

Subject: Level 3 Earth and Space Science

Level: 3

Standards: 91413 91414

Part A: Commentary

Candidates who read the questions carefully and used the information provided to attempt all questions generally achieved by demonstrating an understanding of the relevant processes occurring in the ocean and atmosphere. The use of annotated diagrams by candidates was more frequent than in previous years. Candidates need to ensure their diagrams are well-labelled, and link directly to the question and their response.

Candidates were most successful when they correctly read and interpreted the question, and provided a response that was relevant. Candidates are encouraged to plan their answers focusing on the context of the question, rather than writing general information that is linked to the question. Many candidates provided responses that were related to the standard, but not relevant to the question being asked, or recalled information from contexts in previous examinations that was not necessarily relevant to the question being asked.

Using the correct scientific terminology makes answers clearer and more accurate. Use and explanation of key words would help candidates to improve their responses. Higher grades were awarded to students who were able to link concepts and apply their understanding to the context posed in the question, rather than just recalling information.

Part B: Report on standards

91413: Demonstrate understanding of processes in the ocean system

Examination

The examination consisted of three required questions about ideas selected from the achievement standard, including thermohaline circulation, ocean carbon cycling, and surface ocean salinity. Each question required candidates to apply their knowledge of ocean systems to contexts provided. Candidates were encouraged to develop both written responses, and labelled and annotated diagrams in their answers.

Observations

In preparation for the examination, candidates are encouraged to practise unpacking and developing an understanding of the context and requirements of the exam questions. Planning answers helps candidates to provide clear answers that communicate their understanding of ocean concepts studied.

Grade awarding

Candidates who were awarded **Achievement** commonly:

- attempted to respond to most or all of the questions
- described how solar radiation can influence the density of sea water
- described how salinity can change the density of sea water
- described how upwelling brings nutrients to the surface
- wrote at least one equation linked to carbon cycling in the ocean
- described photosynthesis by phytoplankton as a method through which carbon dioxide can enter the ocean system
- described how evaporation or ice formation changes ocean surface salinity
- drew basic diagrams to support their descriptions.

Candidates who were awarded **Not Achieved** commonly:

- re-wrote or repeated information given within the question
- did not use the diagrams in the question to good effect, or made statements that contradicted the information in the question (in particular, surface salinity shown in Q3)
- drew diagrams that had little to no relevance, or had insufficient annotations
- recalled information related to ocean systems, but not relevant to the question (e.g., writing about El Niño and La Niña for Q1)
- did not accurately identify areas of upwelling and downwelling
- did not link temperature and / or salinity to density changes
- described how carbon is cycled on Earth without specific reference to the ocean
- showed little understanding of ocean chemistry
- described vertical variations in ocean salinity rather than latitudinal changes as required by the question.

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

- explained how temperature and / or salinity drive upwelling and downwelling
- explained various ways in which the biological pump stores carbon dioxide in the ocean
- used relevant, but incorrectly balanced, chemical equations to support their explanations of the physical pump
- explained how ice formation and evaporation changed the density of seawater
- linked lower salinity in equatorial regions to high evaporation and precipitation rates.

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

- showed evidence of planning a structured response, as well as self-assessment of their progress by ticking off the bullet points provided
- provided diagrams with detailed annotations to support their explanations
- accurately linked temperature and salinity changes to the increase / decrease of sea water density
- linked many factors together to explain how heat and matter are transported on a global scale through the horizontal and vertical movement of sea water

- comprehensively explained, using balanced chemical equations, how both the physical and biological pumps store carbon compounds
 - explained the consequences of too much atmospheric carbon dioxide being dissolved into the ocean
 - linked solar insolation, evaporation, ice formation and precipitation rates to changes in surface ocean salinity across the world.
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91414: Demonstrate understanding of processes in the atmosphere system

Examination

The three questions in the examination focused on processes and contexts involved in atmospheric systems. This included the transfer of matter and energy in the atmospheric water cycle, the effects of carbon dioxide and aerosols on the troposphere, and the structure and layers of the atmosphere. Each question required candidates to apply their knowledge of atmosphere systems to contexts provided, and candidates are encouraged to develop both written responses, and labelled and annotated diagrams in their answers.

Observations

Candidates generally provided a lot of detail in responses that demonstrated a high level of understanding of atmosphere systems.

Grade awarding

Candidates who were awarded **Achievement** commonly:

- included annotated diagrams to help explain answers, especially in Question One
- included definitions to key terms associated with the question and answer
- were able to briefly describe some processes related to the water cycle, aerosols, or the atmosphere
- confused some processes and effects, such as those related to aerosols and carbon dioxide, condensation, and precipitation.

Candidates who were awarded **Not Achieved** commonly:

- misread or misinterpreted the requirements of one or more questions
- were unable to name basic processes related to atmosphere systems, such as evaporation and condensation
- repeated information provided in the question, such as describing atmospheric gradients in Question Three, instead of explaining the reasons for the gradients described by the question
- omitted or were unable to define key terms related to atmospheric systems.

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

- explained water cycle processes in terms of energy or phase change: for example, explaining evaporation as a phase change of water from liquid to gas, due to latent heat absorption, causing water molecules to vibrate faster, the breaking of bonds between molecules

- explained processes in terms of physics principles related to atmospheric systems; for example, density, temperature, adiabatic cooling, and albedo.

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

- accurately explained the links between energy, process, and effects
 - accurately linked latent and sensible heat exchange to water cycle processes
 - comprehensively explained relationships between temperature, pressure, and density
 - compared and contrasted effects of carbon aerosols and carbon dioxide.
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