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NZQA

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

QUALIFY FOR THE FUTURE WORLD
KIA NOHO TAKATŪ KI TŌ ĀMUA AO!

Tohua tēnei pouaka
mēnā kāore he tuhituhi
i roto i tēnei pukapuka

Te Pāngarau me te Tauanga, Kaupae 2, 2020

91267M Te whakahāngai tikanga tūponotanga hei whakaoti rapanga

9.30 i te ata Rāpare 19 Whiringa-ā-rangi 2020
Ngā whiwhinga: Whā

Paetae	Kaiaka	Kairangi
Te whakahāngai tikanga tūponotanga hei whakaoti rapanga.	Te whakahāngai tikanga tūponotanga mā te whakaaro whaipānga hei whakaoti rapanga.	Te whakahāngai tikanga tūponotanga mā te whakaaro waitara hōhonu hei whakaoti rapanga.

Tirohia mēnā e rite ana te Tau Ākonga ā-Motu (NSN) kei runga i tō puka whakauru ki te tau kei runga i tēnei whārangi.

Me whakamātau koe i ngā tūmahi KATOA kei roto i tēnei pukapuka.

Tirohia mēnā kei a koe te Puka Tikanga Tātai L2–MATHMF.

Tuhia ō mahinga KATOA.

Ki te hiahia koe ki ētahi atu wāhi hei tuhituhi whakautu, whakamahia te wāhi wātea kei muri i te pukapuka nei.

Tirohia mēnā e tika ana te raupapatanga o ngā whārangi 2-23 kei roto i tēnei pukapuka, ka mutu, kāore tētahi o aua whārangi i te takoto kau.

ME HOATU RAWA KOE I TĒNEI PUKAPUKA KI TE KAIWHAKAHAERE Ā TE MUTUNGA O TE WHAKAMĀTAUTAU.

TAPEKE

MĀ TE KAIMĀKA ANAKE

Kua nui ake te kaingākautia o te whai motokā hiko (EV) i Aotearoa i te pai haerenga o te hangarau, te hekenga o ngā utu, me te mōhio haere o te tangata ki ngā take taiao.

E hāngai ana ngā tūmahi i roto i tēnei pepa ki ngā rangahau mō ngā EV.

https://www.my-car-w.com/about

TŪMAHI TUATAHI

Ka kitea e Tia ngā otinga o tētahi rangahau i ngā kaimahi me ngā ākonga o tētahi whare wānanga o Aotearoa. Kei roto i te rangahau ko ngā pātai mō ngā tūmomo take e pā ana ki te whai EV.

- 15% o ngā kaiwhakautu rangahau he kaimahi, ā, ko ērā atu he ākonga.

- 90% o ngā kaimahi me te 43% o ngā ākonga he taraiwa ki te whare wānanga.

- O ngā ākonga i taraiwa ki te whare wānanga, 36% i kī ka hiahia rātou i tētahi EV, ā, 60% o ngā ākonga kāore i taraiwa ki te whare wānanga i kī ka hiahia rātou i tētahi EV.

(a) (i) Whiriwhiria te tūponotanga ko tētahi kaiwhakautu i tīpako matapōkeretia i roto i te rangahau he kaimahi i taraiwa ki te whare wānanga.

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(ii) Whiriwhiria te tūponotanga ko tētahi kaiwhakautu i tīpako matapōkeretia i roto i te rangahau he ākonga kāore i taraiwa ki te whare wānanga, ā, **kāore** i te hiahia i tētahi EV.

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(iii) Mēnā i kī tētahi kaiwhakautu **ākonga** kei te hiahia ia i tētahi EV, he aha te tūponotanga i taraiwa ia ki te whare wānanga?

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(iv) O ngā kaimahi i taraiwa ki te whare wānanga, 52% i kī ka hiahia rātou i tētahi EV, ā, he hauwhā anake o ngā kaimahi kāore i taraiwa ki te whare wānanga ka hiahia rātou i tētahi EV.

He aha te ōrau o ngā kaiwhakautu rangahau **katoa** kei te hiahia i tētahi EV?

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Owning an electric vehicle (EV) in New Zealand has become more popular as the technology has improved, prices have dropped, and people have become more aware of environmental issues.

