

Assessment Schedule – 2022

Earth and Space Science: Demonstrate understanding of the causes of extreme Earth events in New Zealand (91191)

Evidence Statement

Question One

	Expected Coverage	Achievement	Merit	Excellence
(a)	<p>Tectonic plate: Australian Plate</p> <p>Key process: Melting due to an increase in temperature with depth.</p> <p>Tectonic plate: Pacific Plate</p>	<p>Describes:</p> <ul style="list-style-type: none"> • TWO correct labels 	<p>Explains:</p>	<p>Explains comprehensively:</p>
(b)	<p>Mt Taranaki is formed from andesitic magma, which has intermediate amounts of silica, gas, and viscosity, making the magma sticky.</p> <p>Stratovolcano eruptions alternate between gas eruptions and lava flows.</p> <p>The cone shape of a stratovolcano is formed from the relatively quick cooling of the ash and lava layers which build up over successive eruptions.</p> <p>Sticky magma / lava results in a steep sided cone shape of volcano as magma / lava does not flow far from vent before solidifying / crystallising.</p>	<ul style="list-style-type: none"> • TWO characteristics of andesitic magma – intermediate silica, viscosity, gas content • TWO types of eruption – ash and lava 	<ul style="list-style-type: none"> • the link between magma composition and cone shape OR • how successive eruptions contribute to the cone shape 	<ul style="list-style-type: none"> • how magma composition and alternating eruptive products lead to the cone shape of a stratovolcano

<p>(c)</p>	<p>Due to the intermediate viscosity of andesitic magma, trapped gases are released explosively from the sticky magma. This leads to pyroclastic eruptions of tephra (ash) and lava flows.</p> <p>Lava flows from the volcano will travel short distances due to its intermediate viscosity / silica. Andesitic lava cools relatively quickly, so will not travel far from the vent before it solidifies. Everything in the path of the lava will be knocked over, surrounded, buried, or ignited by the extremely hot temperature of the lava.</p> <p>In a future eruption from Mt Taranaki, hot ash and gas is erupted into a high eruption column / plume. This column then descends (due to gravity), producing a pyroclastic flow which can travel large distances due to its very fast speed. A pyroclastic flow will knock down, shatter, bury, or carry away nearly all objects or structures in its path, as well as starting fires due to its extreme temperature.</p> <p>Ash from the eruption will be transported by wind over larger distances and will fall over a much larger area than the pyroclastic flows because of this. Ash may collapse roofs, contaminate drinking water and waterways, and cause breathing problems.</p> <p>Ash and lava which build on the sides of the volcano may become unstable due to the steep sides of the cone. These may collapse due to gravity, and large landslides may occur. These would travel a moderate distance from the vent depending on their size. Roads, bridges, and forest in a landslide path may be destroyed.</p>	<ul style="list-style-type: none"> • link between lava distance and cooling rate • pyroclastic eruption characteristics • link between ash distance, and wind • link between landslide and unstable / steep slope. 	<ul style="list-style-type: none"> • the relationship between ONE eruptive product and its effect on the surrounding area OR the relationship between the nature of the eruptive product and the distance it travels. 	<ul style="list-style-type: none"> • the likely characteristics of a future eruption from Mt Taranaki referring to TWO of lava, ash, pyroclastic flows, or landslides AND the likely damage caused by different eruptive products on surrounding area.
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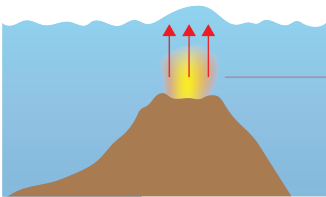
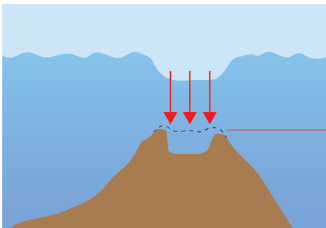
NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response or response does not relate to the question.	Describes ONE partial point at the Achievement level.	Describes TWO points at the Achievement level.	Describes THREE points at the Achievement level.	Describes FOUR points at the Achievement level.	Explains ONE point at Merit level.	Explains TWO points at Merit level.	Explains ONE point at Excellence level (with minor errors or omissions).	Explains comprehensively ONE point at Excellence level.

Question Two

	Expected Coverage	Achievement	Merit	Excellence
(a)	A fault line is a crack in the Earth’s crust, along which stress from an earthquake is / has been released. OR A crack or fracture caused by crust movement.	Describes: • a fault line	Explains:	Explains comprehensively:
(b)	The Rauoterangi Fault sits on the Australian Plate, which is colliding with the Pacific Plate off the east coast of the North Island, with the PP subducting beneath the Australian Plate. This collision compresses the crust to the west of the plate boundary. This will result in a build up of stress along fault lines. As the stress energy builds up over a period of time, eventually the rock cannot withstand any more stress, causing a break along the fault line, resulting in an earthquake.	• the plate motion causes the crust to come under pressure / stress • compression of crust generates ruptures / fault	• links subduction of Pacific Plate at plate boundary to stress build-up / rupture. • Earthquakes due to large build-up of stress over time being suddenly released along a fault	• Australian Plate is compressing due to convergence of Australian Plate / Pacific Plate boundary leading to large build-up of stress over time in crust surrounding the Rauoterangi Fault. When the stress is released, an earthquake occurs
(c)	Magnitude – magnitude is the energy released from an earthquake’s focus. The larger the magnitude, the greater the amount of energy released. Depth – depth of the focus effects the amount of energy that reaches the Earth’s surface. The deeper the quake, the more energy is lost due to friction. Bedrock – bedrock affects the amount of shaking experienced on the surface, as earthquake waves travel through it at different speeds. Locality – Fault line passes through the centre of a built-up area, therefore there is likely to be a lot of damage to older buildings, roads, rail tracks, and fences. As there are flood plains and rivers passing through the area, there is risk of liquefaction due to the soft soils / sediments.	• describes magnitude • shallow / deep quakes more / less damaging • bedrock affects speed of seismic waves • one visible effect of an earthquake on this fault.	• the link between magnitude and damage caused by an earthquake AND the link between depth of a quake and damage caused by an earthquake OR the link between bedrock and damage caused by an earthquake.	• how magnitude, depth, and either bedrock or locality affect the likely damage caused along the Rauoterangi fault line.

