91171M

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NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

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

2

SUPERVISOR'S USE ONLY

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

Ahupūngao, Kaupae 2, 2020

91171M Te whakaatu māramatanga ki te pūhanga manawa

9.30 i te ata Rāhina 16 Whiringa-ā-rangi 2020
Whiwhinga: Ono

Paetae	Kaiaka	Kairangi
Te whakaatu māramatanga ki te pūhanga manawa.	Te whakaatu māramatanga hōhonu ki te pūhanga manawa.	Te whakaatu māramatanga matawhānui ki te pūhanga manawa.

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 Rau Rauemi L2–PHYSMR.

Ki roto i ō tuhinga, whakamahia ngā whiriwhiringa tohutau mārama, ngā kupu, ngā hoahoa hoki, tētahi, ētahi rānei o ēnei, ki hea hiahiatia ai.

Me hoatu te wae tika o te Pūnaha Waeine ā-Ao (SI) ki ngā tuhinga tohutau.

Mēnā ka hiahia whārangi atu anō koe mō ō tuhinga, whakamahia te (ngā) whārangi wātea kei muri o tēnei pukapuka, ka āta tohu ai i te tau tūmahi.

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

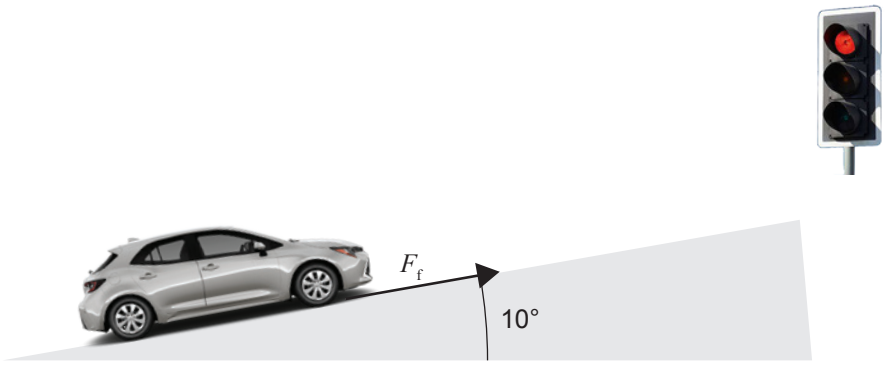
TŪMAHI TUATAHI: I TE TĀONE

MĀ TE KAIMĀKA ANAKE

Kua whakaritea e Alex rāua ko Jo tētahi haerenga i runga huarahi. Ka tīmata rāua mai i te noho tū i tētahi huarahi torotika, ka whakatere atu i te 4.2 m s^{-2}.

(a) Whakaaturia tō rāua tere i muri i te 0.60 hēkona ko te 2.5 m s^{-1}.

(b) I a rāua e tatari ana i ngā rama ārahi waka, ka whakamahia e Jo te katiringa kia kore ai e neke whakamuri te waka i te auheke (10°) poupou kei runga rāua. He 1600 kg te papatipu o te waka me aua tokorua.



Ki te hiahia koe ki te tuhi anō i ngā pere whai tapanga, whakamahia te hoahoa wātea ki te whārangi 16.

He mea urutau mai: www.auto123.com/en/new-cars/technical-specs/toyota/corolla/2019/hatchback/base/
www.luxreview.com/2016/08/17/smart-traffic-lights-to-talk-to-drivers/

E whakaatu ana te hoahoa i runga i te tōpana waku e pā ana i waenga i ngā tāea me te rori.

(i) Tāpirihia ngā pere **whai tapanga** hei whakaatu i ērā atu tōpana e rua e pā ana ki te waka tū noa.

(ii) Whakaotihia tētahi hoahoa pere **whai tapanga** e whakaatu ana he pēhea te tōpū tahi o ngā tōpana katoa e toru.

Ki te hiahia koe ki te tuhi anō i ngā pere whai tapanga, whakamahia te hoahoa wātea ki te whārangi 16.