The questions in this paper relate to research about EVs.

https://www.my-car-w.com/about

QUESTION ONE

Tia finds the results of a survey conducted on staff and students of a New Zealand university. The survey asked about various matters related to ownership of EVs.

- 15% of the survey respondents were staff and the rest were students.
- 90% of the staff and 43% of the students drove to the university.
- Of the students who drove to the university, 36% said they would like to own an EV, while 60% of the students who did not drive to the university said they would like to own an EV.

(a) (i) Find the probability that a randomly chosen respondent in the survey is a staff member who drove to the university.

(ii) Find the probability that a randomly chosen respondent in the survey is a student who did not drive to the university and would **not** like to own an EV.

(iii) If a **student** respondent said they would like to own an EV, what is the probability that they drove to the university?

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(iv) Of the staff who drove to the university, 52% said they would like to own an EV, while only a quarter of the staff who didn't drive to the university would like to own an EV.

What percentage of **all** survey respondents would like to own an EV?

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(b) I ako anō a Tia ko te 40% o ngā kaimahi me te 72% o ngā ākonga i whakautu i te rangahau he noho tūtata ki te whare wānanga (iti iho i te 15 km te tawhiti o te haere). E whakapae ana ia ko te tawhiti ka haeretia e rātou ki te whare wānanga ka whai pānga ki ō rātou whakaaro mō te whai waka EV.

I whakamōhiotia atu a Tia, he **huarua ake te tūponotanga** ka hiahia ngā kaimahi me ngā ākonga e noho tūtata ana ki te whare wānanga i tētahi EV tēnā i te hunga kāore e noho tūtata ana. Ka hangaia e ia tētahi rākau tūponotanga mō tēnei āhuatanga, ā, e whakaaturia ana he wāhanga o tēnei i raro.
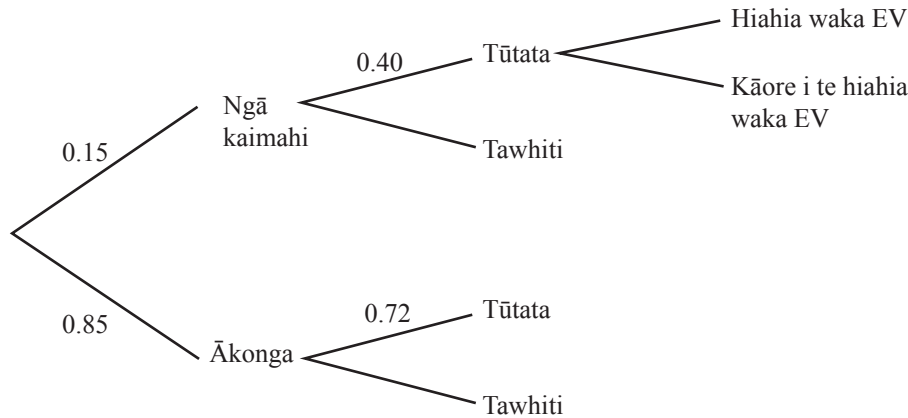

I tātaihia e Tia e 49% o ngā kaimahi me te 43% o ngā ākonga kei te hiahia i tētahi waka EV (ahakoa ka taraiwa rātou ki te whare wānanga, kāore rānei, ahakoa te tawhiti rānei o tā rātou noho).

Whiriwhiria te tūponotanga mō tētahi kaiwhakautu rangahau i tīpako matapōkeretia e noho tūtata ana ki te whare wānanga kei te hiahia i tētahi waka EV tēnā i tētahi kaiwhakautu kāore e noho tūtata ana.

(b) Tia also learns that 40% of the staff and 72% of the students who responded to the survey live close to the university (travelled less than 15 km). She suspects that the distance they travel to the university would have an impact on their opinion on owning an EV.

