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Level 3 Earth and Space Science, 2015

91413 Demonstrate understanding of processes in the ocean system

9.30 a.m. Tuesday 24 November 2015
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 2–12 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 THERMOHALINE CIRCULATION

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http://science.nasa.gov/science-news/science-at-nasa/2004/05mar_arctic/

The thermohaline circulation (THC), also called the global conveyor belt, is an enormous density-driven ocean current that transports heat and water around the globe.

Discuss how gradients in density, salinity, and temperature cause the THC to form a slow-moving global loop.

Include in your answer

- factors that alter the temperature and salinity of water
- how density is affected by differences in temperature and salinity
- an explanation of the role of upwelling in the tropics and downwelling in the Arctic and Antarctic
- how these factors combine to give a global circulation.

An annotated diagram may assist your answer.

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

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QUESTION TWO: EFFECTS OF THE SOUTHERN OSCILLATION IN THE PACIFIC

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Normal (neutral) conditions

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El Niño conditions

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http://oceanservice.noaa.gov/education/yos/resource/JetStream/tropics/enso_patterns.htm

The southern oscillation is a cycle that causes major climate fluctuations across the Pacific Ocean due to variations in ocean temperature. The El Niño phase brings weaker currents and warmer water with fewer nutrients in the mixed (upper) ocean layer, especially in the eastern Pacific / along the South American coast.

Compare the ocean processes involved in the two conditions illustrated above – the normal (neutral) conditions and the El Niño conditions.

In your answer, explain:

- the three ocean temperature layers (deep ocean layer, thermocline, mixed layer)
- how the trade winds in each condition shown in the diagrams above affect the prevailing westerly current
- how the three ocean temperature layers interact to bring nutrients to the surface
- how the three ocean temperature layers interact at the South American coast (Lima, Peru).

An annotated diagram may assist your answer

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

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QUESTION THREE: OCEAN TEMPERATURE AND THE CARBON CYCLE

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Ocean temperature instruments have shown that ocean temperatures are increasing.

Discuss the effects that increasing ocean **temperatures** could have on the ocean's ability to store and cycle carbon compounds.

In your answer, include:

- how the physical (solubility) carbon pump works
- how the biological carbon pump works
- appropriate chemical equations
- how both pumps work together to cycle and store carbon compounds
- how temperature may affect the physical pump and the biological pump.

An annotated diagram may assist your answer.

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

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

QUESTION NUMBER

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