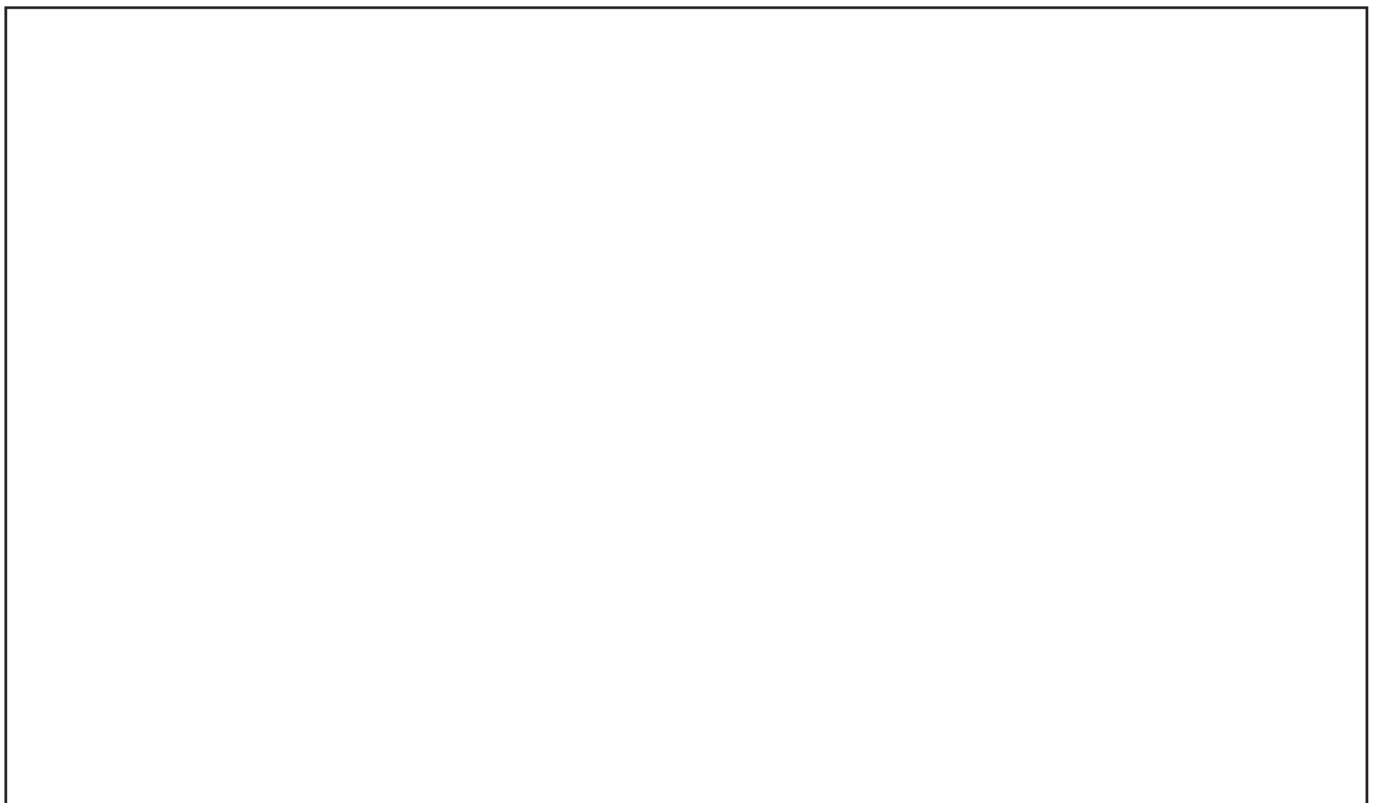
At the eastern edge of ocean basins, surface circulation causes water movement along coasts towards the Equator. These are known as eastern boundary currents. In turn, this causes regions of coastal upwelling and rich feeding grounds for marine life.

With reference to the Humboldt Current shown on the map above, explain the cause and effects of the eastern boundary currents.

In your answer you should:

- explain how surface circulation patterns lead to the Humboldt Current
- explain the role of wind and the Coriolis effect in the formation of surface currents
- explain in detail why these areas are rich feeding grounds for marine life.

