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91191

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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.

Merit

TOTAL 16

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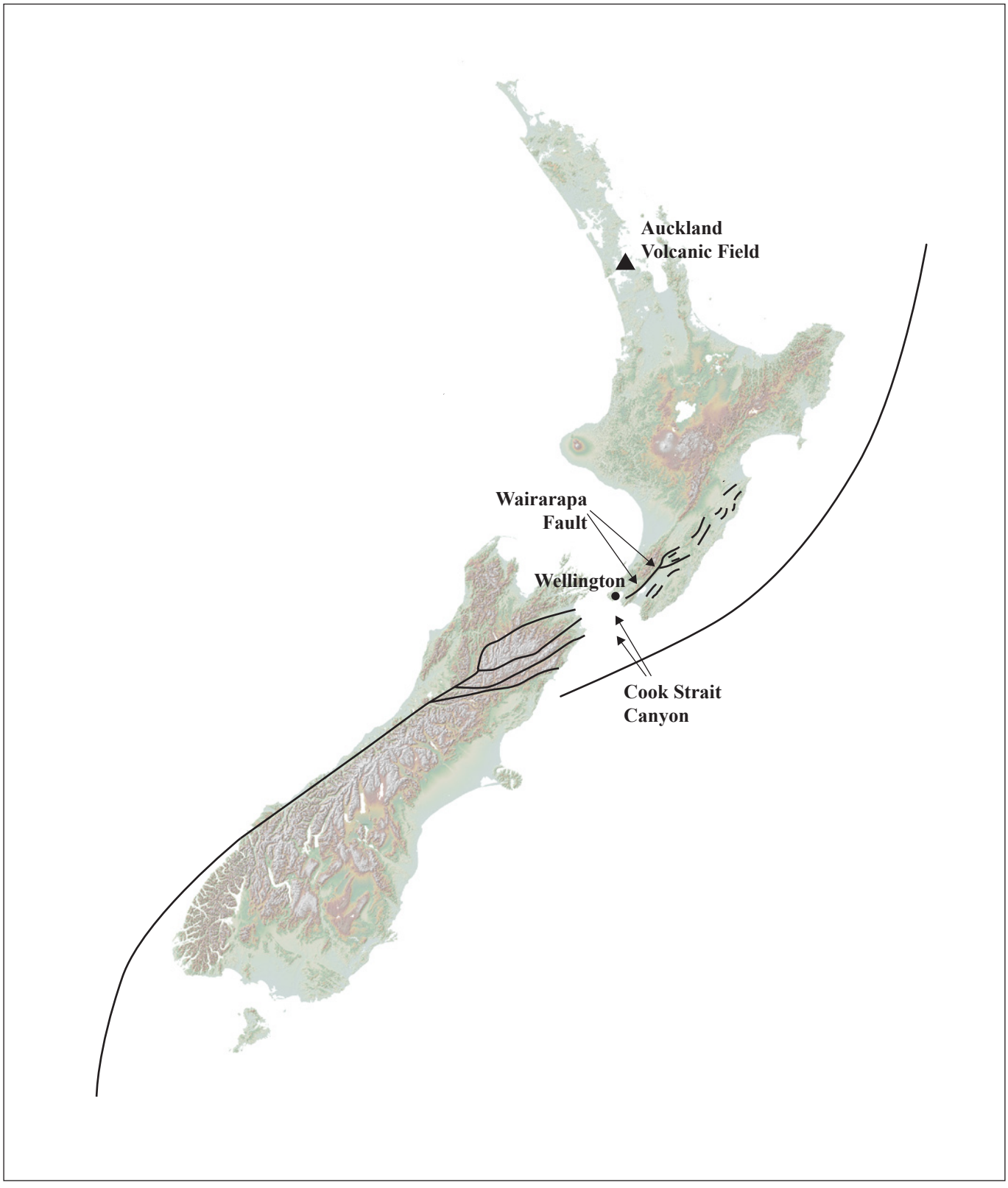
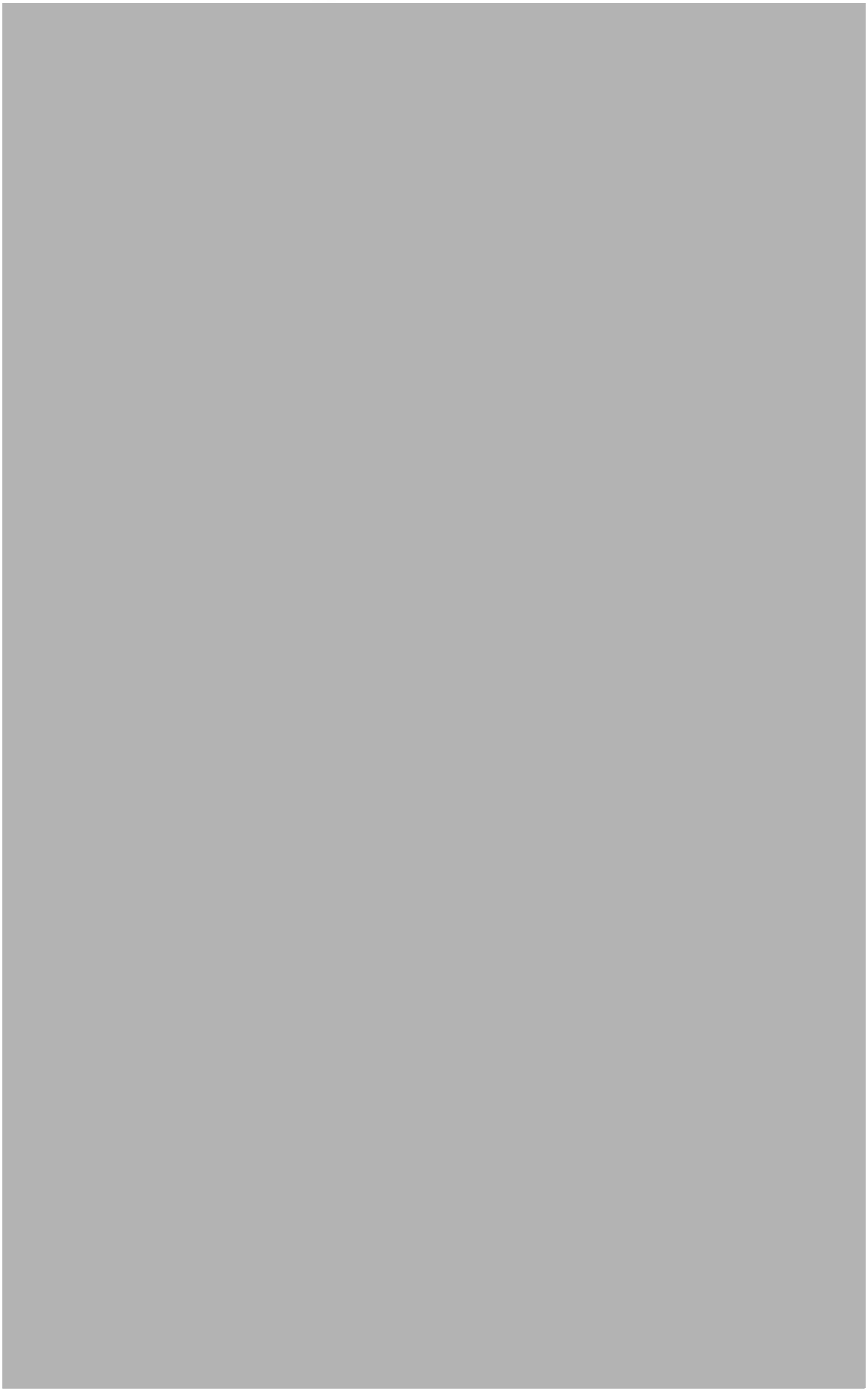
The examination starts on the following page.

