Assessment Schedule – 2024

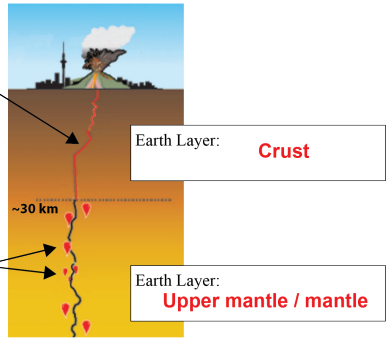
Earth and Space Science: Demonstrate understanding of the causes of extreme Earth events in New Zealand (91191)

Evidence Statement

Question One

<table>
<tr><th>Q</th><th>Expected Coverage</th><th>Achievement</th><th>Achievement with Merit</th><th>Achievement with Excellence</th></tr>
<tr><td>(a)</td><td>
<table>
<tr><th></th><th>Temperature</th><th>Silica Content</th><th>Viscosity</th><th>Gas Content</th></tr>
<tr><td>BASALTIC MAGMA</td><td>High</td><td>Low</td><td>Low</td><td>Low</td></tr>
</table>
</td><td rowspan="2">Describes:
• two out of the four characteristics of basaltic magma
• crust and mantle in the diagram
• monogenetic eruption
• the AVF as an intraplate / hotspot volcano
• explosive eruption when basaltic magma meets water
• basaltic lava not usually being explosive.</td><td rowspan="2">Explains:
• how molten, less dense rock separates from surrounding rock in mantle and rises due to density difference
• how magma from the mantle forces its way through cracks in the crust to reach the surface causing a volcanic eruption
• the role of sea water / groundwater in producing possible initial explosive eruption of steam leading to formation of tuff ring
• how a dry eruption builds up loose material forming scoria cones
• formation of lava flows / shield volcano in relation to a characteristic of basaltic magma.</td><td rowspan="2">Explains comprehensively:
• how volcanic eruptions in Auckland were formed from one basaltic magma source
• the similarities and differences in the type of basaltic eruption that occur on land and under the ocean.</td></tr>
<tr><td>(b)</td><td>
Earth Process:
Magma rises up though cracks in the crust towards the surface.

Earth Process:
Less dense / hotter magma rises due to density difference with surrounding mantle.



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.
</td></tr>
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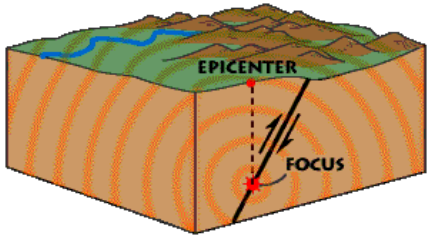
(c)	Basaltic lava is usually associated with less explosive eruptions. The first stage of an eruption either in water or on land can be explosive / violent (phreatomagmatic) as when cold sea water or water from the water table meets magma / molten rock, the rapid cooling of the magma creates an explosive amount of steam (tuff ring formation). Once water can no longer reach the hot lava, or if the land eruption is dry, a fire fountain occurs building up craters of loose erupted material, leading to the formation of scoria cones. Later stages of eruption for all eruption types may produce lava fountains and basaltic lava flows from the base of the scoria cone, as the lava is runny due to its low viscosity (silica content), meaning it spreads long distances from the vent, producing gentle sloping shield volcanoes such as Rangitoto.			

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response or response does not relate to the question.	Describes ONE partial point at Achievement level.	Describes TWO points at Achievement level.	Describes THREE points at Achievement level.	Describes FOUR points at 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

Q	Expected Coverage	Achievement	Merit	Excellence
(a)	 Focus is the position below the surface where the rupture occurs. Epicentre is the position directly above the focus on the surface.	Describes: • the focus and epicentre of an earthquake (can be diagram) • the North Island as sitting on the Australian plate • the convergent plate tectonic boundary with Pacific plate OR the subduction of Pacific plate • the build up of stress / elastic potential energy over time • the earthquake as a release of built-up stress / energy on a fault • the seismic waves lose energy as they travel through the crust • the seismic waves spread out more for a deeper quake.	Explains: • how earthquakes are generated, e.g. earthquake as release of stress / elastic potential energy built up over time through a rupture on a fault • how earthquake in the Australian plate is generated over 100 km away from plate boundary • how energy is lost as seismic waves travel to the surface leading to the intensity of the shaking being less for deep quake • how the seismic waves spread out as they travel to the surface leading to deeper quakes being felt over a larger area.	Explains comprehensively: • how tectonic processes led to this earthquake occurring on the west coast of the North Island over 100 km away from the plate boundary • why the Kāpiti Coast earthquake was felt by so many people across the country, with little to no damage caused close to the epicentre.
(b)	The North Island of New Zealand sits on the Australian (continental) tectonic plate. Off the east coast of the North Island, the Australian plate converges and locks up with the Pacific (oceanic) plate. This more dense plate subducts beneath the less dense Australian plate. Stress (elastic potential) energy builds up over time as the plates converge, until eventually the rock in the Australian plate cannot withstand any more stress, and a break / rupture occurs along a fault line, in this case the one off the Kāpiti Coast. The energy is released as the plates move releasing large amounts of (kinetic) energy, resulting in an earthquake.			
(c)	The deeper the earthquake, the less dangerous it is compared with a shallow earthquake of the same magnitude. When the stress / energy is released at the focus, the energy travels away in seismic waves from the focus. As the seismic waves travel through the crust, energy is lost to the surrounding rock. The further the seismic waves have to travel to reach the surface, the more energy they lose, meaning deeper earthquakes of the same magnitude as shallow have lost more energy by the time they reach the surface and cause less damage due to less energy and therefore less shaking at the surface. Surface shaking intensity is what causes damage to infrastructure in an earthquake. As the seismic waves travel towards the surface, they also spread out more, this means that for a deep quake the waves have spread out much further meaning that the quake is felt over a much larger area.			

