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NZQA

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

QUALIFY FOR THE FUTURE WORLD
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Level 2 Earth and Space Science, 2019

91191 Demonstrate understanding of the causes of extreme Earth events in New Zealand

9.30 a.m. Wednesday 27 November 2019
Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of the causes of extreme Earth events in New Zealand.	Demonstrate in-depth understanding of the causes of extreme Earth events in New Zealand.	Demonstrate comprehensive understanding of the causes of extreme Earth events in New Zealand.

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should attempt ALL the questions in this booklet.

If you need more room for any answer, use the extra space provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–16 in the correct order and that none of these pages is blank.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

Excellence

TOTAL 21

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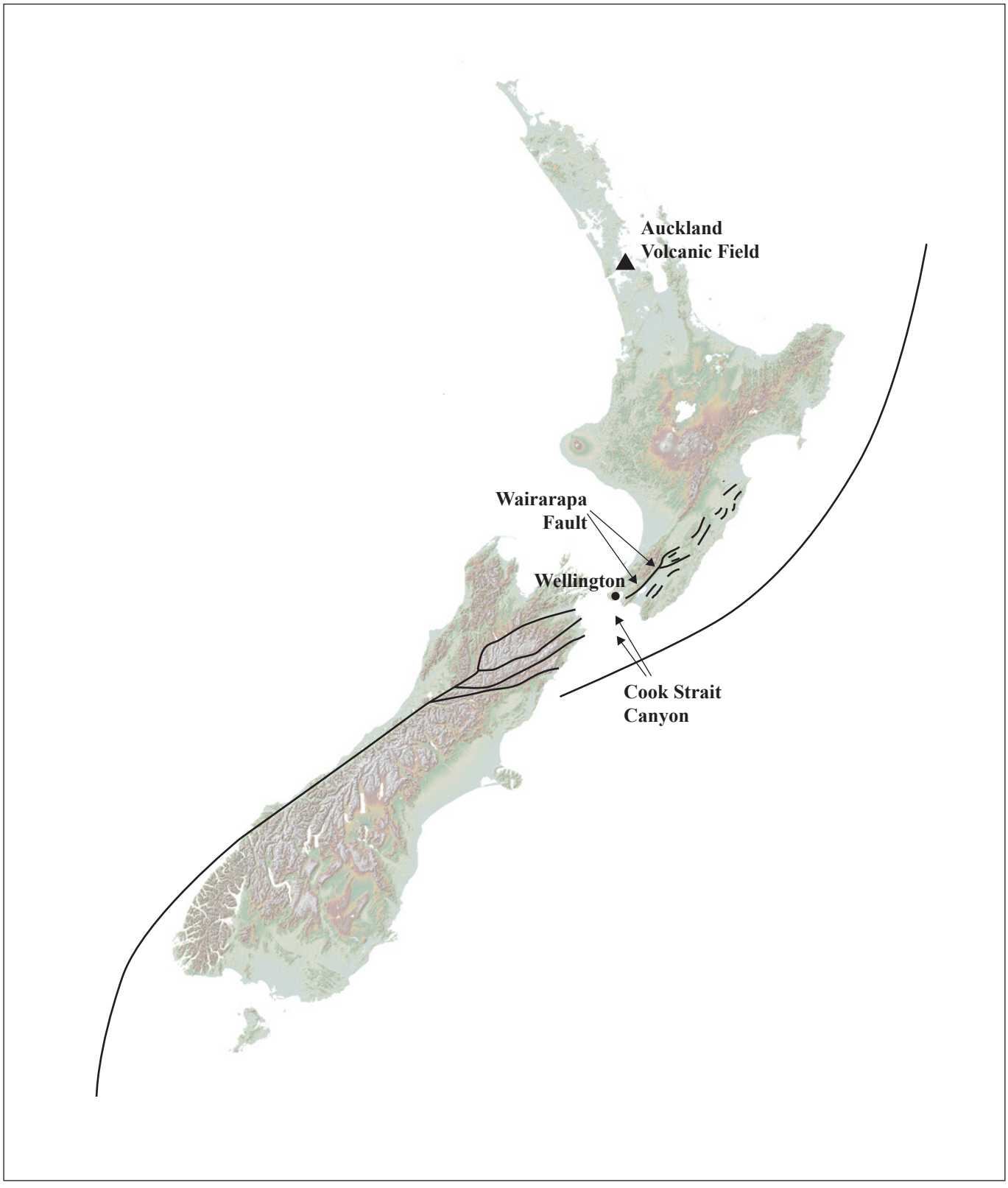
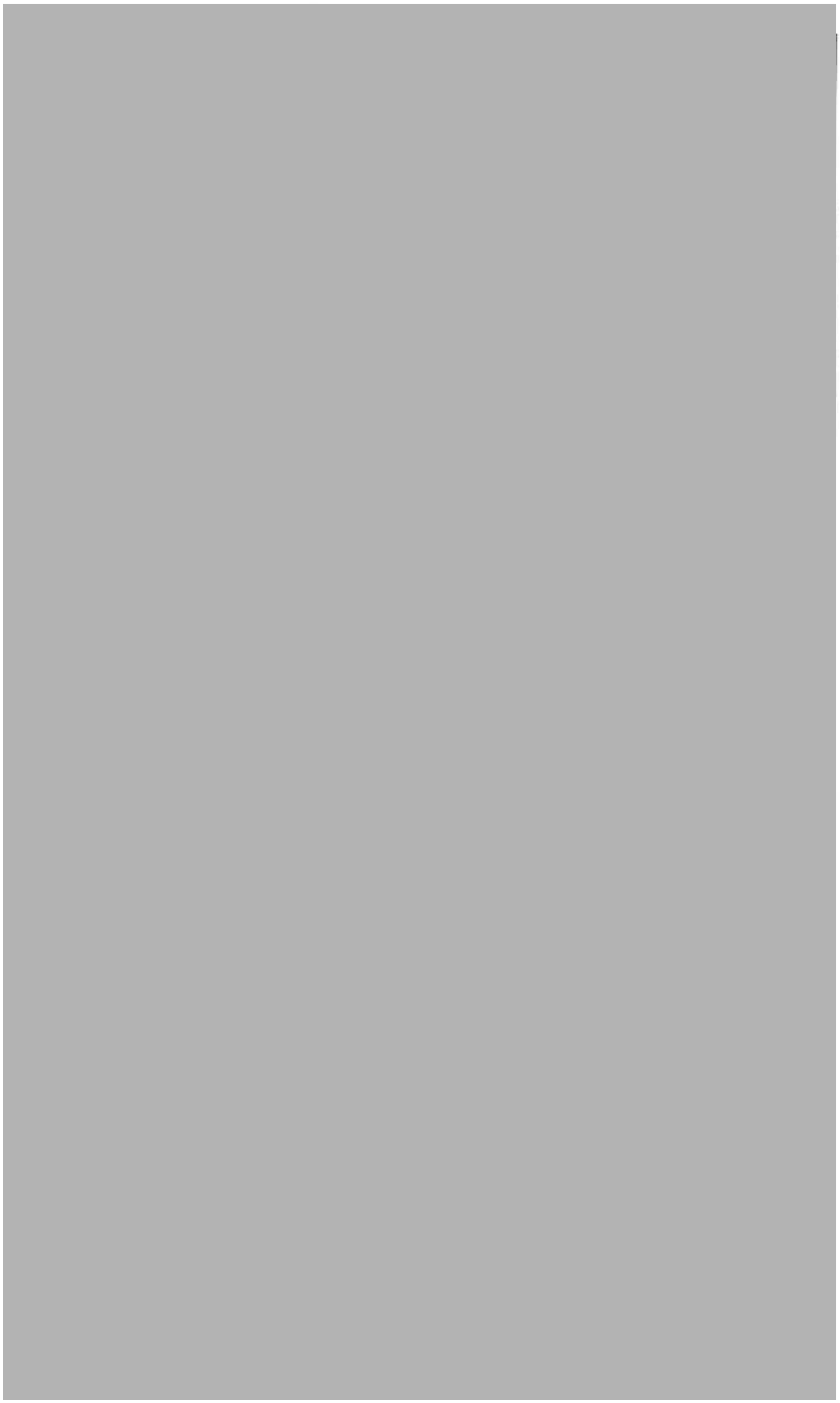
The examination starts on the following page.

