2024 NCEA Assessment Report

Subject: Earth and Space Science

Level: 2

Achievement standard(s): 91191, 91192, 91193

General commentary

A significant number of candidates made only a superficial attempt at the examination, with many only attempting certain sections of individual questions or leaving complete questions blank, reducing their opportunity to achieve at any level. There was also a reliance from some candidates on previous years' assessment schedules, with candidates attempting to superimpose answers into questions with little thought as to the question's context or relevant section. Candidates must also realise the importance of carefully reading the question before they attempt to answer it.

Many candidates provided annotated diagrams to supplement their answers, enhancing their responses, while others utilised the space provided for diagrams to plan their answers, which added value by providing a sequential, well-written response.

In several cases, candidates lacked the fundamental understanding of the relevant concepts or vocabulary expected by the Achievement Standards at Curriculum Level 7, hindering their opportunity to achieve.

Where questions required the candidate to step outside the box and apply their understanding of the concepts, some excellent discussions were put forward, showing a high degree of decision-making skills when posed with a problem. Candidates achieving higher grades planned their responses well, used correct vocabulary, linked the concepts to the context of the question, and provided concise responses.

Report on individual achievement standard(s)

Achievement standard 91191: Demonstrate understanding of the causes of extreme Earth events in New Zealand

Assessment

The examination consisted of three questions, of which the candidates were required to respond to all three. Questions One to Three required the candidates to apply their understanding of the causes of extreme Earth events in New Zealand. The questions covered the requirements of the 2024 assessment specifications, which were that extreme Earth events are those that are extraordinary or remarkable on planet Earth, but which may occur commonly in parts of New Zealand (and its continental shelf) due to its position on plate boundaries. The questions required the candidates to apply their understanding of hotspot volcanoes, earthquakes, and tsunami by explaining the causes of these events in terms of the processes and effects that occur in one or more of the geosphere, hydrosphere, biosphere, or atmosphere.

Commentary

Candidates who achieved were familiar with the characteristics of basaltic magma and the formation of hotspot volcanoes, the features of earthquakes, and energy transfer in tsunami formed by uplift.

Many candidates understood that magma rises but were not able to link the cause to magma being less dense than the surrounding material. Although many candidates were familiar with most concepts related to tsunami, they displayed a poor understanding of the terms “run-up height” and “inundation”.

To reach a Merit or Excellence grade, candidates needed to understand the geological processes in different locations in and around New Zealand, and link their ideas to explain the formation and effects of volcanoes, earthquakes, and tsunami.

Grade awarding

Candidates who were awarded **Achievement** commonly:

- described the formation of a hotspot volcano
- described the characteristics of basaltic magma
- described the condition required for the formation of tuff rings and shield volcanoes
- defined the focus and epicentre of an earthquake
- described the impact of a shallow or deep earthquake
- defined a tsunami as a large water displacement
- described the energy transfer from the uplift to the water above
- described the amplitude or frequency of a tsunami wave in a stated location
- defined the terms run-up, height, and inundation.

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

- understood how density is related to magma
- explained how magma rises through cracks in the crust
- linked the characteristics of basaltic magma to the formation of a scoria cone or shield volcano
- explained the explosiveness of phreatomagmatic eruptions
- linked earthquake formation to friction and the plates becoming stuck
- linked energy to the depth or distance of an earthquake
- explained how a tsunami is generated by uplift
- explained the energy transfer from the uplift to the water above
- explained the nature of a tsunami in deep or shallow water
- explained the terms run-up height and inundation.

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

- linked the formation of a hotspot volcano to basaltic magma
- explained the movement of the crust in relation to hotspot volcanoes
- linked the characteristics of basaltic magma to the different types of eruption and volcanic features produced
- explained the relationship between the depth and distance from an earthquake and the damage caused
- linked the run-up height and inundation of a tsunami to the height of the shoreline.

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

- provided generic statements about all magma types
- could not identify the tectonic plates involved
- listed all types of plate movement
- provided generic statements about tsunami formation
- provided limited statements or a labelled diagram.

Achievement standard 91192: Demonstrate understanding of stars and planetary systems

Assessment

The examination included three questions, of which candidates were required to respond to all three Questions One to Three required candidates to apply their understanding of stars and planetary systems.

The questions covered the requirements of the 2024 assessment specifications, which were an understanding of the role of gravity in the life cycle of stars and planet formation and a Hertzsprung-Russell diagram, and absolute and apparent magnitude. The questions required the candidate to apply their understanding of a Hertzsprung-Russell diagram, star formation and life stages, and planet formation.

Commentary

While many candidates demonstrated familiarity with the relevant concepts being examined, many lacked a specific understanding of the terms being used and their associated meaning. For instance, magnitude was confused with mass, and luminosity with brightness or star temperature.

Candidates must be able to interpret a Hertzsprung-Russell diagram and use evidence from it to explain observable phenomena. Many candidates struggled to interpret the reverse scale for absolute magnitude, as well as the luminosity and temperature scales. Some candidates were confused around the reactant and product of nuclear fusion during different life stages of stars, for example stating that hydrogen and helium fuse together, and helium is fused to iron. Candidates appeared to understand the formation of gas giants outside of the frostline better than they did the formation of rocky planets at higher temperatures.

