2022 NCEA Assessment Report

Mana Tohu Mātauranga o Aotearoa
New Zealand Qualifications Authority

Subject: **Earth and Space Science**

Level: **2**

Standards: **91191, 91192, 91193**

Part A: Commentary

Many candidates appeared to only attempt one paper, answer certain sections of questions, or leave out whole questions, reducing their opportunity to achieve at any level. Candidates must realise they need to read the questions thoroughly before committing to their response, and be aware that parts follow on from each other and are linked. Each part builds on from the other, requiring transfer of basic knowledge to a context in the later sections of the question.

Candidates who took the time to plan and clarify their responses provided stronger answers. Well-annotated and labelled diagrams were used by many candidates to support their written answers, helping them achieve higher grades than those who did not. Candidates should therefore be actively encouraged to use the spaces provided for diagrams to support their understanding of basic principles and definitions.

Some candidates are still relying on the use of pre-learned responses from previous examination materials, or text material that has little relevance to the context of the questions or are not appropriate. Candidates are encouraged to identify the key ideas within the question as a starting point for their written answers, rather than look for some similarity to previous questions.

Part B: Report on standards

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

Examination

The examination included three questions, of which candidates were required to respond to all three. Questions 1–3 required candidates to apply their understanding of the causes of extreme Earth events in New Zealand. The questions covered the requirements of the 2022 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 candidate to apply their understanding of a subduction volcano, earthquake, 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

Observations

Candidates were familiar with events such as subduction volcanoes and earthquakes, but struggled to transfer their knowledge from one area to another, such as the formation of tsunami as a result of a phreatomagmatic eruption and caldera formation.

Reference to the correct tectonic plates involved with the extreme Earth event, as well as their respective movement in answers, is vital for Achievement at any level. Achievement also requires an understanding of the characteristics of different magma types in order to explain the features of volcanic eruptions and their shape. To reach a Merit or Excellence grade, candidates need to refer to energy transfer when explaining both earthquakes and tsunami.

Grade awarding

Candidates who were awarded **Achievement** commonly:

- identified the characteristics of andesitic magma
- described how layering contributed to the shape of a stratovolcano
- described the damage caused by erupted products
- described a pyroclastic flow
- defined an earthquake fault
- described features of an earthquake
- described impacts of a shallow or deep earthquake
- defined tsunami
- described energy transfer from a volcanic eruption into a water column
- described the formation of a caldera volcano
- described a phreatomagmatic eruption.

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

- provided generic statements related to magma
- could not identify tectonic plates or their movement
- could not identify the stages of an earthquake
- could not explain how energy transfer formed a tsunami.

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

- linked the characteristics of andesitic magma and other eruptive products to the layering of a stratovolcano
- linked the formation of eruptive products to their effects on the surrounding area or distance from the volcano
- linked friction or tectonic plates becoming ‘stuck’ to earthquake formation
- linked energy from an earthquake to depth or distance
- described how a phreatomagmatic eruption or caldera formation generates a tsunami.

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

- linked the layering of a stratovolcano to different eruptive products and multiple eruptions
- explained in-depth the nature of eruptive products and the damage they cause
- linked earthquake formation to time
- explained how energy from an earthquake is related to magnitude, depth and locality
- explained the formation of a phreatomagmatic eruption and caldera and how these generate tsunami.

91192: Demonstrate understanding of stars and planetary systems

Examination

The examination included three questions, of which candidates were required to respond to all three. Questions 1–3 required candidates to apply their understanding of stars and planetary systems. The questions covered the requirements of the 2022 assessment specifications, which were an understanding of the role of gravity in the life cycle of stars, and a Hertzsprung-Russell diagram, with temperature on the x-axis, and luminosity or absolute magnitude on the y-axis. The questions required the candidate to apply their understanding of a Hertzsprung-Russell diagram, theories of moon formation, and star life cycles.

Observations

The questions provided within the examination provided a level of critical thinking that allowed those candidates who understood to display their understanding of the astronomical and physical principles required of the standard.

