Assessment Report

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Level 3 Earth and Space Science 2021

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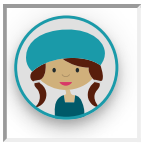
Standards 91413 91414

Part A: Commentary

Candidates who read each question in depth and addressed the requirements of the question were more successful. Specific guidance is given for each question, and those that integrated the bullet points from each question into well planned responses that addressed the focus of the question were more successful. This enabled candidates to link ideas more convincingly than those that addressed each bullet point individually. Many responses contained unnecessary information that may have been used for previous exams but were not relevant to the question being answered.

Many widely held misconceptions persist in candidate responses, particularly about ocean salinity, temperature and density, and the relationship between these. For example, many merged the ideas of thermohaline circulation and the layering of ocean waters near the equator. Very few were able to define halocline, thermocline and pycnocline. Another common misconception was to merge or confuse vertical thermohaline motion with north / south surface currents.



Candidates with a thorough knowledge of subject specific language were more successful. Many confused ideas such as thermohaline and thermocline, defined Coriolis as a wind, direction of westerly winds (which come from the west) and stated incorrect ideas, such as “when water gets colder, it gets saltier”.

In 91414, candidates who read each question in depth and addressed the requirements of the question were more successful. Specific guidance is given for each question, and that integrated the bullet points from each question into well planned responses that addressed the focus of the question were more successful. This enabled to link ideas more convincingly than those that addressed each bullet point individually. Many responses contained unnecessary information that may have been used for previous exams but were not relevant to the question being answered.

Successful used clear labelled diagrams effectively as evidence in responses and attempted to answer each question. This enabled them to adequately demonstrate their ability to explain atmospheric events in terms of fundamental atmospheric phenomena and processes.

Part B: Report on standards

91413: Demonstrate understanding of processes in the ocean system

Examination

The examination included three questions which candidates were expected to complete. The questions covered a selection of ideas selected from the achievement standard, including the El Niño Southern Oscillation and its effects, marine surface currents and ocean composition in terms of gradients of temperature, salinity, and density. Each question required candidates to apply their knowledge of ocean systems to contexts provided, and candidates were encouraged to develop both written responses and labelled and annotated diagrams in their answers.

Observations

Many candidates struggled with demonstrating knowledge of foundational ideas including:

- confusing thermohaline and thermocline
- saying that Coriolis is a wind
- salt in water is dense, so it sinks
- when water gets colder is gets saltier
- westerlies are battling the trade winds, and when the westerlies win, it is El Niño
- easterly winds go from west to east
- the thermocline is a horizontal line
- cardinal points east/west reversed.

To reach grades beyond Achievement, thorough planning that integrated the information from the bullet points with the candidate's subject knowledge was very beneficial. This enabled candidates to provide responses relevant to the question and to make links between ideas.

Grade awarding

Candidates who were awarded **Achievement** commonly:

- explained El Niño by drawing an annotated diagram showing trade winds weakening
- suggested that El Niño events may become more intense or frequent with climate change
- explained a reduction in upwelling off the coast of South America is an impact of an El Niño event
- established the link between the action of wind and the movement of ocean surface currents
- explained the Coriolis effect on ocean currents as being a deflection to the left in the Southern Hemisphere
- explained that nutrient-rich water leads to an area with rich marine life or provided a basic explanation of upwelling water at the coast bringing nutrients to the surface
- explained that the surface layer is heated by solar radiation

- explained how changes in ocean temperature and/or salinity changes the density of sea water.

Candidates whose work was assessed as **Not Achieved** commonly:

- provided responses not linked to the context and question
- provided confused points on the compass, and/or interchanged the terms such as westerly and westward when describing wind and water current directions
- explained sea level changes due to rates of evaporation/precipitation
- confused thermocline and thermohaline circulation
- explained the Coriolis effect as a deflection to the east or west or for air movement
- only described upwelling as bringing phytoplankton up from the deep ocean
- used terminology incorrectly and/or provided incorrect definitions for key terms such as halocline being salinity, rather than a halocline being a vertical zone where salinity changes rapidly with depth
- discussed sea-ice formation at the equator affecting salinity and water density
- directly linked a change in temperature to a change in salinity
- showed misunderstanding in explaining key concepts, such as sinking salt at the equator while trying to account for salinity in the deep ocean.