Tia is told that both staff and students who live close to the university are **twice as likely** to want to own an EV as those who do not live close. She constructs a probability tree for this situation, part of which is shown below.
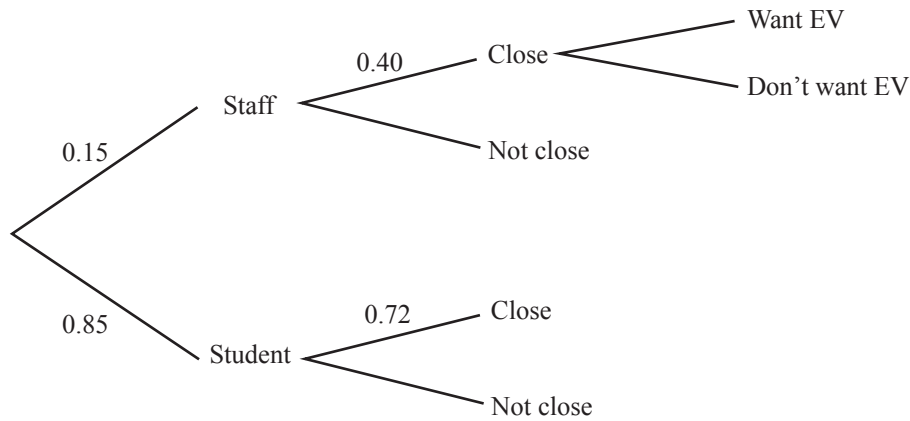
Tia has calculated that, overall, 49% of staff and 43% of students would like to own an EV (regardless of whether they drive to the university or not or how close they live).

Find out how much more likely it is for a randomly chosen survey respondent who lives close to university to want to own an EV than a respondent who does not live close.

TŪMAHI TUARUA

Ko te "anipā tawhiti" te māharahara o ngā kaitaraiwa motokā hiko (EV) mō te tawhiti o te whakahiko o te pūhiko. Koinei tētahi o ngā tino māharahara e aukati ana i te hoko a te tangata i tētahi EV.

(a) E whakapae ana tētahi kaihanga waka he 172 km te tawhiti ka taea e ana waka EV i te whakahiko pūhiko kotahi. I tuhia e Geoff, he waka EV tōna, te tawhiti i haeretia e tōna waka i muri i ia whakahikotanga, ā, ka kitea ka taea te whakatauira mā tētahi tuari māori, me te tau toharite o te 165 km me te ine mahora o te 14 km.

(i) Whiriwhiria te tūponotanga ko te tawhiti ka haerehia e te EV o Geoff kei waenga i te 150 km me te 165 km i runga i te whakahiko kotahi.

(ii) Whiriwhiria te tūponotanga ko te tawhiti ka haerehia e te EV o Geoff he tawhiti atu i te 172 km i runga i te whakahiko kotahi.

(iii) I te 10% o te wā kāore a Geoff i te rata ki te tawhiti o te haere a tētahi whakahiko pūhiko kotahi o tōna waka EV.

Kia rata ai a Geoff, he aha te tawhiti iti rawa ka haerehia e tōna waka i te whakahiko pūhiko kotahi?

QUESTION TWO

"Range anxiety" is the worry that electric vehicle (EV) drivers have about how long their battery charge will last. This is one of the most common concerns that stops people from buying an EV.

(a)   A car manufacturer claimed that its EV was able to travel 172 km on one full battery charge. Geoff, an EV owner, recorded the distance that his car travelled after each full battery charge, and found it could be modelled by a normal distribution, with a mean of 165 km and a standard deviation of 14 km.

   (i)   Find the probability that Geoff's EV will travel between 150 km and 165 km on one full battery charge.

   (ii)   Find the probability that Geoff's EV will travel more than 172 km on one full battery charge.

   (iii)   10% of the time Geoff is unsatisfied with how far one full battery charge takes his EV.

   For Geoff to be satisfied, what is the minimum distance his car will have to travel on one full battery charge?
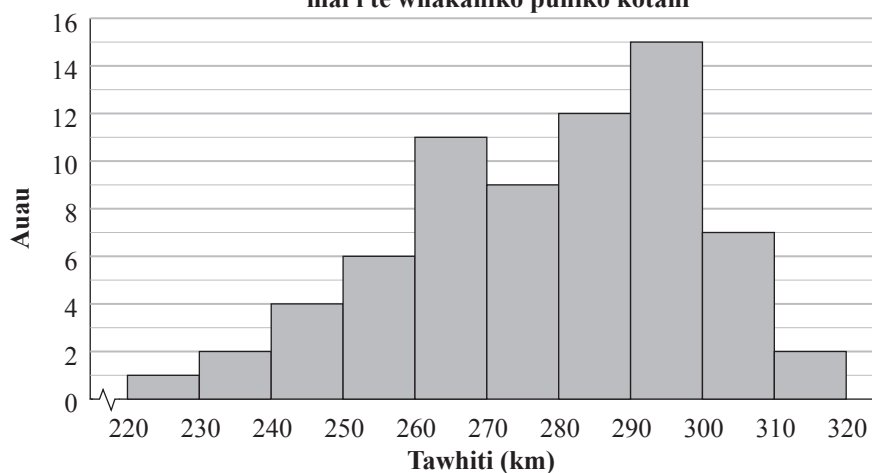
(b) I whakaputahia e taua kaihanga waka anō tētahi waka EV reanga taurua.

