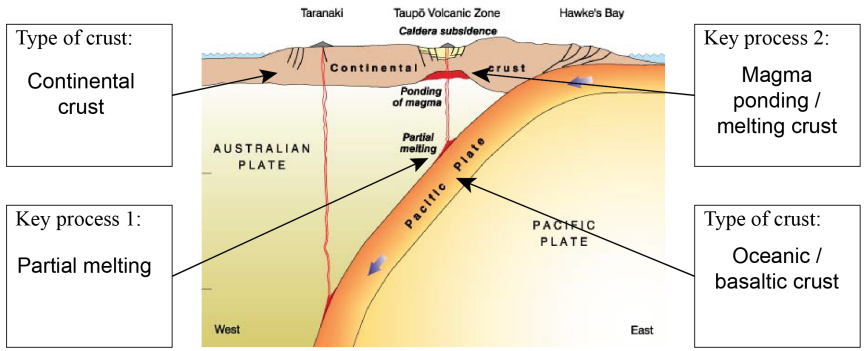
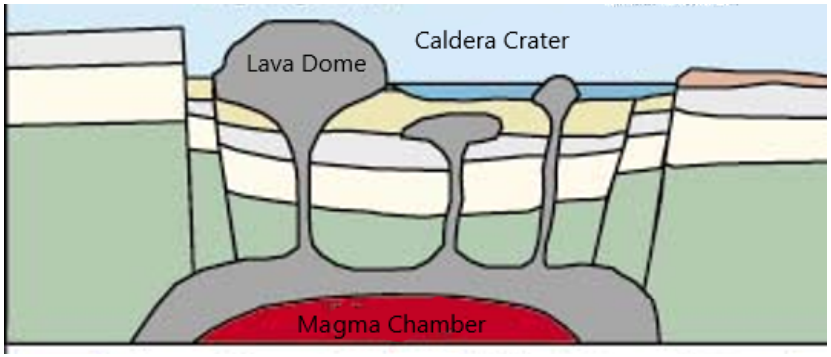
Assessment Schedule – 2020

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

Evidence Statement

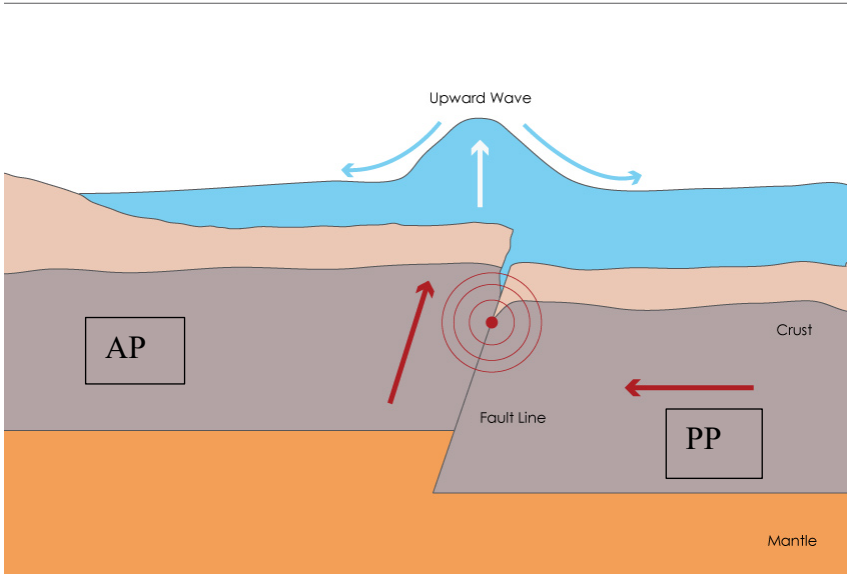
Question One: Central Taupō Volcanic Zone