Regional Map Showing Locations Referred to in this Paper



QUESTION ONE: AUCKLAND VOLCANIC FIELD



Adapted from: www.sciencelearn.org.nz/images/716-auckland-volcanic-field

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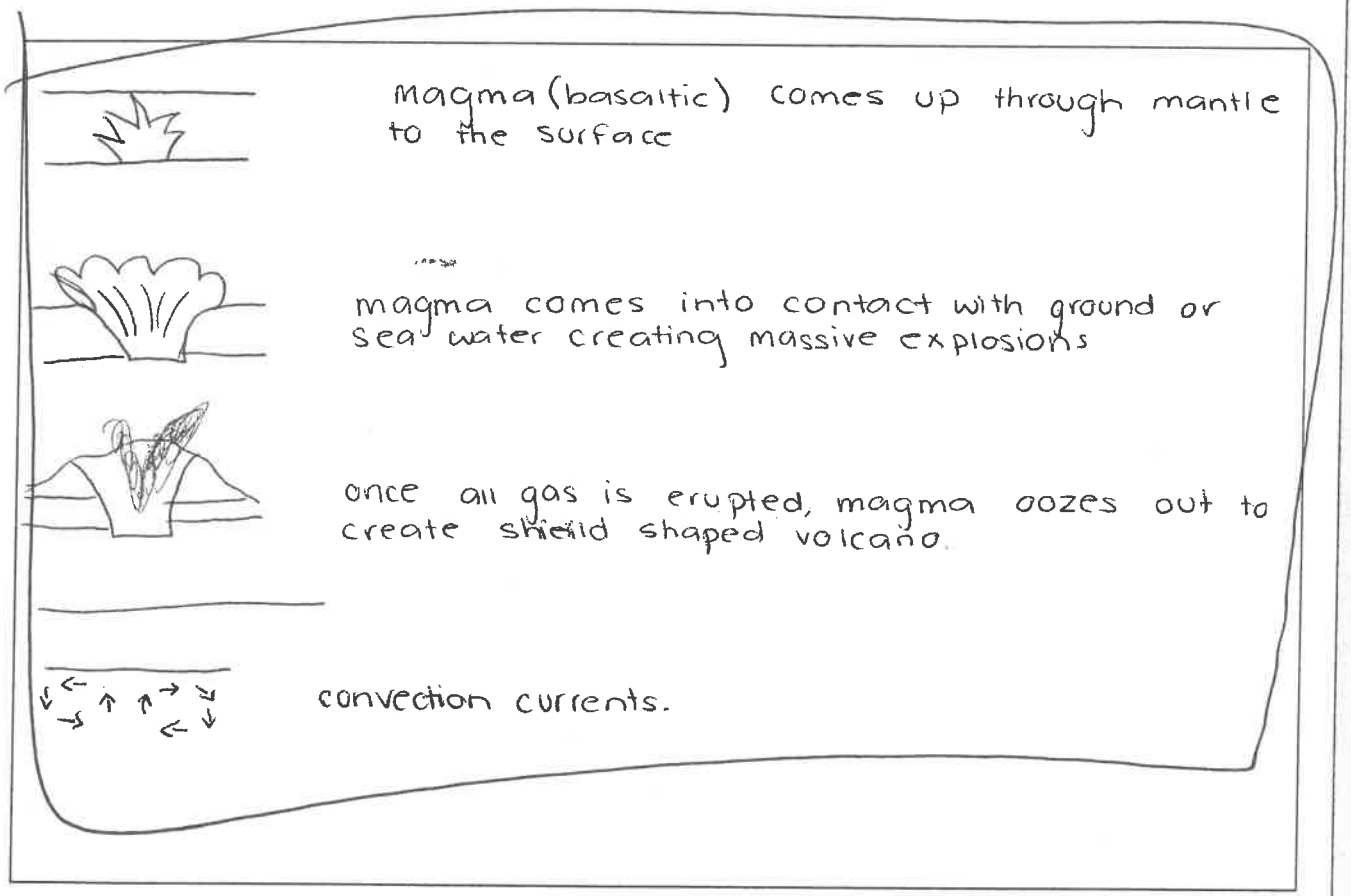
Auckland sits over an active volcanic field, which includes more than 50 volcanoes. While scientists don't expect any of these existing volcanoes to erupt again, they are almost certain that more eruptions are likely to take place at some time in the future. The type of eruption that occurs may depend upon whether the eruption meets water as it rises through the crust.