I kite tētahi rangatira o tētahi waka EV ko te 20% o ngā tawhiti i haeretia i tētahi whakahiko pūhiko he iti iho i te 265 km.

Tātaitia tētahi whakatau tata mō te tau toharite o te tawhiti i haeretia i runga i tētahi whakahiko e tētahi waka EV reanga tuarua mō tēnei rangatira. Me kī ko ngā tawhiti i haeretia ka taea te whakatauira mā tētahi tuari māori me te ine mahora o te 14 km.

(c) I oti i tētahi kamupene motuhake ngā taraiwa whakamātautau 70 o tētahi waka EV reanga tuarua. I tīmata ia whakamātautau me tētahi whakahiko pūhiko kī, ā, i mutu i te whakaatu a tētahi tūtohu he iti iho i te 5 km te tawhiti e toe ana. I ia whakamātautau i taraiwa i runga i ngā tūmomo rori tāone i ngā wā rerekē o te rā i ngā rā mahi. Ka whakaaturia ngā kitenga i te Hoahoa 1 i raro nei.

Hoahoa 1: Tawhiti i haeretia mā te EV mai i te whakahiko pūhiko kotahi

Ko te whakapae a te kaihanga waka he 280 km te tawhiti toharite ka haeretia e ana waka EV reanga tuarua i runga i tētahi whakahiko kotahi, **ka mutu** ko te tikanga ka tuari māoritia ēnei tawhiti, me tētahi ine mahora o te 14 km.

Arotakehia tēnei whakapae mā te:

*   whakataurite i te hanga, te pokapū, me te hōrapa o te kauwhata pouhere i roto i te Hoahoa 1 me te tuari māori e whakapaetia ana
*   tuku i ngā uara tohutau ina tika ana
*   whiriwhiri i te kounga o te whakamātautau i puta ai ngā otinga i pūrongotia i te Hoahoa 1.

(b)   The same car manufacturer released a second-generation EV.

A new owner of a second-generation EV found that 20% of the distances travelled on a full battery charge were less than 265 km.

Calculate an estimate for the mean distance travelled on a full charge by a second-generation EV for this owner. Assume that the distances travelled can be modelled by a normal distribution with a standard deviation of 14 km.

(c)   An independent company completed 70 test drives of a second-generation EV. Each test started with a full battery charge and ended when an indicator showed that the expected remaining travel distance was less than 5 km. Each test involved driving on a range of city roads at different times of the day on weekdays. The results are shown in Figure 1 below.

Figure 1: Distance travelled in EV from one battery charge
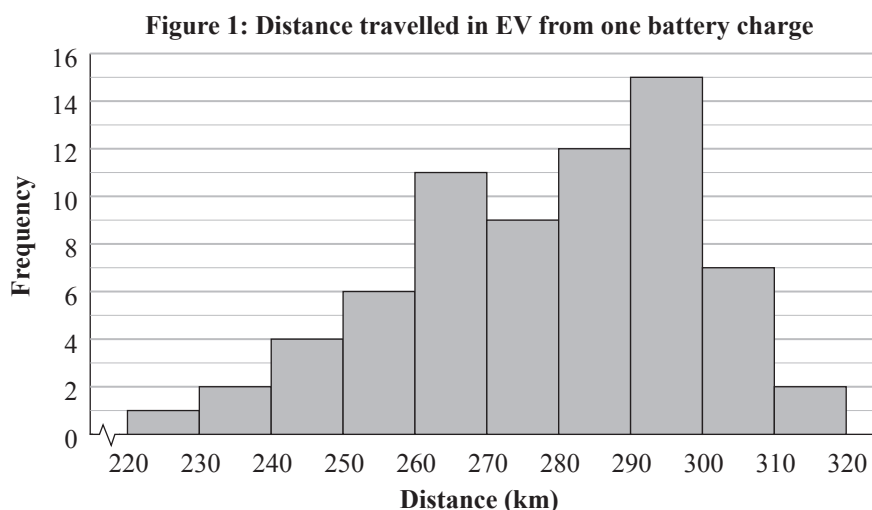
The car manufacturer claimed that its second-generation EVs can travel 280 km on one battery charge on average **and** that these distances would be normally distributed, with a standard deviation of 14 km.

