Assessment Schedule – 2019

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

Evidence Statement

Question One: Auckland Volcanic Field

Expected Coverage	Achievement	Merit	Excellence
The Auckland Volcanic Field (AVF) is monogenetic (erupts once and each new eruption is usually in a different location). These volcanoes are hotspots or intra-plate volcanoes that are not linked to subduction zones. An active hotspot of molten rock exists about 100 km beneath the surface. Every so often, some rocks melt and separate from the surrounding rock and rise to the surface. This hot magma rises through the crust via a new pathway, reaching the surface and causing a volcanic eruption in a new location. Basaltic magma is associated with hotspot volcanoes such as those in the AVF. It arises from deep in the mantle and contains a low silica content, and so is therefore not very viscous (runny) and contains little dissolved gas. Basaltic lava is therefore usually associated with less explosive eruptions. However, the first stage of an eruption in the water or on land could be an explosive / violent (phreatomagmatic) eruption, as cold sea water or from the water table meets magma / molten rock, rapidly creating an explosive amount of steam (tuff ring formation) Once the water can no longer reach the hot lava, or if a dry eruption occurs, the ongoing fire fountain would build craters of loose erupted material (scoria cones). Later stages may produce lava fountains and basaltic lava flows from the base of the scoria cone which, as it is quite runny (compared with other lavas), may spread long distances from the vent, producing a gentle sloped shield similar to Rangitoto. *Note: each of Auckland's volcanic eruptions has been unique, and any future eruption may have some or all of the features described.*	Explains: • The AVF is an intraplate / hotspot volcano. • If magma meets water, an explosive eruption will occur. • Basaltic lava is low in silica / not very viscous / low in gas content / usually not explosive. • Dry eruption may form a cone of loose material / scoria cone. • Eruption may form a gentle sided / shield volcano.	Explains in detail: • Future eruptions will rise from the same hotspot in the mantle to a different location to existing craters / cones. • Role of sea / groundwater in producing possible initial explosive eruption of steam. tuff ring • Dry eruption building / scoria cones depending upon gas content of lava. • Formation of lava flows / shield volcano in relation to a characteristic of basaltic magma.	Explains comprehensively: • Melted rock from the existing hotspot 100 km deep rises to the surface via a new path, which lead to a basaltic eruption in a new location / not an existing volcano. • Basaltic lava that originates in the mantle / usually lower in gas and silica (usually) forming less explosive eruptions AND linking to the surface features that are formed. • The role of water linked to the type of eruption / surface features that may be formed.

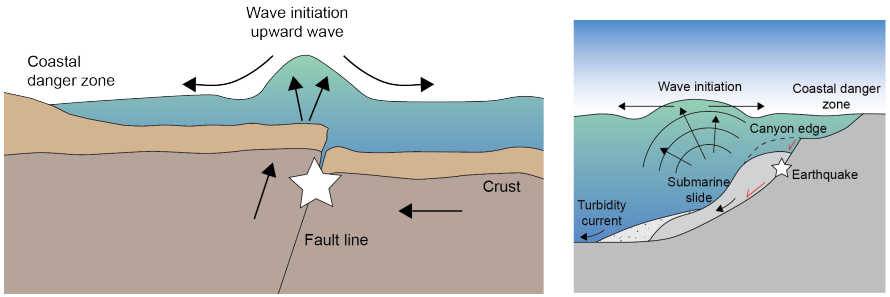
Not Achieved			Achievement		Achievement with Merit		Achievement with Excellence	
NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response: no relevant evidence.	Partially describes one point.	Describes two points.	Describes three points.	Describes four points.	Explains one point.	Explains two points.	Explains comprehensively one point, with minor errors	Explains comprehensively one points.