Explain in detail how possible future eruptions in the Auckland Volcanic Field may be formed, and their likely characteristics.

In your answer, you should refer to:

- the processes within the upper mantle and crust that may cause an eruption within the Auckland Volcanic Field
- the type of magma that is likely to erupt in this area, and the characteristics of this type of magma
- the likely phases of an eruption in this area, and the features that may form from this type of eruption.

A diagram may assist your explanation.



In the Earths crust there is a pocket which magma is able to rise into to create an eruption. It is not a magma chamber. There are convection currents under the crust from magma ~~which~~ that rises when it is hot and decends when it is cool. When there are two convection currents travelling in —

More space for this answer is available on the following pages.

opposite directions, it begins to pull the crust a part. The less dense, basalt magma is then able to rise to the surface and an eruption begins. Basalt magma is most likely in this area. Basalt magma has a low viscosity due to a lower silica content, between 45% and 55%. It does not trap as much gas as it is not sticky enough, making the eruptions less explosive. The basalt magma is more runny than other types of magma, so when it becomes a lava flow on the surface, it creates volcanoes which are shorter in height but are wider. The likely phases of an eruption in the Auckland Volcanic Field begin with the less dense basalt magma rising toward the surface and melting through the Earths crust. If ~~it cor~~ the magma comes into contact with ground or sea water, the ~~heat and~~ magma and water colliding creates explosions of gas and pyroclastic pieces will be exploded out to form a tuff ring around the vent. Following this if water was involved, once the ~~magma~~ explosions have stopped, a lava flow then oozes out to create a ~~dome~~ shield shaped volcano. However, if the magma did not come into contact with water, it would ooze out ~~mag~~ basalt magma which contains a lot of tephra. # The magma oozes out and creates steep slopes because it is runny and it forms a scoria cone. It is difficult to predict where the next volcano could form and it could create a lot of damage as the Auckland Volcanic Field is a very populated area. //

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QUESTION TWO: WAIRARAPA EARTHQUAKE 1855