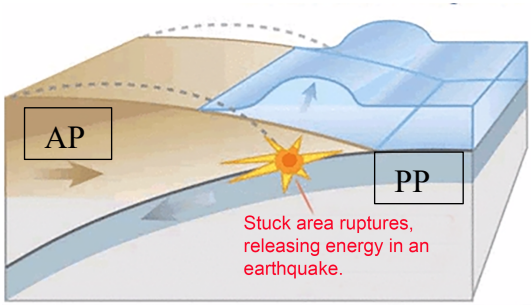
	Expected Coverage	Achievement	Merit	Excellence
(a)	 https://teara.govt.nz/en/diagram/8693/subduction-under-the-north-island	Describes: • TWO correct labels. • Correct plate movement arrow for Pacific Plate.		
(b)	As the dense oceanic Pacific Plate (PP) subducts under the continental Australian Plate (AP) by gravity, heat is generated by friction and pressure. Water within the oceanic PP lowers the melting point of the rock, and the plate will melt, forming less dense magma, which will rise towards the AP crust. This rising magma will pond at the base of the AP, causing the silica-rich AP to melt, increasing the silica content of the rising magma. This silica makes the magma more viscous, which traps gases, so they are unable to escape, building up pressure beneath the surface. This rhyolitic magma will have a high silica content (>69%), will be relatively cool (750–850 °C), and contain a large amount of trapped gases, making it very explosive when it reaches the surface.	• TWO characteristics of rhyolitic magma e.g.: - relatively low temperature (750–850 °C) - highly viscous - contains high quantity of trapped gases - silica rich. • Relevant description of rhyolite formation.	Explains in detail: • Subduction of PP under AP causes melting that results in (basaltic) magma rising. • Characteristics of rhyolitic magma leading to trapping gases, which are explosively released.	Explains comprehensively: • Subduction of PP under the AP causing (basaltic) magma rising and ponding under AP (continental crust) leading to increased silica content of rhyolite and more viscous / explosive magma due to trapped gases.

(c)	 http://volcano.oregonstate.edu/vwdocs/volc_images/australia/new_zealand/rotorua.html The pressure from the trapped gases and rising magma under the crust eventually becomes too great and there is an explosive eruption releasing gases and rhyolitic magma. This empties the magma chamber and the collapse of the crater forms a caldera, e.g. Ōkataina. The caldera fills with ash / pumice / ignimbrite and water. Magma continues to form in the same way but the built up gases have been released and there are 'cracks' – faults – that allow any released gases to escape. Subsequent eruptions are of silica-rich magma, which oozes out to form steep sided domes such as Haroharo. *Evidence may be taken from anywhere in Question One.*	• Formation of caldera from magma containing a high quantity of gases / highly explosive eruption. • After caldera eruption dome formed from degassed / viscous lava OR magma forces out by sinking crust (post eruption).	• Caldera formation once the pressure is released, the crust collapses, forming a caldera. • Degassed magma is forced out through the crust forming (steep sided) dome volcanoes within / around caldera.	• Viscous rhyolite traps gases building up huge pressure forming very explosive eruption as gases release forming caldera crater. AND Sinking crust forces degassed (viscous) rhyolite through cracks forming steep sided domes.

Not Achieved			**Achievement**		**Achievement with Merit**		**Achievement with Excellence**	
NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response or response does not relate to the question.	Describes ONE partial idea at the Achievement level.	Describes TWO ideas at the Achievement level.	Describes THREE ideas at the Achievement level.	Describes FOUR ideas at the Achievement level.	Explains ONE idea at Merit level.	Explains TWO ideas at Merit level.	ONE point.	TWO points.

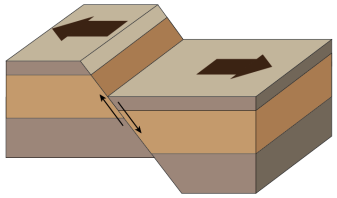
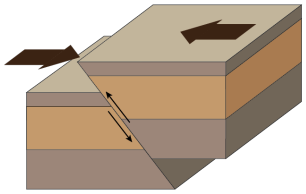
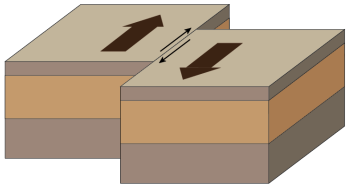
Question Two: Hikurangi megathrust tsunami risk