Evaluate this claim by:

- comparing the shape, centre, and spread of the histogram in Figure 1 with the claimed normal distribution
- providing numerical values where appropriate
- considering the quality of the testing that led to the results reported in Figure 1.
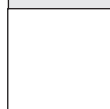
TŪMAHI TUATORU

I kitea e ngā rangahau ētahi hono i waenga i te whai waka EV me te whakamaunga o tetahi pūnaha hiko kōmaru ā-kāinga.

I whakahaerehia he rangahau tuihono i Amerika ki te Raki o ngā rangatira EV, ngā rangatira waka mono-mai momorua (PHEV) me ētahi atu tāngata e kaingākau ana (he waka penehīni ō rātou) i roto i te toru marama te tau 2018.

Kua tuhia ngā otinga ki te ripanga i raro nei.

Ripanga 1: Ko te momo waka me te whai pūnaha hiko kōmaru ā-kāinga i te Amerika ki te Raki

	Pūnaha hiko kōmaru ā-kāinga	Kāore he pūnaha hiko kōmaru ā-kāinga	Tapeke
Waka hiko (EV)	104	171	275
Waka mono-mai momorua (PHEV)	45	100	145
Waka penehīni	205	1375	1580
Tapeke	354	1646	2000

(a) Whakamahia te Ripanga 1 hei whakautu i ngā wāhanga (i) ki te (iv).

(i) He aha te ōwehenga o ngā kaiwhakautu rangahau he EV, he PHEV rānei ō rātou?

(ii) Ko tēhea te rangatira waka (EV, PHEV, penehīni rānei) i Amerika ki te Raki he nui ake te tūpono ka whai pūnaha hiko kōmaru ā-kāinga, e ai ki ēnei otinga rangahau?

(iii) E 22 144 ngā pūnaha hiko kōmaru ā-kāinga i whakaurua i Aotearoa i mua o te mutunga o te tau 2018.

Whakamahia ngā otinga mai i te rangahau o Amerika ki te Raki i te Ripanga 1 hei whakatau tata i te maha o ngā rangatira pūnaha hiko kōmaru ā-kāinga i Aotearoa he whai waka EV anō.

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(iv) Homai kia kotahi te pūtake tauanga i te iti rawa e kī ana kāore pea e puta he whakatau tata tika i tēnei āhuatanga mā te whakamahi i te Ripanga 1 i roto i tō whakautu ki te wāhanga (iii).

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QUESTION THREE

Studies have found some links between EV ownership and the installation of a home solar system.

An online survey was taken in North America of EV owners, plug-in hybrid vehicle (PHEV) owners and other interested people (who owned non-electric vehicles) during a three-month period in 2018.

The results are summarised in the table below.

Table 1: Vehicle type and home solar system ownership in North America

	Home solar system	No home solar system	Total
Electric vehicle (EV)	104	171	275
Plug-in hybrid electric vehicle (PHEV)	45	100	145
Non-electric vehicle	205	1375	1580
Total	354	1646	2000

(a)   Use Table 1 to answer parts (i) to (iv).

(i)   What proportion of survey respondents owned an EV or a PHEV?

(ii)   Which type of vehicle owner (EV, PHEV or non-electric) in North America is more likely to have a home solar system, according to these survey results?

(iii) There were 22 144 home solar systems installed in New Zealand by the end of 2018.

Use the results from the North American study in Table 1 to estimate how many of the home solar system owners in New Zealand also have EVs.

(iv) Give at least one statistical reason why using Table 1 in your answer to part (iii) may not lead to a valid estimate in this case.