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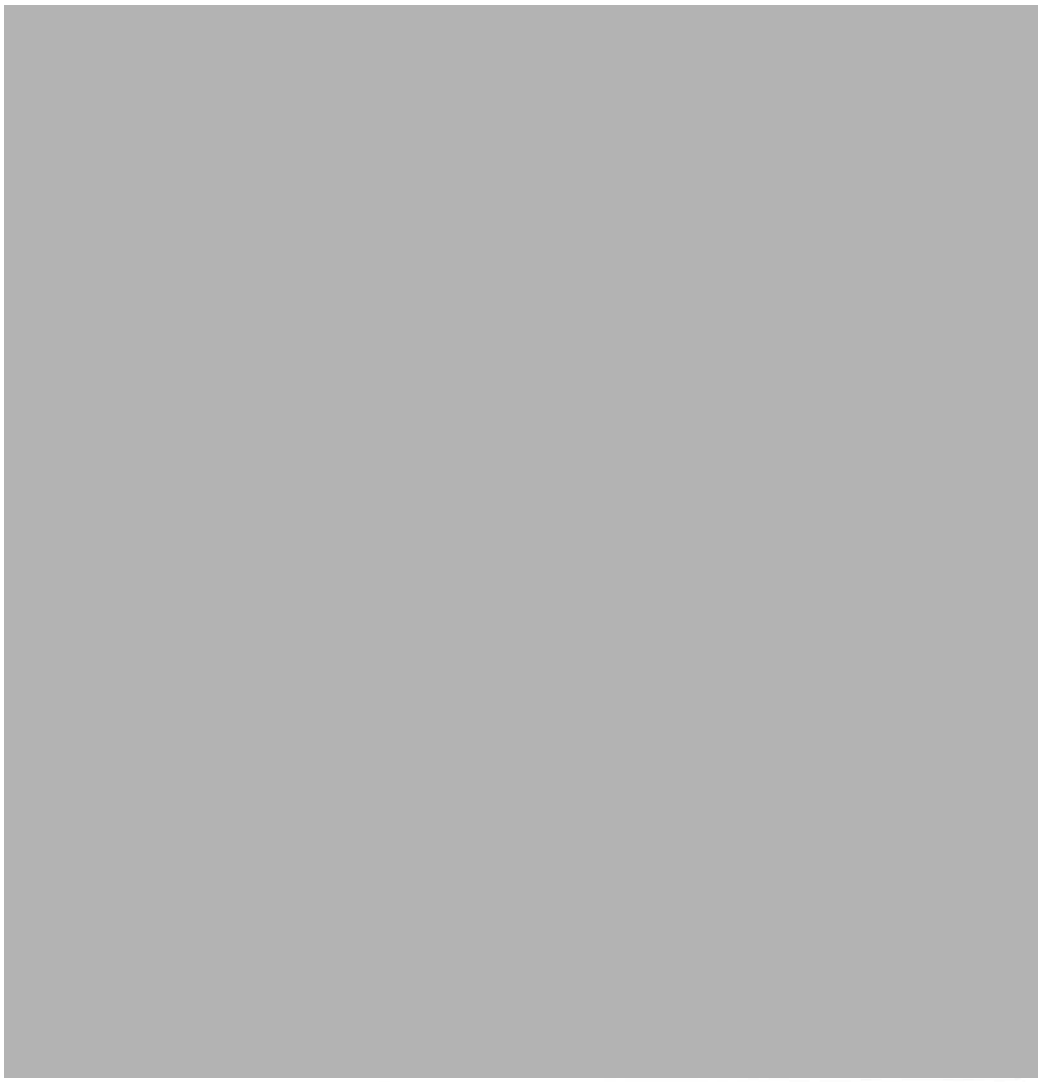

Source: www.nzgeo.com/stories/the-day-the-earth-shifted/

In 1855, the most severe earthquake in New Zealand's recent history occurred along the Wairarapa Fault. The depth was shallow, and it was recorded as a magnitude 8.2–8.3.

Explain in detail how a rupture along this fault could lead to a large-magnitude earthquake.

In your answer, you should consider:

- the types of faults represented by letters A and B on the block diagram opposite
- the tectonic plate movements that may have resulted in this fault
- the cause of this large magnitude earthquake
- the effects seen on the land **(do not include tsunami effects)**.

The type of fault represented is a reverse fault when there is uplift on a particular side of the fault. The tectonic plate movements may have resulted in this fault from the strain and stress that the subduction of the Pacific Plate has put on the surrounding continental crust. Due to the

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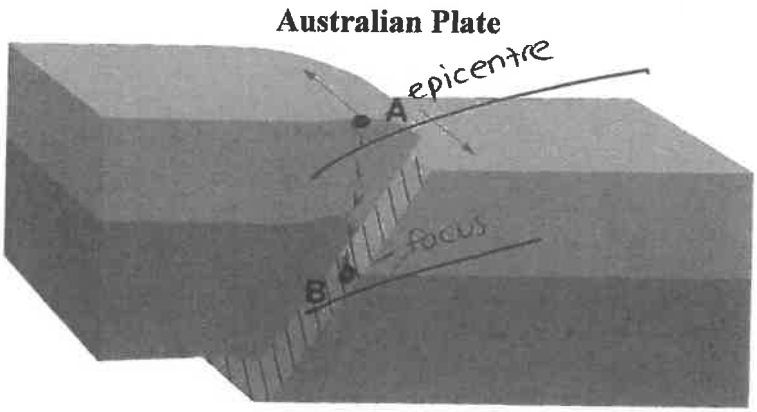

Labelling the diagram may assist your answer.