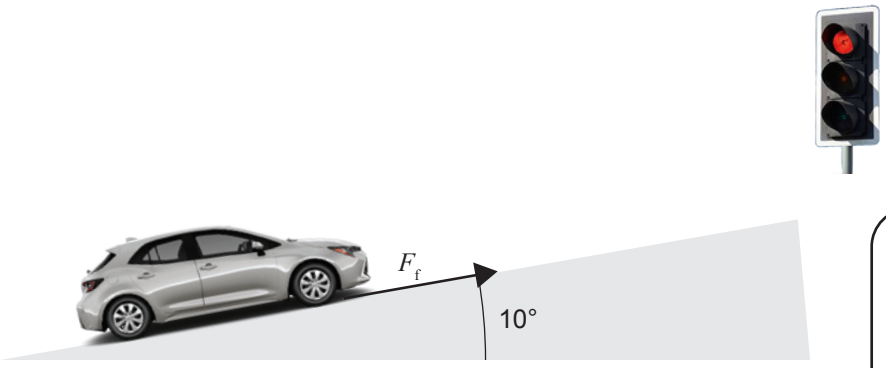
QUESTION ONE: IN TOWN

ASSESSOR'S USE ONLY

Alex and Jo have decided to take a road trip. They start from rest on a straight road, and accelerate at 4.2 m s^{-2}.

(a) Show their velocity after 0.60 seconds is 2.5 m s^{-1}.

(b) While waiting at traffic lights, Jo has to put on the handbrake to stop the car rolling down the steep (10°) slope they are on. The mass of the car and occupants is 1600 kg.



If you need to redraw your labelled arrows, use the spare diagram on page 17.

Adapted from: www.auto123.com/en/new-cars/technical-specs/toyota/corolla/2019/hatchback/base/
www.luxreview.com/2016/08/17/smart-traffic-lights-to-talk-to-drivers/

The diagram above shows the friction force acting between the tyres and the road.

(i) Add **labelled** arrows to show the other two forces acting on the stationary car.

(ii) Complete a **labelled** vector diagram showing how all three forces add together.

If you need to redraw your labelled arrows, use the spare diagram on page 17.

(c) Mā te whiriwhiri i te tō ā-papa e pā ana ki te waka i te tuatahi, me whakaatu ko te uara o te tōpana waku e hiahiatia ana kia noho tū tonu te waka he 2700 N.

MĀ TE KAIMĀKA ANAKE

(d) I a rāua e haere ana i te 50 km h^{-1}, ka kite a Jo i tētahi pokorua kei te rori i te 15 m i mua i a rāua. Me mātua whakaheke ia i tana tere mai i te 50 km h^{-1} ki te 20 km h^{-1} kia kore ai e tūkinotia te waka.

Mēnā ko te wā e hiahiatia ana kia haumaru ai te pereki mai i te 50 km h^{-1} ki te 20 km h^{-1} he 2.3 hēkona, me whakaatu mā te tātaitai mēnā kei te rawaka te wā ki te pereki i mua i te taenga atu ki te pokorua.

Me tīmata koe mā te whakaatu ko 50 km h^{-1} = 13.89 m s^{-1}.

ASSESSOR'S USE ONLY

(c) By first working out the force of gravity on the car, show that the value of the friction force required to keep the car stationary is 2700 N.

(d) While travelling at 50 km h^{-1}, Jo sees a pothole in the road 15 m ahead. She must reduce her speed from 50 km h^{-1} to 20 km h^{-1} to avoid damaging the car.

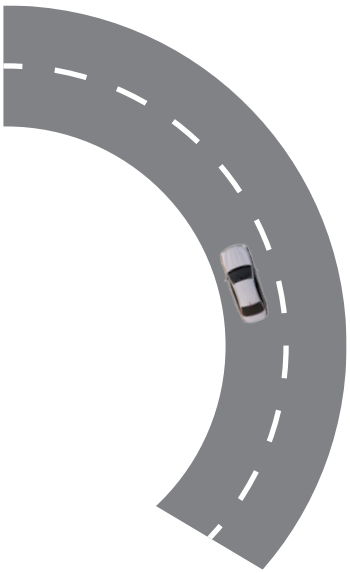
If the time needed for safe braking from 50 km h^{-1} to 20 km h^{-1} is 2.3 seconds, show by calculation whether there is enough time to complete braking before reaching the pothole.

You should start by showing that 50 km h^{-1} = 13.89 m s^{-1}.