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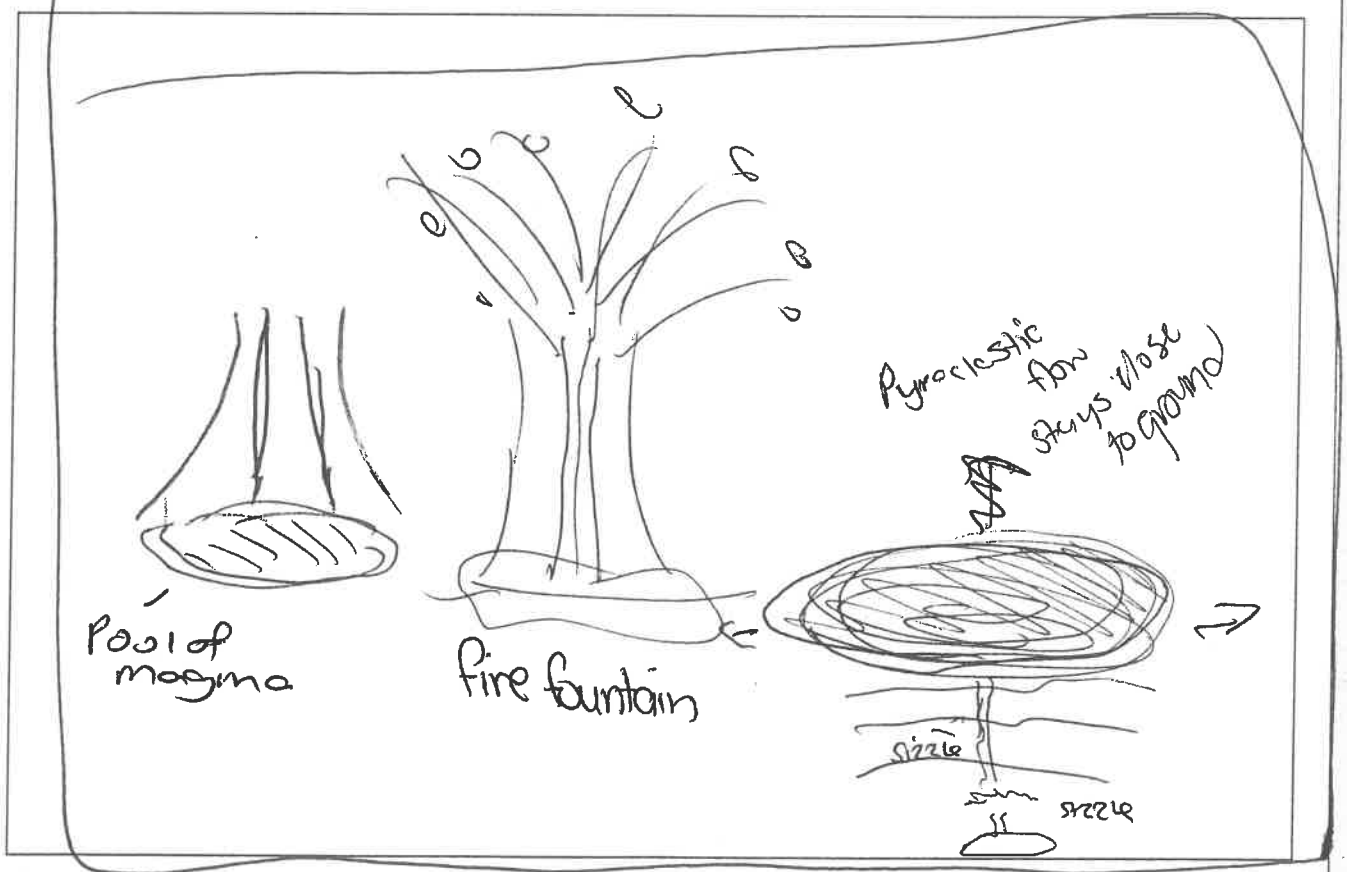
Auckland sits over an active volcanic field, which includes more than 50 volcanoes. While scientists don't expect any of these existing volcanoes to erupt again, they are almost certain that more eruptions are likely to take place at some time in the future. The type of eruption that occurs may depend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