Pacific Plate subducting under the Australian plate, pressure and strain can build. Because the edges of the tectonic plates are not smooth, the plates can get stuck while sliding past one another. The pressure in this area builds and it creates stress and stain on the surrounding crust. When the crust can no longer withstand the pressure, it cracks, becamming a fault line. The Wairarapa fault is a reverse fault as there is uplift on the ~~East~~ West side of the fault. As the crust is moving, the edges of the crust on the fault also are not smooth and they get stuck while moving. The fault had maybe only just ruptured for the first time, which would create an Earthquake of such a large magnitude. The crust was trying to continue moving but the pressure was building up for such a long time that when it ruptured, the amount of energy released was a lot. An earthquake then happened as the seismic waves travel in all directions away from the focal point. The shallow depth of the fault would have made the damage in the area worse as the was not as much crust for the waves to travel through and slow down before reaching the surface. The effects seen on the land would have affected the

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area closest to the focal point the most. The distance furthest away would have the least damage. The further away from the epicentre, the less damage there is. The effects on land could have included liquefaction or landslides. Liquefaction occurs when ~~wet~~ soil that contains water is shaken by the seismic waves. The particles in the soil lose contact with one another and the soil acts like a liquid, during this, water separates from the soil and rises to the surface creating flooding of mud.

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QUESTION THREE: WELLINGTON TSUNAMI 1855

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The 1855 Wairarapa Fault rupture triggered uplift of the Australian Plate and a series of landslides into the Cook Strait Canyon. This resulted in a number of tsunami, up to 11 metres high, reaching Wellington.

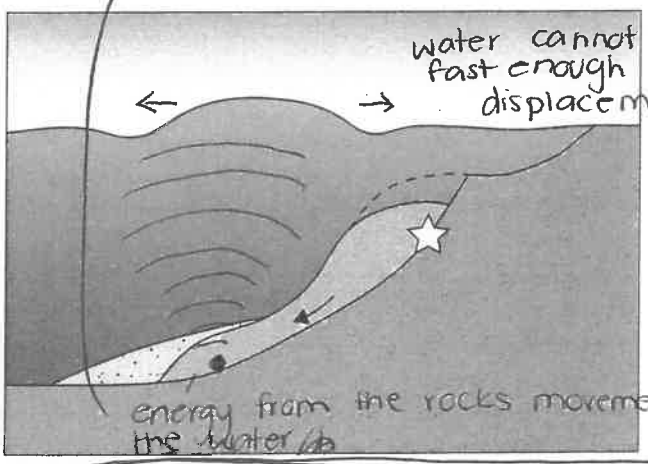
https://teara.govt.nz/en/map/5604/underwater-canyon

Explain in detail how tsunami could have formed as a result of the sea floor uplift and landslides into the Cook Strait Canyon.

