Assessment Report

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Level 2 Earth and Space Science 2021

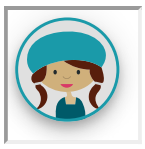
Standards 91191 91192 91193

Part A: Commentary

Candidates need to read the questions thoroughly before committing to their response and be aware that question parts may follow on from each other and be linked. Each part builds on from the other, requiring transfer of basic knowledge to a context in the later sections of the question. Therefore, a candidate should be actively looking for this connection, and referring to the earlier parts and resources provided. Candidates who do not answer certain sections of questions or leave out whole questions reduce their opportunity to achieve at any level.

Candidates who took the time to plan and clarify their responses provided stronger answers. Bullet points in the questions are a guide to the selection of relevant principles to be considered and provide a structure to answering the question.

Candidates who provided well-annotated and labelled diagrams to support their written answers achieved higher grades than those who did not. Therefore, a candidate should be actively encouraged to use a diagram to support their



understanding of basic principles and definitions. Candidates should not rely on the use of pre-learnt responses from previous examination materials or text material that has little relevance to the context of the question.

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 2021 assessment specification 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 an earthquake, tsunami, and hotspot volcano 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

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. While many candidates wrote explanations about earthquake and tsunami formation, not referring to the process of energy transfer prevented many from reaching a Merit or Excellence grade. Achievement requires an understanding of the characteristics of different magma types in order to explain the features of volcanic eruptions and their shape.

Candidates were familiar with events such as hot spot volcanoes, but struggled to transfer their knowledge from familiar contexts such as Auckland, to an unfamiliar context such as Dunedin.

Grade awarding

Candidates who were awarded **Achievement** commonly:

- used annotated diagrams to answer their questions
- could name the tectonic plates involved in the extreme Earth event (for example, the Australian and Pacific plates for the Edgecumbe earthquake)
- described features of an earthquake (for example, the epicentre, focus and fault)
- related the damage caused by an earthquake to either depth of the earthquake or distance away from earthquake
- understood that a tsunami was a displacement of water
- understood that the cause of the Arica tsunami was a vertical uplift of the seafloor
- clearly described the characteristics of a tsunami wave in the deep ocean and shallow coastline
- understood that hot spot volcanoes erupt once.

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

- did not attempt all the questions in the paper
- answered questions using irrelevant information
- lacked knowledge of tectonic plates involved, characteristics of magma, and understanding of what caused a tsunami.

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

- provided clear, well-labelled, and well-annotated diagrams
- linked the correct plate movement to earthquake formation
- clearly explained earthquake damage in terms of depth and distance
- linked wave characteristics (for example, amplitude, wavelength, speed) to the behaviour of a tsunami in deep and shallow water
- linked the characteristics of basaltic lava to the resultant shape of a shield volcano
- linked the single eruption of a hot spot volcano to plate movement.

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

- clearly explained the formation of earthquakes by linking the correct plate names and movement, to the correct fault type
- comprehensively linked the damage caused by the Edgecumbe earthquake to the associated factors (for example, time, depth, distance)
- explained in depth the formation of the Arica tsunami in terms of plate tectonic movement, and energy transfer
- comprehensively explained the formation of the Dunedin hotspot volcano.

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 2021 assessment specification 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 planet formation, relationship between luminosity and life stage of a star, and star formation.

Observations

Candidates who had clearly read the questions and planned their answers were able to show a good application of the correct astronomical and physical principles that applied to each question. While many candidates could demonstrate their familiarity with the concepts being examined, many were unable to apply those principles to the context within the question, demonstrating a lack of ability to transfer their knowledge to new situations.

The contexts provided within the examination provided a level of critical thinking that showed application of the astronomical and physical principles required of the

standard, allowing those candidates who understood these to display their understanding.

Grade awarding

Candidates who were awarded **Achievement** commonly:

- provided correct definitions for common astronomical terms (for example, frost line, luminosity, protostar)
- were able to use a Hertzsprung-Russell diagram to gather information about stars
- described the formation of planets in terms of a planetary disk, and development of planetesimals
- provided a logical reason for the non-existence of gas giants in the Kepler star system
- provided a reason for the difference in luminosities of stars on the Hertzsprung-Russell diagram
- described the life cycle of stars (for example, Antares A and B), and their eventual outcome
- related the eventual outcome of a star to its original mass
- described the fusion products of stars during their life cycle
- understood that star formation began in a giant molecular cloud
- described the possible outcome of low mass protostars.

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

- did not understand/use basic astronomical terms (for example, frostline)
- omitted sections or whole questions
- did not read the questions correctly
- provided irrelevant information
- referred to the burning of hydrogen, instead of hydrogen fusion
- confused planetary formation with star formation
- believed that red dwarf stars were not main sequence stars.

