2025 NCEA Assessment Report

Subject: Earth and Space Science

Level: 2

Achievement standard(s): 91191, 91192, 91193

General commentary

As seen in previous years, a significant number of candidates made only a superficial attempt at questions, with many only attempting certain sections of individual questions, and in some cases leaving them completely blank; as a result, many left the examination early. Many candidates are not reading the questions properly and using familiar terms or phrases to provide responses that, although correct, do not answer the question posed.

Candidates should understand that the bullet points provided in questions serve as a framework for planning and structuring their responses to the question.

It was evident that previous examination papers and schedules are being used to model answers and provide an idea of the expectations at this level. While important to use, some candidates are replicating this material in their responses, which is not relevant to the current question. This highlights the need for candidates to adapt their responses to the specific context of the question rather than relying on memorised material.

Where space was provided for annotated diagrams, many candidates used this space for planning and providing annotated diagrams to support their written response, enhancing the quality of their response.

Several candidates demonstrated gaps in their fundamental understanding of key concepts and vocabulary expected at Curriculum Level 7 under the Achievement Standards, which limited their ability to achieve. Difficulties with interpreting scales – such as time scales and those on the Hertzsprung–Russell diagram – were evident, underscoring the importance of ensuring these concepts are clearly understood.

Candidates achieving higher grades provided detailed explanations and showed an in-depth understanding of the relevant concepts as well as an ability to apply or use information provided to novel contexts.

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 aligned with the 2025 assessment specifications by focusing on extreme Earth events that are unusual globally but common in New

Zealand due to its location on plate boundaries The questions required the candidates to apply their understanding of andesitic and rhyolitic 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

At Achieved, candidates attempted most of the questions and demonstrated an understanding of basic geological concepts, such as magma formation, energy transfer in earthquakes, and the movement of energy through the water in a tsunami.

To reach a Merit or Excellence grade, candidates need 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.

Candidates that received an Excellence grade demonstrated comprehensive understanding of the relevant geological processes, explaining all aspects and clearly linking processes, causes, and affects.

Grade awarding

Candidates who were awarded **Achievement** commonly:

- drew and labelled annotated diagrams
- described the processes of magma formation
- described the characteristic properties of Andesitic magma
- described the processes involved in the layering of stratovolcanoes
- defined a fault
- described the features of an earthquake
- described the impact(s) of both shallow and deep earthquakes
- defined the focus and epicentre of an earthquake
- stated that energy is lost when an earthquake is deep
- defined a tsunami as a large water displacement that caused water to move in all directions
- linked energy transfer from the plate uplift to water displacement
- described either amplitude, frequency, or wavelength of a wave in the deep or shallow water
- described at least one stage of a caldera eruption.

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

- explained how density of magma varied
- explained how less dense magma could rise to the surface through cracks
- understood that sea water lowered the melting point of the pacific plate
- linked the melting of the australian plate to the addition of silica to the magma
- linked the characteristics of andesitic magma to steepness of a stratovolcano
- linked energy to the depth or distance from the epicentre of an earthquake
- understood that energy absorption causes the damage in an earthquake
- explained how plate uplift can generate a tsunami
- explained the nature of a tsunami in either deep or shallow water
- explained one eruption stage of an underwater volcano.

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

- explained the formation of andesitic magma and the reasons for the increase in silica content in terms of earth processes
- explained, in depth, how the energy from an earthquake is related to an earthquake's depth, and the distance away from the eipcentre
- explained how seafloor uplift generates a tsunami and the associated energy transfer involved
- linked the characteristics of tsunami waves in deep water to little energy being lost, and tsunami waves in shallow water to friction with the seabed
- explained the stages of formation of a submerged (underwater) caldera.

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

- confuded hotspot volcanism with subduction volcanism
- provided generic statements about magma
- could not identify the correct tectonic plates and movement on the diagram
- listed all possible options for tsunami formation
- did not understand the word submerged.

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 2025 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 moon formation.

Commentary

While many candidates demonstrated familiarity with the relevant concepts, many lacked a specific understanding of several terms and their associated meaning, for example luminosity being interchanged with magnitude, and temperature of a star not being linked to its colour.

Candidates must be able to interpret a Hertzsprung-Russell diagram, and use evidence from it to explain observable phenomena. Several candidates struggled to read the scales or did not understand the scale leading to misinterpretation in their answers. When giving a reading from a scale on the Hertzsprung-Russell diagram, it should be written as a definitive value, not a range.

Some candidates were confused by the time scale used in both the moon formation and star formation questions. The difference of 0.09 billion years was perceived as minimal by some candidates in the moon formation question, while in the star formation question candidates perceived the time scale to be in hundreds of years not millions of years.