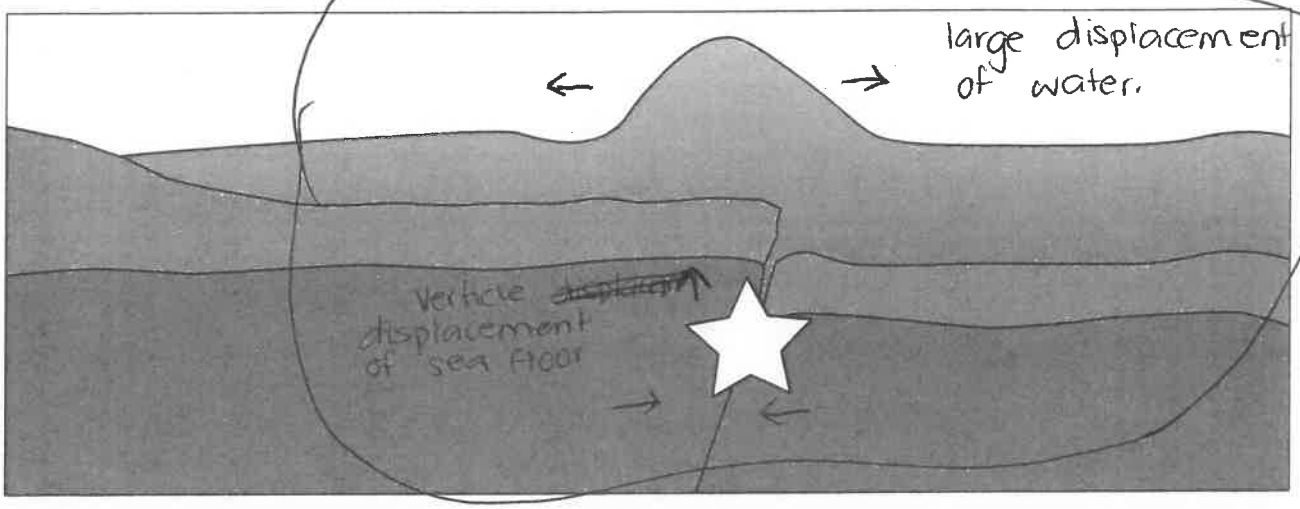
In your answer, you should:

- annotate the diagrams below, showing how tsunami are produced
- explain, in detail, how sea floor uplift in the Cook Strait AND underwater landslides into the Cook Strait Canyon can generate tsunami
- explain, in detail, the energy transfers that occur in each type of tsunami formation
- explain, in detail, the factors which may affect the size of the Wellington tsunami.

Tsunami caused by underwater landslide



Tsunami caused by seafloor uplift



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A tsunami is large displacement of water which occurs when too much energy is being transferred into the water for the water to absorb. The verticle movement of the sea floor ~~creat~~ can create a tsunami because when an earthquake happens at an under water fault, verticle displacement can occur. When the sea floor is displaced, there is energy released, but there is so much that the water can not absorb it all. When the water can not absorb all of the energy, the water travels in ~~both~~ all directions away from the epicentre. An underwater land slide can also cause a tsunami in the area. When the material ~~fro~~ is falling, it is building up kinetic energy and that kinetic energy increases until it is no longer moving. When the material comes to a stop, the kinetic energy is transferred into the water and like the verticle floor displacement, there is too much energy for the water to absorb. The water travels in tsunami waves away from the epicentre. During the under water earthquake, the potential energy from the built up pressure is what is released into the water to create tsunami wares. The factors that would affect the size of the Wellington tsunami would be the depth of the sea floor. The depth in the Cook Straight canyon is not very great meaning that ~~it does~~ the tsunami waves don't travel at full speed as they would in the open ocean. It would still be travelling fast but the contact and friction with the ocean floor would cause the tsunami waves amplitude to increase and the wavelength to decrease. There is also not

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a great distance for the tsunami to travel before it reaches the coast, so the process of wave shoaling would happen fairly early in the tsunami travels. The contact with the sea floor means that it would lose energy more than ~~when it~~ if it were travelling through the open ocean.