TŪMAHI TUARUA: TE HUARAHI TUWHERA

MĀ TE KAIMĀKA ANAKE

Ka haere tonu a Jo rāua ko Alex kātahi ka whai i tētahi koki koi kei te rori i tētahi tere pūmau o te 12 m s^{-1}.



Ki te hiahia koe ki te tuhi anō i te pere, whakamahia te hoahoa wātea ki te whārangi 18.

(a) Tātuhia he pere ki te waka ki te hoahoa i runga ake hei whakaatu i te ahunga o te whakaterenga i tēnei pūwāhi.

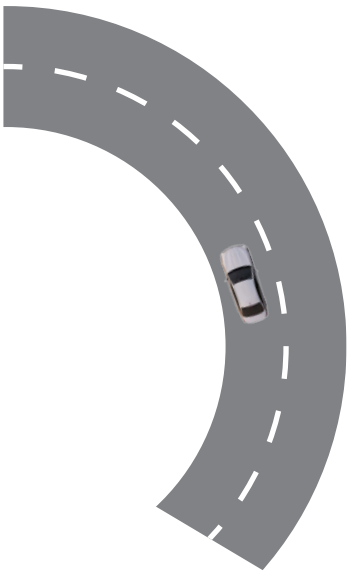
(b) Tātaitia te rahi o te whakaterenga mēnā ko te pūtoro o te koki he 25 m, ka whakamārama he aha te pūtake o tēnei whakaterenga.

(c) Hoatu kia RUA ngā āhuatanga ā-waho tērā pea ka huri i te nekehanga o te waka i te wā e haere ana i te koki, ka whakamārama he pēhea te pānga o ēnei āhuatanga ki te nekehanga.

QUESTION TWO: OPEN ROAD

ASSESSOR'S USE ONLY

Jo and Alex continue their drive and take a sharp bend in the road at a constant speed of 12 m s^{-1}.



If you need to redraw your arrow, use the spare diagram on page 19.

(a) Draw an arrow on the car on the diagram above to show the direction of the acceleration at this point.

(b) Calculate the size of the acceleration if the radius of the bend is 25 m, and explain what causes this acceleration.

(c) State TWO external factors that could change the motion of the car as it travels around the corner, and explain how these factors would affect the motion.

(d) Ka haere tonu rāua i te tere pūmau o te 12 m s^{-1}. He wāhanga kōpenupenu kei roto i te waka. E kī ana a Alex ka taea e te wāhanga kōpenupenu te whakapiki ake i te wā papātanga i tētahi tukinga mai i te 0.2 hēkona ki te 0.8 hēkona.

He 1600 kg te papatipu o te waka me aua tokorua.

Whakamahia ngā mātāpono ahupūngao me te (ngā) tātaitai e tika ana hei whakamārama he pēhea nei te whakahaumaru ake a te wāhanga kōpenupenu i tēnei waka mō te hunga i roto i tētahi tukinga.

MĀ TE KAIMĀKA ANAKE

(d) The pair continue on their journey at a constant speed of 12 m s^{-1}. The car is fitted with a crumple zone. Alex says the crumple zone can increase the time of impact in a collision from 0.2 seconds to 0.8 seconds.

The mass of the car and occupants is 1600 kg.

Use physics principles and appropriate calculation(s) to explain how having a crumple zone can make this car safer for the occupants during a collision.