Candidates who were awarded **Achievement with Merit** commonly:

- explained in detail one idea in each question using correct terminology
- explained the link between weakening trade winds and a reduction in water flow to the west and therefore the ability for warm pooled surface water in the west to move east
- explained the link between an increase in warm surface water in the eastern Pacific and a deepening of the thermocline
- explained in detail how winds act to move surface waters through transfer of energy by friction

- explained in detail how the process of evaporation at the surface increases sea water salinity
- explained in detail how solar radiation is absorbed by and increases surface water temperature.

Candidates who were awarded **Achievement with Excellence** commonly:

- developed a sequence of several ideas in a logical way without misconceptions and with correct terminology
- fully explained the effect of weakening trade winds and subsequent reduction in east to west current to sea level and surface temperature changes across the Pacific
- explained how weakened trade winds result in a build-up of warm surface water in the eastern Pacific which deepens the thermocline
- explained how the Coriolis effect and/or Ekman transport will deflect Humboldt current surface waters away from the coast of South America which leads to upwelling of deep nutrient rich water
- explained each layer in the ocean at the equator and explained the relationship between the halocline, thermocline, and pycnocline using correct definitions.

91414: Demonstrate understanding of processes in the atmosphere system

Examination

The examination included three questions which candidates were expected to complete. The questions covered a selection of ideas selected from the achievement standard, including atmospheric circulation and weather systems, transport of matter and energy in the troposphere and the carbon cycle. Each question required candidates to apply their knowledge of atmosphere systems to contexts provided, and candidates were encouraged to develop both written responses and labelled and annotated diagrams in their answers.

Observations

Many N, A, and M students did not explain details of the appropriate cycles and interactions that occur in the atmospheric systems. Many students did not interpret the requirements of the question accurately, leading them to focus on somewhat related but irrelevant content, e.g., NZ local weather systems, instead of atmospheric circulation.

Grade awarding

Candidates who were awarded **Achievement** commonly:

- responded to at least two questions
- explained rising, less dense, warm air linked to low pressure and sinking more dense cold air linked to high pressure
- accurately linked atmospheric circulation to the formation of weather systems
- described how volcanic aerosols reflect incoming solar radiation to cause decrease in surface temperature
- understood and explained the basic processes in the atmospheric system, but failed to express the link between energy, process, and effect
- described photosynthesis, respiration, combustion and/or diffusion, but didn't explain impacts of human activities on how much carbon is moved between the atmosphere and sinks/sources.

Candidates whose work was assessed as **Not Achieved** commonly:

- answered only one question
- misinterpreted requirements of questions
- did not link rising warm air to low pressure and descending cold air to high pressure
- described pressure at the tropopause instead of pressure on earth’s surface
- described NZ weather conditions near the Southern Alps, instead of atmospheric circulation
- described carbon stores (sinks and sources), instead of processes that move carbon between the stores.

Candidates who were awarded **Achievement with Merit** commonly:

- explained science ideas with relevant fundamental principles, e.g., the reason for low pressure at equator is direct insolation heating the surface, then conducting heat to air, leading to expansion and lower density air rising
- were able to some extent to link and explain the relationships between energy, process, and effect in atmospheric systems, e.g., the energy released during the large Tambora eruption flung ash and aerosols into the stratosphere where it remained for a long time
- did not explain the human impacts on processes in the carbon cycle as required, but instead explained impacts on climate and global temperature.

Candidates who were awarded **Achievement with Excellence** commonly:

- integrated the nature of the fundamental aspects and processes in atmospheric systems and explained the sequence of events and processes that lead to the observed results.
- comprehensively explained atmospheric circulation and how it leads to formation of high- and low-pressure bands and associated climate conditions
- compared human impacts on the addition and removal of carbon in the atmosphere and/or discussed the balance or imbalance in the carbon cycle as a result of these activities
- comprehensively linked size of sulfur compound aerosols to global transport by stratospheric winds and increased albedo leading to surface cooling and lower tropospheric temperatures.

Science subject page

Previous years' reports

2020 (PDF, 175KB)

2019 (PDF, 105KB)

2018 (PDF, 114KB)

2017 (PDF, 45KB)

2016 (PDF, 212KB)

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