N0	N1	N2	A3	A4	M5	M6	E7	E8
No response or response does not relate to the question.	Describes ONE partial point at the Achievement level.	Describes TWO points at the Achievement level.	Describes THREE points at the Achievement level.	Describes FOUR points at the Achievement level.	Explains ONE point at Merit level.	Explains TWO points at Merit level.	Explains ONE point at Excellence level (with minor errors or omissions).	Explains comprehensively ONE point at Excellence level.

Question Three

	Expected Coverage	Achievement	Merit	Excellence
(a)	<p>A tsunami is a series of waves caused by the LARGE displacement of the water column that carry the energy of the disturbance.</p>	<p>Describes:</p> <ul style="list-style-type: none"> • a tsunami as a displacement of water 	<p>Explains:</p>	<p>Explains comprehensively:</p>
(b)	<div style="display: flex; flex-direction: column; align-items: center;"> <div style="text-align: center; margin-bottom: 20px;"> <p style="color: red; font-size: small;">Gas bubble pushes up through water column, displacing it.</p>  <p style="color: red; font-size: small;">Eruption of lava from volcano mixes with water causing seawater to evaporate and increase in volume.</p> </div> <p style="text-align: center;">As the volcano erupts, seawater comes in contact with the high temperature magma (phreatomagmatic eruption), causing the seawater to evaporate with an explosive increase in volume, forming a large gas bubble. The gas bubble travels upwards, displacing the whole water column above it, transferring its energy into the water, generating a tsunami wave.</p> <div style="text-align: center; margin-bottom: 20px;"> <p style="color: red; font-size: small;">Water column is displaced downwards due to a caldera collapse.</p>  <p style="color: red; font-size: small;">Roof of magma chamber collapses due to weight of sea water.</p> </div> <p style="text-align: center;">Once the magma chamber of a caldera is empty, the weight of the seawater above causes the roof of the chamber to collapse. Seawater rushes in to fill the chamber, causing the water column to drop, transferring its energy into the water, generating a tsunami wave.</p> </div>	<ul style="list-style-type: none"> • TWO correct labels • identifies cause of displacement for eruption • identifies cause of displacement for Caldera • refers to transfer of energy from eruption / caldera collapse to water 	<ul style="list-style-type: none"> • Formation of tsunami as a result of phreatomagmatic eruption <p style="text-align: center;">OR</p> <ul style="list-style-type: none"> • formation of tsunami as a result of collapse of caldera 	<ul style="list-style-type: none"> • how the initial eruption from a caldera causes an upwards LARGE displacement of the water column, due to the phreatomagmatic eruption <p style="text-align: center;">AND</p> <ul style="list-style-type: none"> • how a caldera collapses then creates a tsunami due to a downwards displacement of the water column

(c)	<p>The size of the tsunami formed by a submarine volcano would depend on:</p> <ul style="list-style-type: none"> the width and depth of the magma chamber of the volcano, as a wider and deeper chamber would result in a greater downwards displacement when the chamber collapses the depth of the water column above the volcano. If the volcano occurred in shallow water, the amount of displacement would be a lot less than if it occurred in deep water. <p>A caldera volcano like Healy, has different stages of eruption. Initially eruptive products are exploded through cracks in the magma chamber. These products would cause a phreatomagmatic eruption, causing an initial tsunami due to the upwards displacement of the water. Once the magma chamber has emptied, which can be quite a while after the initial eruption, the weight of the water causes a caldera collapse, resulting in a second tsunami event.</p> <p>There is also the possibility of a landslide due to the collapse of one side of the caldera, leading to a submarine avalanche, leading to a tsunami.</p>	<ul style="list-style-type: none"> identifies one factors that affect the size of the tsunami identifies one stage of eruption of a caldera volcano. 	<ul style="list-style-type: none"> the link between the width and depth of the magma chamber to the size of a tsunami formed <p>OR</p> <p>the link between depth of the ocean and the tsunami formed</p> <ul style="list-style-type: none"> the link between ONE stage of a caldera eruption and tsunami formation. 	<ul style="list-style-type: none"> the factors that would affect the size of a tsunami produced by a submarine volcano like Healy, and why there is likely to be two tsunami events as a result of this type of eruption.
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NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response or response does not relate to the question.	Describes ONE partial point at the Achievement level.	Describes TWO points at the Achievement level.	Describes THREE points at the Achievement level.	Describes FOUR points at the Achievement level.	Explains ONE point at Merit level.	Explains TWO points at Merit level.	Explains ONE point at Excellence level (minor errors or omissions OK).	Explains comprehensively ONE point at Excellence level.

Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 6	7 – 12	13 – 18	19 – 24