*An annotated diagram may assist your explanation.*



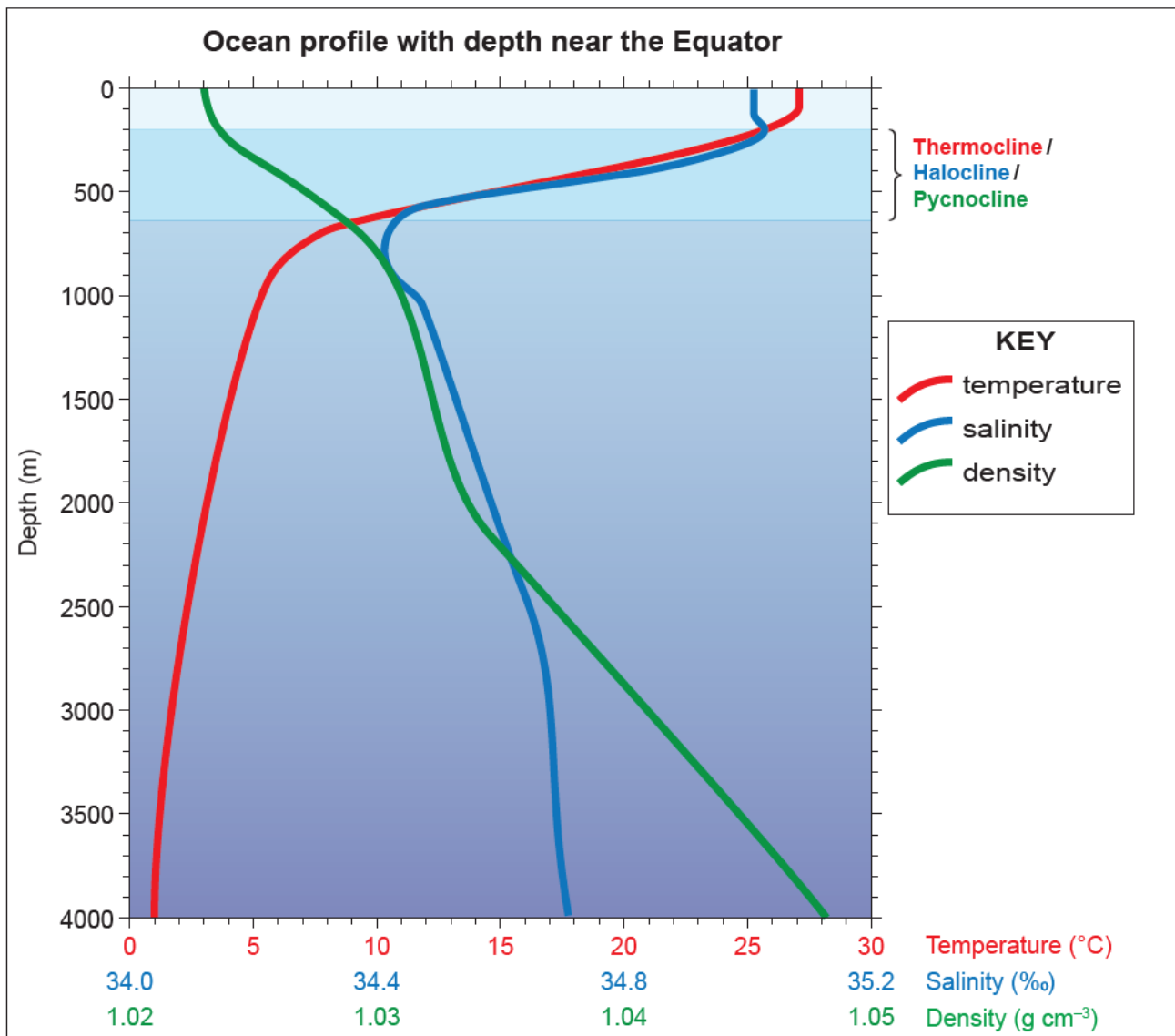
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### QUESTION THREE: THERMOCLINE, HALOCLINE, AND PYCNOCLINE



Adapted from: [http://www.rocksea.org/bin/research/roxy\\_lecture\\_physical\\_oceanography.pdf](http://www.rocksea.org/bin/research/roxy_lecture_physical_oceanography.pdf)

Explain in detail the relationship between ocean temperature and salinity, and how they affect the density of water as depth increases.

