

Assessment Schedule – 2024**Scholarship Earth and Space Science (93104)****Evidence Statement****Question One: Rivers in the sky**

Evidence	1–2	3–4	5–6	7–8
Effects on North and South Islands - Moist air from the Tasman Sea is forced over the Southern Alps. As it rises, it cools, condenses, and forms rain. This is called orographic rainfall. - Warmer oceans cause more evaporation, and therefore more moisture in the air. This could cause more atmospheric rivers to form, which is more likely to affect the North Island. - The Southern Ocean is warming but not causing as large an increase in evaporation due to the lower ocean temperatures at higher latitudes. This means that atmospheric rivers may not originate from this area as often as the northern ones. - The Southern Alps are very high, which means that the orographic rainfall will affect a smaller area much more severely. These areas will already have high rainfall. This will be increased significantly by the influence of an atmospheric river. - Even though the Waitākere ranges are smaller than the Southern Alps, they will still cause rain clouds to lift and west Auckland will still experience some orographic rainfall, but to a lesser extent than the Southern Alps. - A very strong atmospheric river may cause more damage in Auckland as the rainfall might be much higher than infrastructure would account for. Whereas, on the West Coast, it isn't as populated, but there could be more landslides, etc. - Flooding and landslides are often caused by large amounts of rain. In the Southern Alps, there is often large amounts of rain, so areas known for landslides can be avoided or they may have already been triggered. ENSO effects - La Niña causes a warming in the ocean north of New Zealand, which could enhance an atmospheric river because there would be more evaporation. - During La Niña the easterly trade winds are strengthened, which brings rain to the north and east coast of both islands, which means that if atmospheric river occurs during this time, then these areas are most at risk. - If an atmospheric river happened during winter when a La Niña is occurring, then it is likely to affect the eastern side of the South Island, as this is already experiencing an increased amount of rainfall.	Very little understanding of the question with very little development of ideas.	- Shows some understanding of the question with only some development of ideas. - Some synthesis and integration of the processes.	- Good understanding of the question with good development of ideas. - Good analysis, synthesis, and integration of the processes, exhibiting well developed understanding of the context.	- Thorough understanding of the question with excellent development of ideas. - Sophisticated analysis, synthesis and integration of the processes, showing perception and insight applied to the context. - Reflection on the answer resulting in extrapolation. - All aspects of answer expressed with convincing communication.

• During El Niño, the oceans around New Zealand are cooler, which could mean that the effects of an atmospheric river could be lessened because there is less evaporation. • During El Niño the westerlies are strengthened, which means that the west coast of both islands are more at risk of atmospheric rivers. • Proposed mitigations • The North Island is less prepared and more populous than the South Island. This means that the ground will not be able to absorb water due to being more covered with houses, roads, and concrete. • Appropriate measures need to be put in place, such as more drainage systems. • The West Coast of the South Island is more prone to landslips, which would affect road access to properties. Alternative routes need to be put in place. • For the West Coast, trees need to be planted to help provide stability to slopes, which could help stop them creating a landslide during an atmospheric river. • Atmospheric rivers are occurring at a scale higher than the IVT can measure, so these needs to be adjusted. • The patterns of El Niño and La Niña are well known, so this could be used as a prediction tool of where atmospheric rivers could affect.				
---	--	--	--	--