While many candidates could demonstrate familiarity with the concepts being examined, many did not understand specific terminology such as luminosity, and mass and gravity were interchanged rather than linked. Reference to the role of gravity in star formation and life cycle is vital for Achievement at any level. Achievement also requires candidates to be able to interpret a Hertzsprung-Russell diagram. To reach a Merit or Excellence grade, candidates need to be able to link a star's mass to gravity, the star's fusion process, and its life stage.

Grade awarding

Candidates who were awarded **Achievement** commonly:

- used the Hertzsprung-Russell diagram to list properties of stars
- used a star's mass and size to identify the correct fuel and rate at which it was consumed
- predicted the likely end outcome of stars
- described the term natural satellite
- linked the mass or orbit characteristics of Triton to the capture theory

- described theories of moon formation
- described fusion in large mass stars.

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

- did not understand the meaning of the term luminosity
- could not describe of role of gravity in star formation or death
- failed to recognise that formation of a supernova is an outcome relevant to the death of a star
- attempted parts of questions.

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

- linked star luminosity to fuel usage and brightness
- linked star mass to its likely end outcome
- understood the link between star mass and gravity
- explained the role of gravity in a star's fusion process
- explained the role of Neptune's gravity on the capture of Triton and its resulting orbital characteristics
- explained a possible theory for the formation of Neptune's inner moons
- explained the likely outcome of a large mass star in terms of either its original size or its core's size after a supernova.

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

- linked the existence and properties of Neptune's inner moons to their formation and differences with Triton
- provided reasoned comparisons for the likely outcome of stars or events using scientific theory and evidence.

91193: Demonstrate understanding of physical principles related to the Earth system

Examination

The examination included three questions, of which candidates were required to respond to all three. Questions 1–3 required candidates to apply their understanding of physical principles related to the Earth system. The questions covered the requirements of the 2022 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, the role of ice in climate regulation, and heat transfer related to geothermal springs.

Observations

While many candidates were able to show their understanding of the physical principles examined in the questions, some candidates demonstrated misunderstandings related to scattering of light by atmospheric particles, behaviour of solar radiation interacting with high clouds, atmospheric warming by radiation, and heat transfer processes. Some candidates still believe that particles get lighter when they are heated, rather than understanding that with more energy the particles move further apart making the substance less dense, for example the air, rather than the particles themselves.

Question Two required not only an understanding of the interaction of radiation with water and ice, but also the atmosphere. While many candidates responded with good answers linking the role of ice and water with the absorption or reflection of solar radiation, many neglected to extend the changes to atmospheric conditions, and hence the climate, preventing them from reaching Merit or Excellence grades.

Grade awarding

Candidates who were awarded **Achievement** commonly:

- described the visible spectrum in terms of wavelength and colour
- described the reasons for the colour of the sky during the middle of the day and evening
- described the behaviour of visible light in clouds
- described the behaviour of solar radiation in water and ice
- described how land absorbs solar radiation
- linked reduction in Arctic ice to greater heat absorption by the ocean
- described how water acts as a heat sink
- stated the origins of heat energy in the Earth’s interior
- described heat transfer from the Earth’s core to the crust
- identified the source of groundwater heat
- described how heated groundwater reaches the Earth’s surface.

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

- described high level clouds as a major absorber and reflector of solar radiation
- stated that red light is scattered at sunset
- linked reflection of solar radiation from ice to heating of the Earth's atmosphere
- could describe one form of heat transfer involved in the Earth's interior.

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

- linked scattering of clue light to wavelength and atmospheric particles
- explained the white appearance of clouds in terms of scattering of all visible wavelengths
- linked the low angle of the Sun to the scattering of red light in the atmosphere at sunset
- linked the albedo of ice to the cooling of the Earth's climate
- linked water's dark colour or high heat capacity to the oceans retaining more heat energy and increased ice melt
- explained the heat transfer processes from the inner core to the crust
- linked the sources of heat within the crust to the heating of groundwater
- explained how convection processes in the crust bring heated water to the surface.

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

- discussed the behaviour of visible light as it travels through the atmosphere
- justified the colour of a sunset by linking the distance visible light travels through the atmosphere and the wavelength of its components
- explained the behaviour of solar radiation with ice, water and land mass
- explained how loss of Arctic ice leads to climate change
- explained how groundwater filtrate deep in the Earth's crust is heated by the Earth's interior, and then moves to the Earth's surface.