Those candidates reaching Merit or Excellence grades demonstrated a good understanding of the relevant concepts and were able to apply their understanding to both familiar and unfamiliar contexts.

Grade awarding

Candidates who were awarded **Achievement** commonly:

- provided generic definitions for absolute and apparent magnitude
- described planet formation in terms of the accretion process and gravity
- described the role of solar winds in moving low melting point materials beyond the frostline
- drew annotated diagrams of star life stages
- understood that a nebula includes dust and gas
- related the mass of a star to its likely future outcome
- applied the correct data or information to the question.

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

- understood the link between data and observed star information
- explained how star luminosity varies with a star's life stage
- explained the process of planet formation
- linked gravity to the stages of star formation and progression through its life cycle.

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

- utilised the Hertzsprung-Russell diagram to ascertain the size, life stage, and fusion process of the stars shown
- applied their knowledge of planet formation to postulate a plausible theory as to why there were no gas giants around a star
- extrapolated the two possible outcomes for Canopus based off its mass
- provided concise, logical explanations linking relevant concepts to the context of the question.

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

- misunderstood the positive and negative values of the absolute and apparent magnitude scales
- misread the scales on the Hertzsprung-Russell diagram
- provided a range of values for a specific reading from the Hertzsprung-Russell diagram
- lacked understanding of the term 'habitable zone'
- confused star and planet formation
- mistook a red dwarf for a red giant or brown dwarf
- confused the fusion sequence for different star life stages
- provided incomplete answers to questions
- lacked understanding of the question's context.

Achievement standard 91193: Demonstrate understanding of physical principles related to the Earth System

Assessment

The examination included three questions, of which candidates were required to respond to all three. Questions One to Three required candidates to apply their understanding of physical principles related to the Earth System. The questions covered the requirements of the 2024 assessment specification, which were sources of both terrestrial and solar heat energy, properties of waves, and the investigation of physical principles in relation to climate change. The questions required the candidate to apply their understanding of physical principles related to behaviour of visible light in water, heat sources and transfer within the Earth's interior, and surface heating and seasonal climate change.

Commentary

While many candidates were able to demonstrate sufficient understanding of the fundamental concepts being examined in the questions, some lacked an understanding of the basic principles, for instance the wavelengths and colours that make up the visible spectrum, and the difference between scattering and heat capacity.

Some candidates demonstrated an excellent understanding of the related concepts but were unable to apply it to the context. For instance, candidates were able to explain seasonal variations in terms of Earth's orbit and tilt but were unable to match this with the climate characteristics of Central Otago.

There were a number of misconceptions associated with physical principles that were apparent amongst candidate responses. These included that lake water colour was the result of reflection or sky colour, convection currents being due to particles becoming lighter, and seasonal variation being due to distance from the Sun.

To reach a Merit or Excellence grade, candidates needed to provide detailed, focused responses that applied the relevant physical principles to the context.

Grade awarding

Candidates who were awarded **Achievement** commonly:

- recognised the correct wavelengths and associated energies of blue and red light
- understood that blue wavelengths were transmitted further in water before absorption
- commented on the ability of material in water and water itself to scatter blue and green light
- stated the heat sources in the Earth's interior
- described the heat transfer processes occurring from the inner core to the crust
- described how the Earth's surface is heated by the Sun
- linked the tilt in the Earth's orbit to seasons
- linked seasonal heating to the amount of solar energy received per square metre
- linked snow's high albedo to reflection of incoming radiation and a cooler climate
- stated the low albedo of bare rock meant solar radiation could be re-radiated
- demonstrated basic understanding of the fundamental concepts required by the standard.

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

- explained the behaviour of blue light as it is transmitted through water and its scattering by water molecules
- linked scattering to the difference in appearance of the deep-water lakes
- explained how heat energy is generated in the Earth's mantle by movement of material
- explained how the lake water was heated by conduction and convection
- linked the Earth's orbit and tilt to the formation of seasonal variations in surface heating in Central Otago
- explained how snow's high albedo leads to a lack of heating within mountainous areas during the winter months
- demonstrated understanding of the concepts and the ability to apply them to the context.

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

- explained how differences in wavelength and properties of visible light leads to the observable colours associated with the deep-water lakes of Rotorua and Putaki
- explained the origins and location of heat energy sources in the Earth's interior
- discussed how the crater lake was heated by the heat generated from the Earth's interior
- linked seasonal heating with environmental heating in Central Otago referring to the albedo
- demonstrated a conceptual application linked to the physical processes involved.

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

- inverted the properties of red and blue light
- confused scattering of light with heat capacity
- described heat transfer processes through the Earth's interior
- stated the crater lake was heated by volcanic eruption

- stated that the Earth was closer to the Sun in summer
- stated that during winter Central Otago is facing away from the Sun
- reversed the role of snow and rock in the absorption of solar radiation and heating of surrounding area
- reversed the wavelengths of solar radiation responsible for heating the environment
- wrote descriptions of the graphic information provided
- misinterpreted the question
- lacked understanding of the basic concepts required by the acheivement standard.