~~Ea~~ the auckland volcanic field lies on a hot spot. This means there is a pool of ~~ma~~ magma sitting under parts of auckland (as seen in diagram on p4) The type of magma is basaltic magma because it sits in a pool. The basaltic magma has low viscosity (45 ~~55~~ %.) it is runny and

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

Slightly sticky. Basaltic magma usually is seen in Scoria cones which Auckland has alot of (Shield volcanoes)

How an eruption in the AVF (auckland volcanic field) occurs can happen two different ways.

1. The less explosive eruption is when magma (from the magma chamber) is more gaseous, the gas pushes the magma to the surface. ~~As it builds up~~ As the magma builds up, pressure builds up also. The magma bursts out of the surface (shield) which is known as a fire fountain. When the lava cools it forms a steep conical shaped hill known as a scoria cone. If the volcano is already formed and a fire fountain takes place bits of the volcano may break off and go shooting into the air (or melt), along with ash, soot and tephra.

2. The more explosive eruption is called a phreato magmatic eruption. This occurs when magma rises under water. The water instantly cools the magma (forming bits of tephra). The flash of water (when water expands and forms into steam) causes a ~~phreatic~~ pyroclastic flow. This flow consists of debris, tephra, vapour and magma. This flow hugs the ground, moving very fast and can go very long distances. The pyroclastic flow is full of fumes deadly to humans like ash and destorys ~~anything~~ whats in its path if strong enough.

A pyroclastic flow creates a tuff ring like a circle of vapour around the cone of the volcanoe.

If one volcanoe goes off in the AUF, there is a good chance that it may set off other volcanoes in the area. This would have absolutely devasting consequences. ||

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QUESTION TWO: WAIRARAPA EARTHQUAKE 1855

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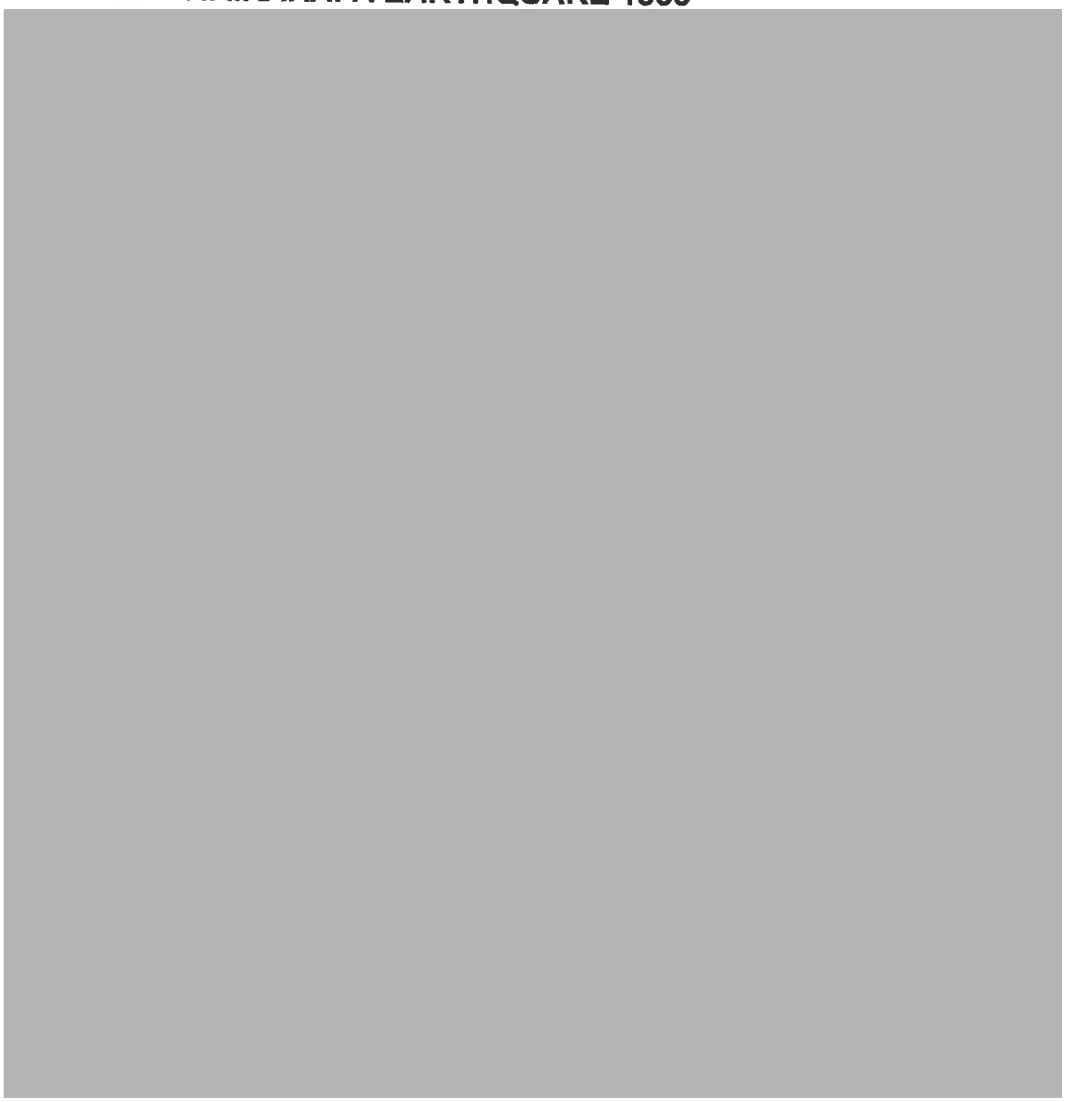