Question Two: New Zealand's geological history

Evidence	1 – 2	3 – 4	5 – 6	7 – 8
Differences in geological history North and South Islands have different geological features: North Island • <i>Subduction.</i> The dense, oceanic Pacific Plate being subducted underneath the less dense continental Indo-Australian Plate. As the Pacific Plate is subducted, it takes water down into the mantle and this lowers the melting point of the rock around it, creating magma. This magma rises to the overlying Indo-Australian Plate, creating the volcanoes in the Taupō volcanic zone. • <i>Hot spot.</i> Auckland has a magma plume sitting beneath the city. Batches of magma break off and rise to the surface and create a volcano. This has created the Auckland volcanic field. South Island • <i>Transform boundary.</i> Indo-Australian and Pacific plates are sliding past each other. Both plates are continental. • While the plates are sliding past each other, they are pushing against each other. This caused the Southern Alps to form. Past evidence • The plate boundary in the North Island between the Indo-Australian and Pacific Plates used to be further west, and has progressively moved east. • Evidence for this is the two lines of volcanoes that are now part of the Northland peninsula; these would have formed similar to the Kermadec Arc volcanoes. • The Coromandel volcanic zone has andesitic volcanoes and calderas just like the Taupō volcanic zone; this shows that they would have formed from the melting of the overlying Indo-Australian Plate. • The Waitākere volcano was also formed due to subduction but a lot earlier than the Coromandel volcanic zone. • The transform boundary started in the South Island 23 million years ago and it hasn't changed position like the subduction zone in the North Island. • There were once some hot spots in the South Island, but these are no longer active. Future • The volcanism will continue eastwards as the plate boundary shifts. • Since there are two lines of volcanoes in the Kermadec Arc, there is potential for another two lines of volcanoes to form.	• Very little understanding of the question with very little development of ideas.	• Shows some understanding of the question with only some development of ideas. • Some synthesis and integration of the processes.	• Good understanding of the question with good development of ideas. • Good analysis, synthesis, and integration of the processes, exhibiting well developed understanding of the context.	• Thorough understanding of the question with excellent development of ideas. • Sophisticated analysis, synthesis, and integration of the processes, showing perception and insight applied to the context. • Reflection on the answer resulting in extrapolation. • All aspects of answer expressed with convincing communication.

• Another volcanic zone like the current Taupō or Coromandel ones. • There could be another volcanic field similar to the Auckland volcanic field. • Transform boundary will keep sliding past each other and the Southern Alps will continue to grow. • South Island will continue to be stretched and may move closer to the North Island.				
--	--	--	--	--

Question Three: TOI 270 system

Evidence	1 – 2	3 – 4	5 – 6	7 – 8
Comparing formation of solar system - Solar winds could have blown gases away from the super-Earth but not strong enough to blow them away from the mini-Neptunes, which is why they have gas. Due to being a smaller star. - The TOI 270 exoplanets are bigger in mass, and therefore could have greater gravity to hold onto gases, which makes the planets bigger. - Frost line would be closer as well; since the star is cooler, this could mean the system has frozen gas giants that haven't been discovered yet. - TOI 270b could be tidally locked, as it is closer to its own star than Mercury. This means that one side is always really hot, while the other side is cold. This could also affect the rotating inner core of the planet, which might affect the magnetic field of the planet and its ability to maintain an atmosphere. - The high activity of the red dwarf when it is younger means more damage to the atmosphere is possible. Due to larger planets cooling slower, it might mean that it can maintain a hot liquid core and protect its atmosphere for longer; it would then depend on if the star settled or the planet cooled first. - It is a super-Earth because the accretion that formed the planet contained more planetesimals than what formed our own Earth. - Habitable zone will be closer because the star is cooler and smaller than our own Sun. - As the red dwarf forms and ages, the star becomes smaller and more stable. - Red dwarf stars are more stable and therefore if there is life, it will last longer than our own solar system. Our star will turn into a red giant and burn up our planet once it uses up its hydrogen. Surface temperatures, atmosphere - The surface temperatures of the first three planets are a lot hotter than our own and this is due to their proximity to the star. - TOI 270 exoplanets are warmer because the atmospheres cause the heat to stay in, like Venus, but possibly without a greenhouse effect. - Planets could be affected by tidal flexing due to proximity to the star and the other planets; this could mean that there is no liquid water as it evaporated due to the friction generated. - Tidal flexing could maintain a hotter core in the planets, meaning a maintenance of the magnetic field, which could protect the atmospheres of the planets. - Stellar winds could strip the planets' atmosphere. Also being closer means they receive more radiation, which can also destroy their atmospheres. - If there is life, it will be in a basic form and the solar flares could have stripped the	Very little understanding of the question with very little development of ideas.	- Shows some understanding of the question with only some development of ideas. - Some synthesis and integration of the processes.	- Good understanding of the question with good development of ideas. - Good analysis, synthesis, and integration of the processes, exhibiting well developed understanding of the context.	- Thorough understanding of the question with excellent development of ideas. - Sophisticated analysis, synthesis, and integration of the processes, showing perception and insight applied to the context. - Reflection on the answer resulting in extrapolation. - All aspects of answer expressed with convincing communication.

planets of an atmosphere. • Once the red dwarf reaches it stable stage, life could develop. • If TOI 270b has an atmosphere and is tidally locked, then it could have liquid water present on the boundary between the hot and cold sides. This could mean that life exists there.				
--	--	--	--	--

Cut Scores

Scholarship	Outstanding Scholarship
14–18	19–24