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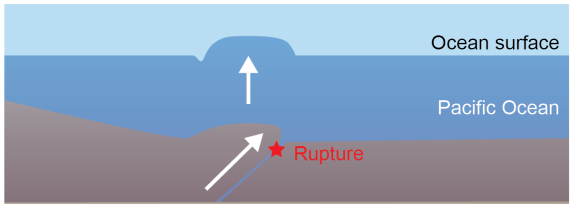
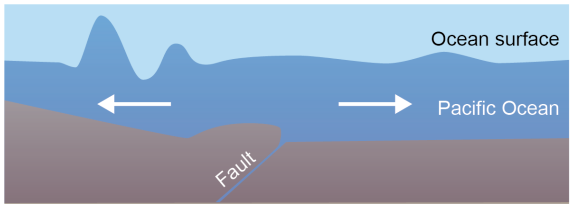
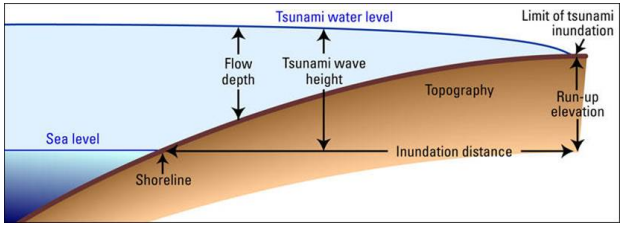
Question Three

Q	Expected Coverage	Achievement	Merit	Excellence
(a)	 **Sea floor on right of rupture moves upwards, displacing the water directly above it.**  **Tsunami wave moves in all directions away from the initial point of displacement.**	Describes: • water displacement and movement on faultline shown on diagram • tsunami moves away from point of displacement in all directions (can be shown on diagram) • a tsunami in terms of displacement of water • elastic potential energy to kinetic energy • speed in deep and shallow water • amplitude / wavelength in deep and shallow water • run-up height of a tsunami (may be diagram) • inundation of a tsunami (may be diagram).	Explains: • how a rupture along a faultline can result in the seafloor uplifting, causing a tsunami • what happens to the speed, amplitude, and wavelength of a tsunami in shallow water (as it approaches the shoreline) • the difference between the run-up height and inundation of a tsunami • factors that affects the run-up height and inundation of a tsunami.	Explains comprehensively: • how a rupture along a faultline can result in the seafloor uplifting, causing a tsunami, and how the speed, amplitude and wavelength vary in deep and shallow water • the difference between run-up height and inundation of a tsunami, and why these are different in different locations.
(b)	A tsunami is a series of waves caused by the physical displacement of the water column (due to earthquakes / volcanoes / landslides). In this case an earthquake has occurred along the faultline. The rupture causes elastic potential energy to build up, due to stress, and then to be released, causing one side of the fault to move upwards, converting the energy into kinetic energy. As the seafloor rises on one side of the fault, it causes the water body above it to be displaced upwards, resulting in a tsunami. The tsunami wave then moves out in all directions. In the deep ocean the wave will move at high speeds, with a small amplitude and long wavelength. As the tsunami approaches shallow water (coastline), friction with the seafloor causes the wave to slow down, bunch up (wavelength shortens), and the amplitude to increase.			

(c)	The run-up height of a tsunami is the maximum vertical height onshore above the mean sea level. The inundation distance is the amount of horizontal distance a tsunami travels landwards from the coastline.  https://www.usgs.gov/media/images/tsunami-terms The topography of the shoreline helps determine the run-up height and inundation of a tsunami. Flat shorelines offer little resistance, allowing the wave to continue inland leading to greater inundation distances, whereas steep walls or cliffs will force the wave up, causing a greater run-up height. Other factors that affect run-up height include how the energy is focused, the travel path of the tsunami, and the coastal configuration. Tsunamis can move up rivers leading to greater inundation distances in localised areas.			

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Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 06	07 – 12	13 – 18	19 – 24