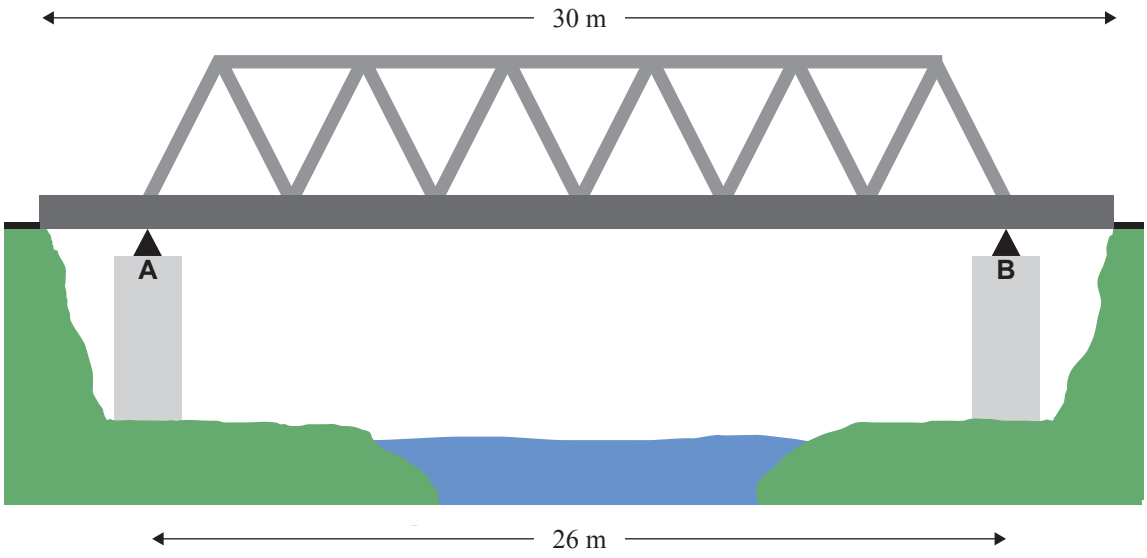
ASSESSOR'S USE ONLY

TŪMAHI TUATORU: TE PIRITI

MĀ TE KAIMĀKA ANAKE

Me whakawhiti a Jo rāua ko Alex i tētahi piriti kia tae rāua ki te wāhi e haere ana rāua.

www.flickr.com/photos/21663749@N03/5225413303



He 30 m te roa o te piriti, ko tōna papatipu he 30 000 kg.

He 26 m te tū wehe o ngā pou tautoko, ā, he rite te tawhiti mai i te pokapū o te piriti.

(a) Tuhia ngā whakaritenga e rua mō tētahi ahanoa kia noho taurite ai.

QUESTION THREE: THE BRIDGE

ASSESSOR'S USE ONLY

Jo and Alex need to cross a bridge to reach their destination.

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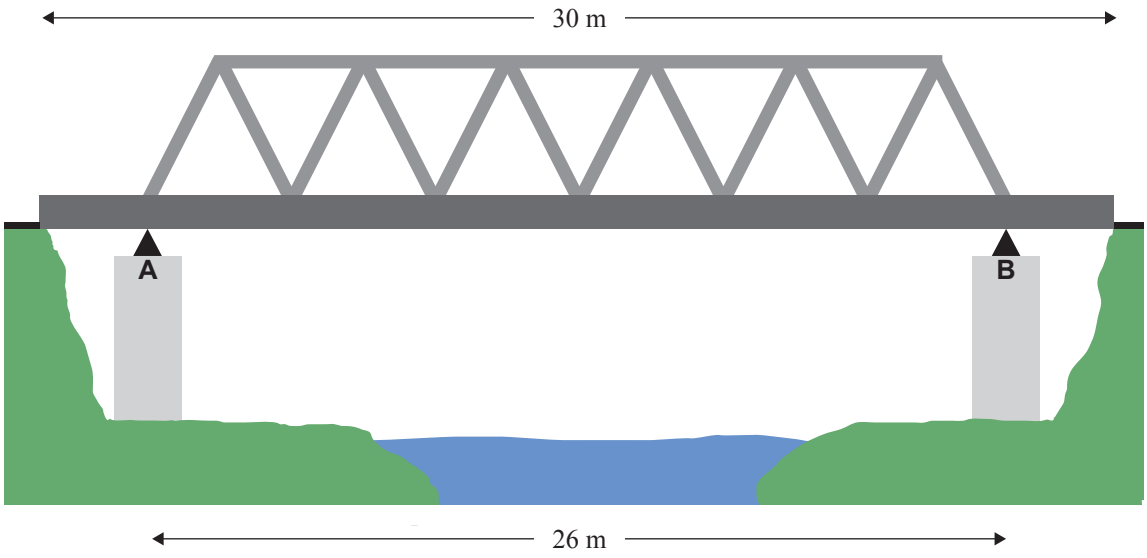


The bridge is 30 m long, and has a mass of 30 000 kg.