(b) I whakahaerehia anō he rangahau ōrite i Uropi i taua wā anō. E whakaaturia ana ētahi o ēnei otinga i te Ripanga 2 i raro.

Ripanga 2: Ko te momo waka me te whai pūnaha hiko kōmaru ā-kāinga i Uropi

	Pūnaha hiko kōmaru ā-kāinga	Kāore he pūnaha hiko kōmaru ā-kāinga	Tapeke
Waka hiko (EV)		162	225
Waka mono-mai momorua (PHEV)	23		96
Waka penehīni			
Tapeke	271		1200

(i) Whakaotihia te ripanga i runga ake ka whakamahi hei whiriwhiri i te tūponotanga o tētahi kaiwhakautu i tīpako matapōkeretia he whai waka penehīni, he pūnaha hiko kōmaru ā-kāinga tāna.

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(ii) I whakaaturia e tētahi tuhipānui nūpepa ētahi o ngā kitenga mai i ngā rangahau e rua i roto i te Ripanga 1 me te Ripanga 2. Ko te whakapae ia:

- I Amerika ki te Raki, he **3 whakareanga ake** te tūponotanga ka whai pūnaha hiko kōmaru ā-kāinga te hunga whai waka EV tēnā i te hunga whai waka penehīni

- I Uropi, he **30 ōrau anake** te tūponotanga ka whai pūnaha hiko kōmaru ā-kāinga te hunga whai waka EV tēnā i te hunga whai waka penehīni.

(Ka tuaruatia i raro nei te Ripanga 1 o te whārangi 14)

Ripanga 1: Ko te momo waka me te whai pūnaha hiko kōmaru ā-kāinga i Amerika ki te Raki

	Pūnaha hiko kōmaru ā-kāinga	Kāore he pūnaha hiko kōmaru ā-kāinga	Tapeke
Waka hiko (EV)	104	171	275
Waka mono-mai momorua (PHEV)	45	100	145
Waka penehīni	205	1375	1580
Tapeke	354	1646	2000

Ka taea ēnei whakapae te tautoko?

Me whakauru ngā tātaitaitanga tūponotanga ki tō whakautu, ka kōrero mō te tika o te whiriwhiri i ēnei whakataunga, e ai ki ngā taunakitanga i tukuna i te Tūmahi Tuatoru.

(b) A similar survey was conducted in Europe at the same time. Some of these results are shown in Table 2 below.

Table 2: Vehicle type and home solar system ownership in Europe

	Home solar system	No home solar system	Total
Electric vehicle (EV)		162	225
Plug-in hybrid electric vehicle (PHEV)	23		96
Non-electric vehicle			
Total	271		1200

(i) Complete the table above and use it to find the probability that a randomly selected respondent whose vehicle was non-electric, had a home solar system.

(ii) A newspaper article quoted some of the findings from the two studies shown in Table 1 and Table 2. It claimed that:
  • In North America, EV owners are **3 times** as likely to have a home solar system as non-electric vehicle owners
  • In Europe, EV owners are **only 30%** more likely to have a home solar system than non-electric vehicle owners.

(Table 1 from page 15 is repeated below)

Table 1: Vehicle type and home solar system ownership in North America

	Home solar system	No home solar system	Total
Electric vehicle (EV)	104	171	275
Plug-in hybrid electric vehicle (PHEV)	45	100	145
Non-electric vehicle	205	1375	1580
Total	354	1646	2000

Can these claims be supported?

Include probability calculations in your answer, and comment on the validity of drawing these conclusions, based on the evidence given in Question Three.

He whārangi anō ki te hiahiatia.
Tuhia te (ngā) tau tūmahi mēnā e tika ana.

Extra space if required.

Write the question number(s) if applicable.

QUESTION
NUMBER

Level 2 Mathematics and Statistics 2020

91267 Apply probability methods in solving problems

9.30 a.m. Thursday 19 November 2020
Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Apply probability methods in solving problems.	Apply probability methods, using relational thinking, in solving problems.	Apply probability methods, using extended abstract thinking, in solving problems.

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.

Make sure that you have Formulae Sheet L2–MATHMF.

Show ALL working.

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

Check that this booklet has pages 2–23 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.