Those candidates reaching Merit or Excellence grades provided detailed explanations and showed a depth of understanding of the relevant concepts being examined. These candidates were able to apply or use the information to support their explanations.

Grade awarding

Candidates who were awarded **Achievement** commonly:

- identified the fusion processes taking place in stars from main sequence to post main sequence giant stars
- described a brown dwarf as a failed star or without enough mass to carry out nuclear fusion
- understood that a protoplanetary disc orbits a star
- identified possible reasons for phobos and deimos being captured within Mars's gravitational field
- linked the shape of phobos and deimos to possible asteroid origin
- recognised the formation of the Moon as a result of a collision, and provided a reason why the collision theory was appropriate or why other theories were not
- recognised that a supernova is a catastrophic explosion
- stated that gravity is responsible for the contraction of a star during certain stages of its life
- recognised that the mass of a star determines its likely outcome.

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

- supported their answers with annotated diagrams
- explained the relationship between a star's surface area and its luminosity
- explained the role of gravity in the stages leading to nuclear fusion in the giant molecular cloud
- linked the evidence provided to explain why Mars's moons were captured asteroids
- applied the evidence supplied with their own knowledge to explain why the Moon was formed by a collision event
- explained the relationship between star mass and gravity to the eventual outcome of a giant-sized main sequence star.

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

- explained the luminosities of arneb and gliese in terms of surface area, the fusion process taking place within the star, and the rate of nuclear fusion
- explained the formation of main sequence stars and how they differed to brown dwarfs
- justified, using evidence of both capture and collision theories of moon formation, the origins of Mars's moons and the Earth's moon
- explained the role of gravitational forces in both star evolution and star death
- linked a star's original size and resulting core mass after supernova to the likely outcome of either a neutron star or black hole.

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

- could not distinguish between luminosity and star temperature
- confused luminosity with apparent and/or absolute magnitude
- used the word 'burns' when referring to fusion
- linked size and / or mass with the temperature of a star rather than life stage
- lacked understanding of the location of the asteroid belt in our solar system
- transposed the information supplied in the booklet for phobos and deimos
- believed that a white dwarf is one of the possible outcomes for the demise of a giant mass star.

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 2025 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 the atmosphere, heat capacity and transfer on land and sea, and effect of clouds on Earth's surface temperature.

Commentary

While many candidates were able to demonstrate sufficient understanding of the fundamental concepts being examined in the questions, some lacked an understanding of basic principles, such as scattering and heat capacity, while others displayed clear misconceptions such as stating that the colour of the Moon was due to reflection of light from Earth, and stating greenhouse gases reflect heat or long wave radiation.

To reach a Merit or Excellence grade, candidates need to demonstrate a good understanding of the concepts relevant to the questions. These candidates provided well planned and crafted responses relevant to the context of the question, with candidates at Excellence being able to apply their understanding in a novel situation.

Grade awarding

Candidates who were awarded **Achievement** commonly:

- described the wavelength of blue (short) and red (long) light correctly in the visible spectrum
- linked the scattering of shorter wavelengths to the sky being blue
- stated that we can see the moon due to reflected sunlight
- stated that the Earth's surface is heated by solar radiation
- referenced the high heat capacity of water compared to land
- described the difference between the heating of the land and sea during the day
- recognised the difference in heat loss from the land and sea at night
- linked the properties of high- and low-level clouds to their effect on incoming solar radiation
- described how the greenhouse effect operates through the interaction of gases, clouds, and long wave radiation.

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

- explained the colour of the sky in terms of rayleigh scattering
- explained the colour of the Moon in terms of the scattering of light passing through the atmosphere
- linked day and night temperatures to the heat capacity of water and surface land
- explained the processes of heat transfer via convection or conduction
- explained the behaviour of low-level clouds on incoming short wave radiation and outgoing long wave radiation
- explained the interaction of greenhouse gases with long-wave radiation and how this process contributes to heat retention in the atmosphere.

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

- linked the short wavelengths of the visible spectrum to their energy and color, and explained how interactions with atmospheric gases cause scattering
- linked increased particle content in the atmsophere to increased scattering of incoming moonlight
- related the temperature changes of land and sea to their respective heat capacities and responses to incoming solar radiation.
- linked the ability of the ocean to retain heat to the transfer of heat energy causing warm coastal climates in winter
- discussed the behaviour of high- and low-level clouds on incoming short wave and outgoing long wave radiation
- justified the possible changes in mountain climate due to changes in cloud cover.

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

- stated that solar radiation was scattered in space before reaching the Moon
- confused scattering with refraction or dispersion
- stated that the Earth's surface is heated by the internal energy from below the crust
- failed to recognise the link between heat transfer and temperature changes
- stated that greenhouse gases reflect heat
- failed to recognise the albedo effect of low-level clouds and their ability to retain heat.