Source: www.nzgeo.com/stories/the-day-the-earth-shifted/

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.

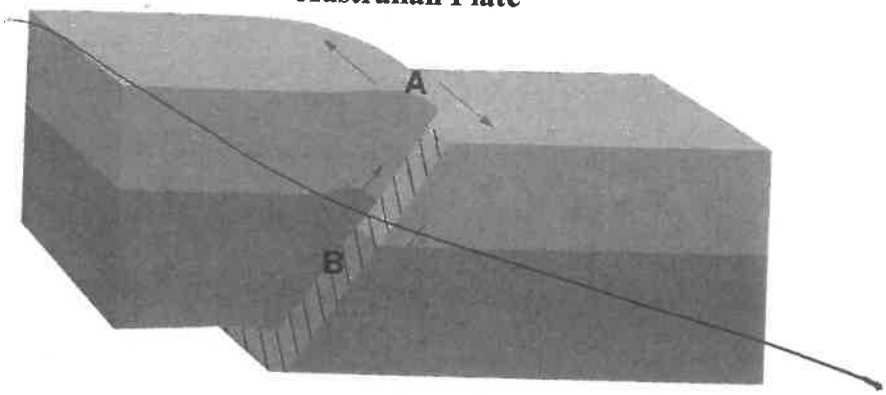
Explain in detail how a rupture along this fault could lead to a large-magnitude earthquake.

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).**

Since there is two movements it is known as an Oblique fault. A represents a Strike slip fault (Sintral) that is going left. A Strike slip fault is when a plate moves left or right while the other plate doesn't move. B represents a reverse fault. A

Australian Plate



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Labelling the diagram may assist your answer.

reverse fault is when one plate moves up the other plate.

A strike slip fault usually occurs when two plates the buoyant less dense Indo-Australian plate and the oceanic dense Pacific plate collide. Friction - and stress builds up forming cracks in the - Australian plate known as fault lines eg. Wairarapa fault. When friction builds up one will eventually move to one side in a fast motion (in this case it's left) causing an earthquake.

A reverse fault usually occurs when the oceanic dense pacific plate is subducting under the less dense buoyant Indo-Australian plate. The Australian plate may get stuck of the tephra or debris and may be partially dragged down when it finally releases it moves up the pacific plate due to pressure.