Question Two: Wairarapa Earthquake 1855

Expected Coverage	Achievement	Merit	Excellence
A – represents a (dextral) strike slip fault (Wairarapa Fault – part of the North Island Fault System). This is two sections of the Australian Plate that are under considerable stress due to the subducting Pacific Plate to the east of the region. A strike-slip fault is a transform boundary where the two plates are moving sideways. B – represents a reverse (or thrust) fault caused by the fracturing of the overlying Australian crust as the Pacific Plate subducts at the Hikurangi Margin. Stress is built up due to the convergence of the two plates. As a result the western side of the Wairarapa Fault displaced upwards, causing a reverse / thrust fault (at different sections along the 150 km of the rupture the angle of displacement varies so both reverse and thrust faults are acceptable answers). The Pacific and Australian plates are converging and locked together, under the Wairarapa region, at a transition zone between the subduction zone of the Hikurangi Margin / Trench where the oceanic Pacific Plate is subducting under the continental Australian crust and the transform boundary. Strain / stress energy builds up over a period of time (recurrence interval of 2 200 years) and eventually the rock cannot withstand any more strain, causing a break along a reverse or transform fault line. The energy is released as the plates move, releasing a huge amount of energy in an earthquake. Visible effects included uplift of parts of Wellington Harbour (meaning no longer usable), uplift of sections of land (and shaking) resulting in multiple landslides all along length of uplift / rupture – 'new' land formed in 'downtown' Wellington from sea floor. Transform movement results in 'broken' displaced roads, rivers, fence lines – damage to building (mainly older brick buildings) can be from either shaking or land movement.	Explains: • A as strike-slip or transform fault. • B as reverse or thrust fault. • Recognise as a mid-plate fault. • Pacific Plate subducting puts Australian Plate under stress, causing fractures / stress / earthquakes / uplift. • Earthquake as release of built-up strain / stress energy. • One visible effect from either uplift or strike slip movement.	Explains in detail: • One type of movement / faults by referring to Australian Plate. • Link subduction at plate boundary (Hikurangi) to stress build-up / rupture at Wairarapa Fault. • Earthquake as a release of a large amount of energy built up over a long period of time. • Effects seen on land from uplift, transform / sideways movement and shaking linked to depth	Explains comprehensively: • Earthquake as release of strain energy built up over time – long build-up between events allows substantial energy being stored in rocks before release. • Complexity of convergence zone where the plate tectonic in the region change from the subduction zone of Hikurangi Trench to the transform boundary of the top of the South Island. • Effects seen on the land from shaking (buildings collapse), vertical and horizontal movement – must include detail of landslides, uplift, and shaking.

Not Achieved			Achievement		Achievement with Merit		Achievement with Excellence	
NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response: no relevant evidence.	Describes one point.	Describes two points.	Describes three points.	Describes four points.	Explains one point.	Explains two points.	Explains comprehensively one point, with minor omissions.	Explains comprehensively one point.

Question Three: Wellington Tsunami 1855

Expected Coverage	Achievement	Merit	Excellence
Tsunami are water waves caused by the displacement of a large volume of water. The amount of displacement is directly related to the amount of vertical uplift from the fault rupture / reverse faulting and from the landslide of material from the sides of the canyon walls. The energy transformed into movement of the water is due to the energy from the vertical displacement of the seafloor, and the movement of material from the canyon walls, which will relate to steepness, amount of material displaced and height of displacement. The energy of the uplift / landslide is directly related to the height (gravitational potential energy) of the source material, which in turn is converted to (kinetic) energy to cause water displacement. The relatively small distance from the source of the uplift and landslide events means that very little energy is dispersed. The size of the body of water means there is little opportunity for energy to be lost, meaning that the size of the initial wave (11 m) hitting the Wellington waterfront is very similar to the initial displacement caused by either the uplift or landslide. Tsunami waves travel outward from the point of initiation in all directions and continue across the surface of the water body – in this case the travel distance of the wave is very small. This can result in a localised large amplitude wave. Annotated diagram, e.g. 	Explains: • Tsunami as displacement of water. • Landslides within the canyon will generate a lot of material and energy. • Uplift of the sea floor / reverse fault will generate displacement of water above. • Shows correct direction of movement of material, displacing water up and out, on diagram. • Shows correct direction of movement of sea floor as a result of uplift, which displaces water up and out, on diagram. • Narrow width of canyon and Cook Strait mean little or no opportunity for water displacement / energy to be lost – all transferred into wave.	Explains in detail: • A tsunami as a displacement of water caused by energy transmission, which radiates out from the point of origin. • Amplitude of tsunami wave related to the amount of water displaced by landslide ~~OR~~ AND seafloor uplift. • Shape of the narrow Cook Strait focuses water displacement, resulting in large tsunami.	Explains comprehensively: • How energy caused by the initial uplift AND landslide material generates water displacement, which radiates from the origin. • Relates the amount of displacement caused by uplift OR landslide AND to the energy transferred / generated and to the size of the resultant wave. • Energy from landslide / seafloor uplift is focused by narrow Cook Strait canyon, which generates large-amplitude tsunami, as there is little opportunity for energy dispersal.

Not Achieved			Achievement		Achievement with Merit		Achievement with Excellence	
NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response: no relevant evidence.	Describes one point.	Describes two points.	Describes three points.	Describes four points.	Explains one point.	Explains two points.	Explains one point, with minor omissions.	Explains comprehensively one point

Cut Scores

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