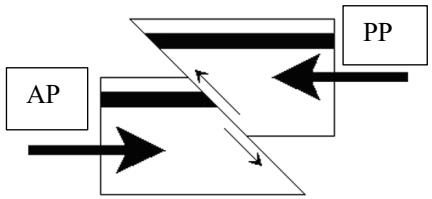
	Expected Coverage	Achievement	Merit	Excellence
(a)		Describes: • Vertical displacement (uplift) of the sea floor. • Resulting in vertical water displacement. • Water moving in all directions.		
(b)	As the denser PP subducts under the less dense AP, friction causes the AP to catch on the PP, bending it and building up a huge amount of energy. Once enough energy has built up, it will suddenly release as an earthquake, and the PP will return to its initial shape, lifting large areas of land near the (thrust) fault. During this process, a huge amount of energy will be released as seismic waves through land or tsunami through water. There is a long build up between events in this area (recurrence interval), so energy has a long time to build-up which leads to the large magnitude.	• Transfer of energy / movement from mantle to crust. • Build-up of energy / tension in the AP as the PP subducts.	• Direction of plate movement, cause of friction linked to build-up and release of energy.	Explains comprehensively: • Direction, movement energy and friction linked to release of large amount of energy due to length of time between events.

(c)	 During a megathrust event, a large amount of energy that has been built up in the crust is suddenly released. This can uplift the sea floor, transferring a large amount of energy to the water column above by displacing a large volume of sea water. This water can then travel away from the epicentre in all direction as a tsunami as the energy transfers into movement energy through the water. *Evidence may be taken from anywhere in Question Two.*	• Earthquake as a sudden release of energy / movement. • Uplift of AP described. • Tsunami as a displacement of water.	• Links vertical displacement of the sea floor with resulting displacement of water movement and energy transfer.	• Release of (elastic potential) energy built up in the AP linked to energy transfer to / through the ocean by vertical displacement of the sea floor / water column leading to movement of the tsunami.

Not Achieved			**Achievement**		**Achievement with Merit**		**Achievement with Excellence**	
NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response or response does not relate to the question.	Describes ONE partial idea at the Achievement level.	Describes TWO ideas at the Achievement level.	Describes THREE ideas at the Achievement level.	Describes FOUR ideas at the Achievement level.	Explains ONE idea at Merit level.	Explains TWO ideas at Merit level.	ONE point.	TWO points.

Question Three: Dunedin Earthquake Risk

	Expected Coverage	Achievement	Merit	Excellence
(a)	 **Normal fault**  **Reverse or thrust fault**  **Strike-slip fault**	• ONE fault type correctly named.		
(b)	At the Alpine Fault, the AP is colliding with and moving along the PP. This collision compresses the crust to the east of the Alpine fault. This will build up a huge amount of pressure in the surrounding crust. Eventually, enough pressure will be built up for a reverse or thrust fault to form running parallel to the Alpine Fault. As there was a long period during which pressure was able to build up, a large earthquake can form along the fault	Describes: • Pacific Plate being compressed. • Compression of crust generates ruptures / fault. • Earthquakes will be shallow. • Long time / interval between events.	Explains in detail: • Pacific Plate is compressing due to the convergent boundary of AP / PP. • Large magnitude earthquakes due to large build-up of pressure / tension.	Explains comprehensively: • Pacific Plate is compressing due to convergence of AP / PP boundary leading to large build-up of tension in crust surrounding the Alpine Fault / plate boundary.

(c)	 The Titri fault sits on the buoyant thick continental crust of the Pacific Plate. The PP and AP are converging along the PP and AP boundary to the west. The Titri fault is a mid-plate fault system, which will only generate shallow earthquakes caused by compression of the PP. One side climbs up the sloping fault face and overlaps the other. The compression causes ruptures within the brittle continental crust, these surface ruptures generate large, shallow earthquakes with a long recurrence interval (period between events). The compression of a reverse fault generates a hanging wall, which is additional 'height' and uplift of the crust. The amount of uplift is determined by factors that include the magnitude of the quake and the underlying rocks structure. In general terms the bigger the magnitude, and the greater the time interval between events the greater the uplift. 3-metre uplift is consistent with a magnitude above 7, with a long recurrence interval. *Evidence may be taken from anywhere in Question Three.*	• Large uplift relates to amount of energy released.	• 3-metre uplift caused by sudden release of large amount of compression force. • Thrust or reverse fault explained in terms of movement producing hanging wall.	• Large uplift caused by sudden release of compressional energy built up over a large period of time. This compressional force produced a hanging wall due to a thrust fault.

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Cut Scores

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