Since the Wairarapa fault had a

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

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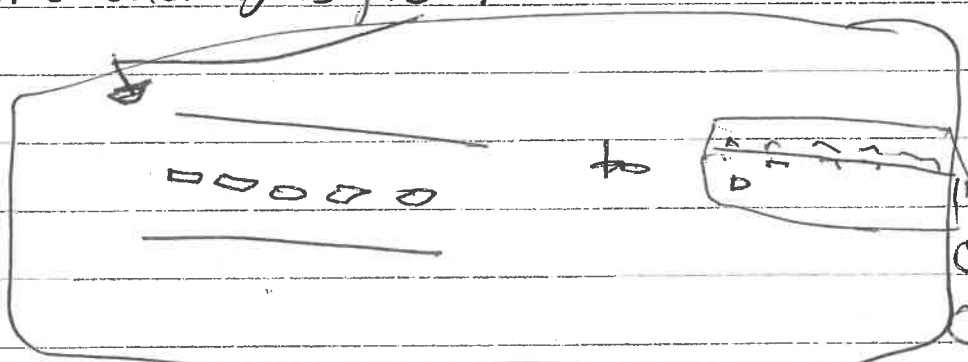
Shallow earthquake the focus point of the seismic waves would be alot shallower, meaning When they reach the epicentre (where sesmic waves are first felt of land) they are much stronger than if they had come from a deeper earthquake. This is because when a earthquake is deep the sesmic waves lose energy to heat and are therefore not as strong when they reach the surface. If they don't have far to go then they become much more powerful.
The sesmic waves are what cause all the domage on land.

Effects on an earthquake can include: liquidifaction, volcanic eruptions, the destruction of roads, buildings, pipes (water), telephone lines, trees might fell down, Usually when roads are destroyed you can see the which fault movement was responsible. This is because the road kind of takes the same effect as the plate movement so when a reverse fault occurs the road goes from



the side might move slightly on top of the other.

Since the shaking destroys buildings people can be trapped, crushed, homeless or die. With an earthquake so destructive trees begin to fall down, which is a problem because they can block first responders

from rescuing people who are trapped on the otherside of that tree. Water pipes and sewage pipes burst making recovery really difficult. The good thing is that because the Wairarapa earthquake was in the 1800's there wouldn't have been any tall buildings so there wouldn't be as much physical damage. However, the buildings may catch on fire if the gas pipes in the building are damaged.//

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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.

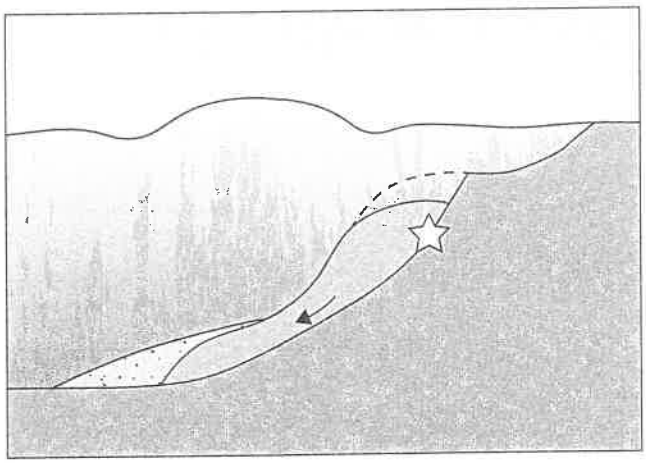
https://teara.govt.nz/en/map/5604/underwater-canyon