Your answer should include:

- an explanation of how this leads to the formation of the surface, transition, and deep layers of the ocean
- an explanation of why the gradients of temperature, salinity, and density vary with depth near the Equator
- a detailed explanation of the relationship between the thermocline, halocline, and pycnocline.

*An annotated diagram may assist your explanation.*

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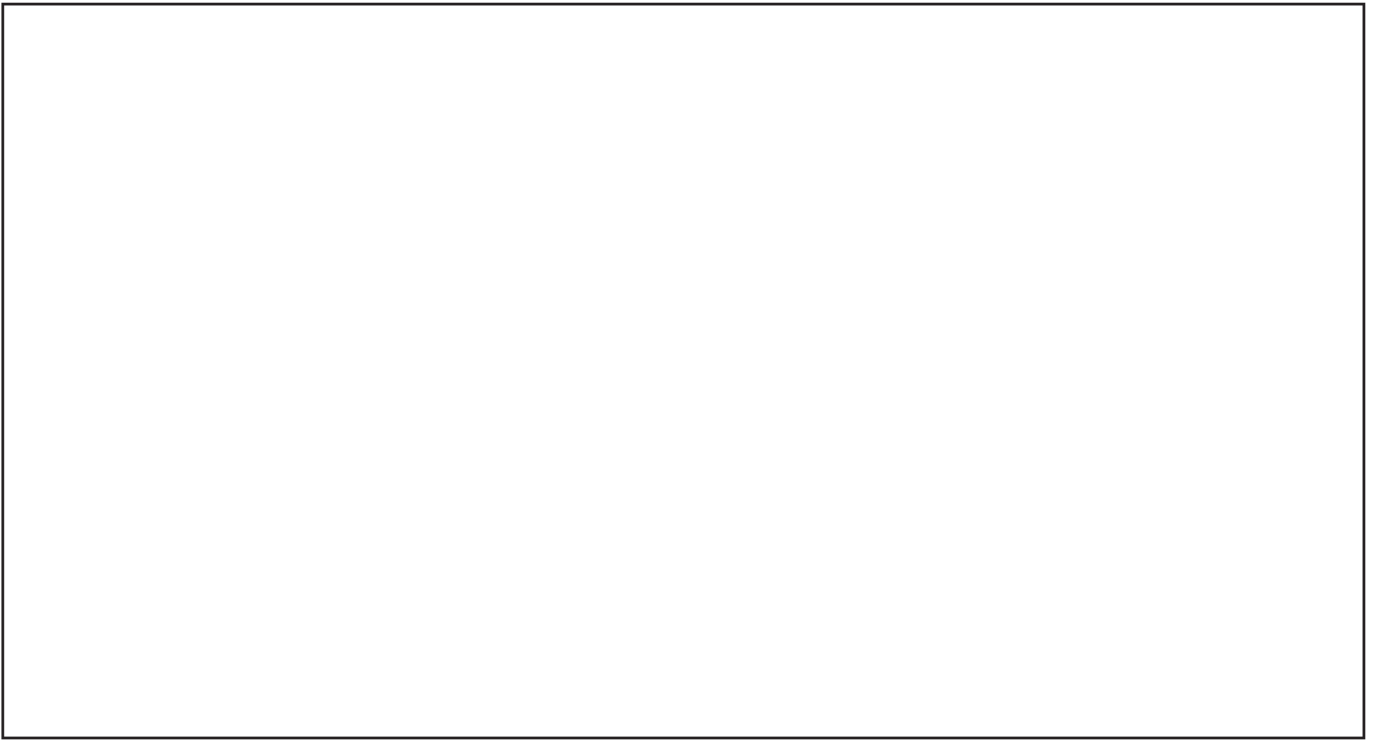
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on the following pages.*





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

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