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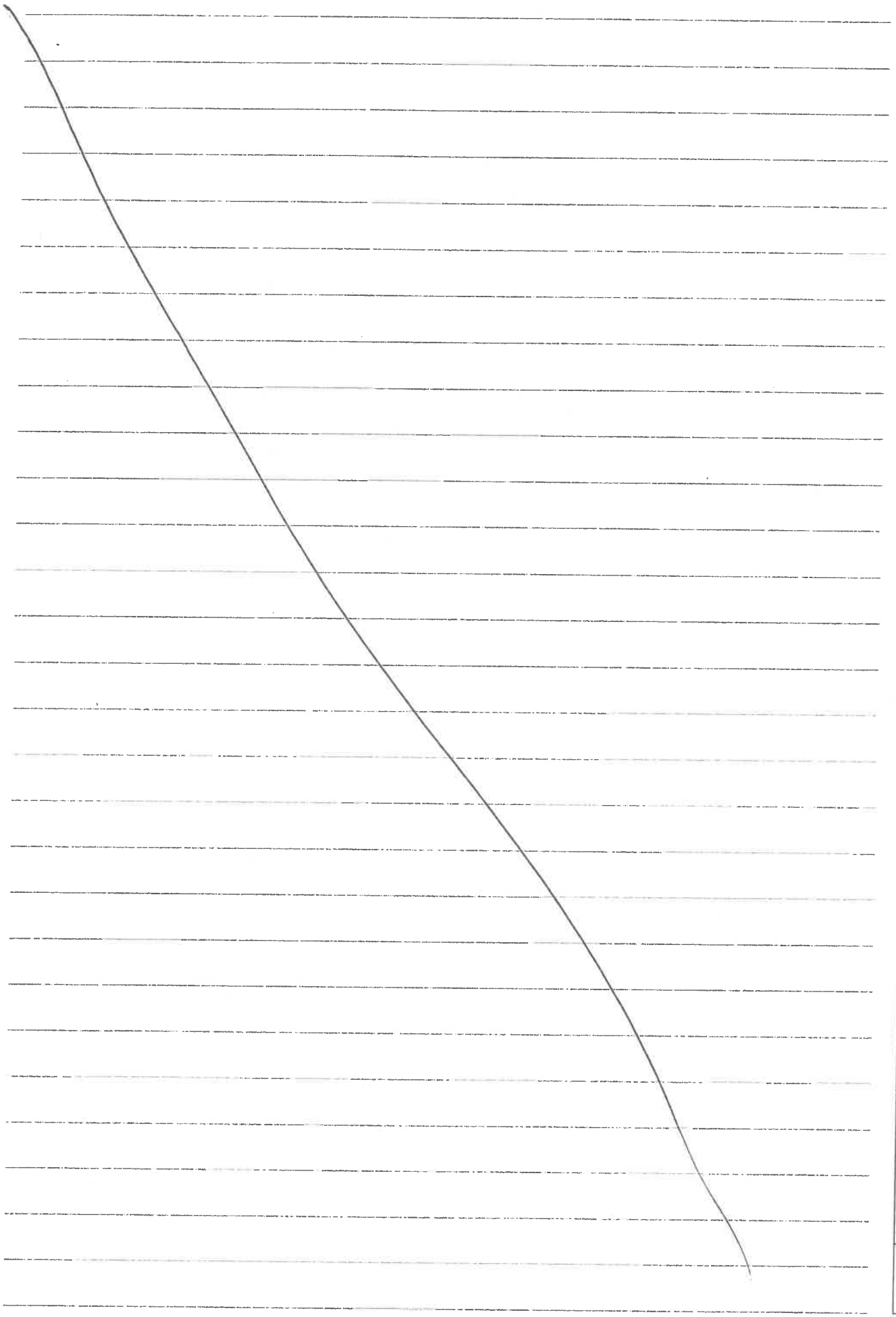

E7

Subject	L2 Earth Space Science	Standard	91191	Total score	21

Q	Grade score	Annotation
1	E7	This is an E7 as the candidate has explained how the characteristics of basaltic magma created volcanic features, such as tuff rings, shield volcanoes and scoria cones. For an E8, a clear explanation of the Australian plate moving over a magma plume was needed.
2	E7	The candidate has explained earthquake formation and depth. For an E8, the candidate needed a clearer explanation linking damage to land movement.
3	E7	The candidate provides enough evidence in this question for an E7 because they explained aspects of tsunami formation such as displacing LARGE amounts of water and energy transfer between the landslide/ Earthquake to the water. To reach E8, a clearer understanding of tsunamis formation in localised areas was needed.

Confirmation of check	Y / N
This exemplar has been checked for similarities with current online exemplars.	Y