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

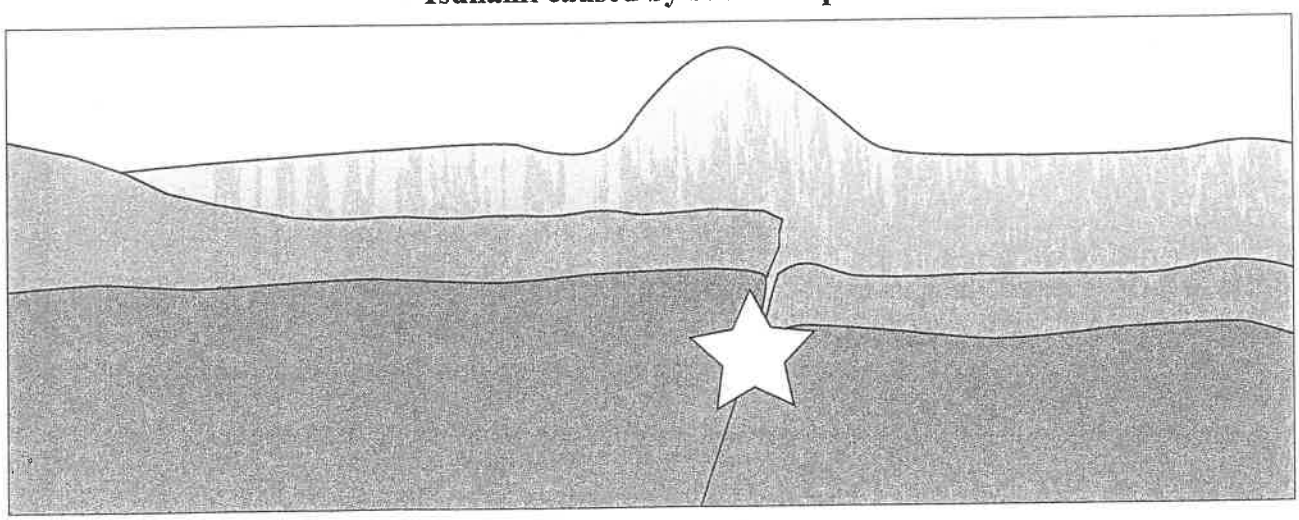
In your answer, you should:

- 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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When the Oceanic dense ~~Pacific~~ Pacific plate subducts under the less dense buoyant Indo-Australian plate, the Australian plate can get caught on tephra fragments and is partially subducted with the Pacific plate. Pressure builds in the form of elastic potential energy. The pressure will force the Australian plate to move in a sudden uplift movement displacing a large amount of water. Energy from this exchange is then transfered to the water above, giving the water energy to move fast in a wave like motion. (The displacement of water is how tsunamis are formed.) The energy goes from potential energy to kinetic energy.

~~The~~ The Cook Strait is in offshore ~~waters~~ waters compared to the middle of the pacific ocean this means that as the tsunami, which may both cm's high when first created, moves towards the shore it gets bigger. As it reaches shallow waters it slows down and the wave height increases while the wave lenght decreases, making the first wave especially high/tall. The energy does not get all used up or ran out of because the wave lenght is so long. A warning size of ~~a~~ a tsunami is when the shore line starts to recoed slowly.

The ~~#~~ factors which may effect a tsunami (in the Cook Strait) would be the amount of Potential energy released in the movement of the tectonic plates. Also

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

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how close the tsunami is ~~formed~~ near Shore. This is because the closer the tsunami is formed by a nearby town the less time is has to gain kinectic energy, making it less powerful. Of course it will still be devasting but a tsunami from deeper waters may have worse effects.

Underwater landslides occur when the movement of tectonic plates causes bits of land to breach off or more. If there is enough land moving it can displace water causing a tsunami. In the diagram part of the underwater hill has broken off and slide down the hill. This has caused the water above to be displaced and given the water enough energy (Potential → kinectic) to form a tsunami wave. The factors affecting this would be the amount of land that has moved, and therefore the amount of energy ~~given~~ transferred to the water. Also how close it is to land as I have already mentioned above.

The landslide tsunamis are nowhere near as high or powerful as offshore and deep tsunamis. However if landslides occur close to a town or city they can still have devasting effects and lose of life.

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M5

Subject	L2 Earth Space Science	***Standard***	91191	***Total score***	16

Q	***Grade score***	***Annotation***
1	M6	If the candidate had explained hotspot formation, they may have scored an E7 rather than an M6.
2	M5	The candidate provides enough evidence for M5, as they described earthquake depth and damage. If they had described how earthquakes were formed, they may have scored an M6.
3	M5	If the candidate had explained in more detail, the transfer of energy, they may have scored a M6 rather than a M5.

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