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

- explained planet formation from the protoplanetary disk formation after the protostar had formed, and the role of gravity in the development of planets
- explained the role of solar winds in moving material to the outer reaches of the planetary system
- explained the possible reasons for the non-existence of gaseous planets (for example, in the Kepler system)
- were able to relate the colour and luminosity of a star to its temperature and surface area
- provided detailed explanations of the life cycle of stars (for example, Antares A and B)
- explained how mass and gravity influence the development of a protostar
- explained the requirements for a protostar to begin fusion in terms of gravity, mass, and temperature of the core
- used well-annotated diagrams to show planet formation and star life cycles.

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

- comprehensively explained the formation and development of rocky planets from their origins in the protoplanetary disk, referring to gravity, temperature, and location
- justified their reasons for the non-existence of gaseous planets in a star system
- compared the current life stage of stars using information from the Hertzsprung-Russell diagram, in terms of luminosity and temperature
- compared the respective outcomes of stars in terms of their fusion processes and the role of gravity
- explained in detail the eventual outcomes of protostars by linking mass, gravity and temperature to their formation.

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

LIVE

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 2021 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 solar radiation in water, melting permafrost and climate change, and the relationship between ocean currents and local climate.

Observations

Reading the question, and clearly identifying the principle being examined is vital to achieving in this standard at any level. While many candidates were able to show their understanding of the physical principles of Earth systems through written answers, the use of well-annotated and labelled diagrams enabled candidates to reach Merit and Excellence grades, as the diagrams clarified their explanations. Certain basic concepts were poorly understood by many candidates, leading to the non-completion of sections or whole questions. Certain misconceptions (for example, the heating of the Earth by the Sun at the equator, the appearance of the ocean, the role of greenhouse gases) were apparent amongst many candidates.

A number of candidates were able to demonstrate their understanding of some of the concepts being examined, however they were not able to apply this knowledge to the context of the question posed preventing them from reaching Merit and Excellence grades. Where candidates relied on recall, the use of planning would have allowed them to clarify their understanding, allowing them to attempt the question.

Grade awarding

Candidates who were awarded **Achievement** commonly:

- identified the properties of visible light (for example, reflection, transmission, absorption)
- understood that white light is a mixture of wavelengths/colours
- linked different colours in the visible light spectrum to short and long wavelengths
- understood that red light was absorbed in shallow water, and that blue light penetrated further
- understood what greenhouse gases were
- described how the Earth's atmosphere was heated from the Earth's surface
- described the role of greenhouse gases in retaining heat within the Earth's atmosphere
- identified three factors that influenced ocean currents
- described why the surface heating at the equator is greater than at the poles in terms of greater concentration of solar radiation
- described the transfer of heat energy from the ocean to the landmass.

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

- believed that the colour of the ocean was due to a reflection of the sky
- wrongly related ocean colour to refraction and dispersion of light
- described atmospheric heating as being due solely as a result of the action of ozone
- believed that greenhouse gases were part of the ozone layer
- stated that greenhouse gases act as an insulator, or that it prevented solar radiation from reaching the Earth's surface
- did not understand the role of ocean currents in distributing heat energy around the Earth
- confused the heat transfer processes of conduction and convection
- mixed up surface currents with the thermohaline current.

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

- explained visible light as a mixture of electromagnetic waves, with different wavelengths, ranging from long (red) to short (blue)
- related the appearance of the ocean in terms of the penetration of blue wavelengths, and the scattering of blue light
- explained the absorption of incoming solar radiation at the Earth's surface
- understood that long wavelength radiation was re-emitted from the Earth's surface
- explained the role of greenhouse gases in the retention of heat energy within the Earth's atmosphere
- linked surface area and solar radiation to heating of the Earth's surface at different latitudes
- explained ho heat is transferred from the ocean to the land via the processes of conduction and/or convection.

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

- comprehensively explained how blue wavelengths of light penetrate the ocean, and are scattered by water molecules giving the ocean its appearance
- linked the depth of colour in the ocean to increased scattering with depth until all the light was absorbed
- explained in-depth the role of greenhouse gases in warming the Earth's atmosphere, and the effect of melting permafrost on this
- explained how greenhouse gases absorb long wavelength radiation and re-emit it in different directions warming the atmosphere
- comprehensively explained how solar heating of equatorial waters affects the climate of the Bay of Islands by incorporating the role of surface ocean currents, water's heat capacity, and heat transfer processes.

Science subject page

Previous years' reports

2020 (PDF, 181KB)

2019 (PDF, 103KB)

2018 (PDF, 105KB)

2017 (PDF, 43KB)

2016 (PDF, 217KB)

LIVE