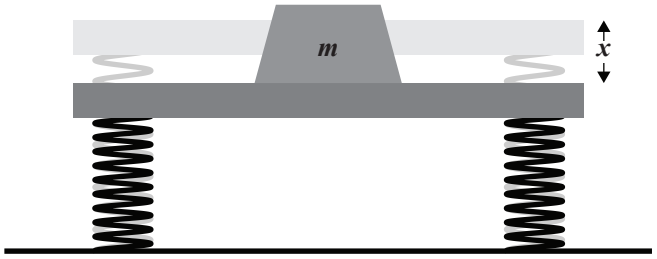
The supports are 26 m apart, and equal distance from the centre of the bridge.

(a) State the two requirements for an object to be in equilibrium.

(b) Kei te kati te rori i te mea kei te tapitapihia te piriti. Ka taea e te pou tautoko i te pito B te tuku te tōpana tautoko mōrahi o te 160 000 N.

Mā te kimi i ngā tōpana whakahuri mō te pou tautoko A, tātaitia te tino tawhiti mai i te pou tautoko A e taea ai tētahi papatipu 1600 kg te uta i mua i te tōpāparutanga o te pou tautoko i B.

(c) Ko te pūnaha pare rū o te piriti he pūniko. I mua i te whakamau ki te piriti, ka whakamātauria ngā pūniko mā te uta ki tētahi papatipu m. Ina utaina ki tētahi papatipu m ka kōpeke ngā pūniko mā tētahi tawhiti x.



Me hōhonu te whakamārama, me pēhea te huri o te rahinga o te papatipu kei ngā pūniko kia taea ai te kōpeke o ngā pūniko ki tētahi tawhiti o te $2x$ mai i te roa taketake.

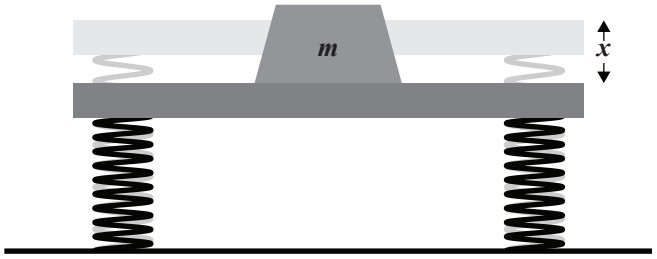
Ka haere tonu te Tūmahi Tuatoru i te whārangi 14.

ASSESSOR'S USE ONLY

(b) The road is closed as the bridge is under repair. The support column at end B can supply a maximum support force of 160 000 N.

By finding torques about support A, calculate the furthest distance from support A that a 1600 kg mass could be placed before the support at B became overloaded.

(c) The bridge has an earthquake-protection system made up of springs. Before being put in place on the bridge, the springs are tested by being loaded with a mass m. When loaded with a mass m the springs compress by a distance x.



Explain, in depth, how the size of the mass on the springs needs to change in order to compress the springs a distance $2x$ from the original length.

Question Three continues on page 15.

(d) Ka whakaaro ake a Jo rāua ko Alex mēnā ka taea e tētahi pūniko kōpeke mai i te piriti te whakatere tō rāua waka ina tukuna te pūniko, e ai ki te hoahoa i raro. Ka whakarite rāua ki te whakamātau i te pānga o te pūniko ki te nekehanga o te waka. Ko tā rāua whakatau tata mō tēnei pūniko, ka kōpeke tētahi tōpana o te 50 000 N i te roa o te pūniko mai i te 6.0 m ki te 4.2 m. He 1600 kg te papatipu tapeke o te waka me te hunga i roto.

MĀ TE KAIMĀKA ANAKE

(i) Tātaitia te tere mōrahi e whakaterehia ake ai te waka me te hunga i roto e tēnei pūniko mēnā i kōpeketia ki te 4.2 m.

Me tīmata tō tuhinga mā te whiriwhiri i te pūmau o te pūniko, k, i te tuatahi.

(ii) He aha te/ngā whakapae kua tukuna e koe i tēnei tātaitanga?

ASSESSOR'S USE ONLY

(d) Jo and Alex wonder whether a compressed spring from the bridge could accelerate their car once the spring is released, as in the diagram below. They decide to determine the effect of the spring on the car's motion. They estimate that for this spring, a force of 50 000 N would compress the spring length from 6.0 m to 4.2 m. The total mass of the car and occupants is 1600 kg.

(i) Calculate the maximum speed to which this spring could accelerate the car and its occupants if it was compressed to 4.2 m.

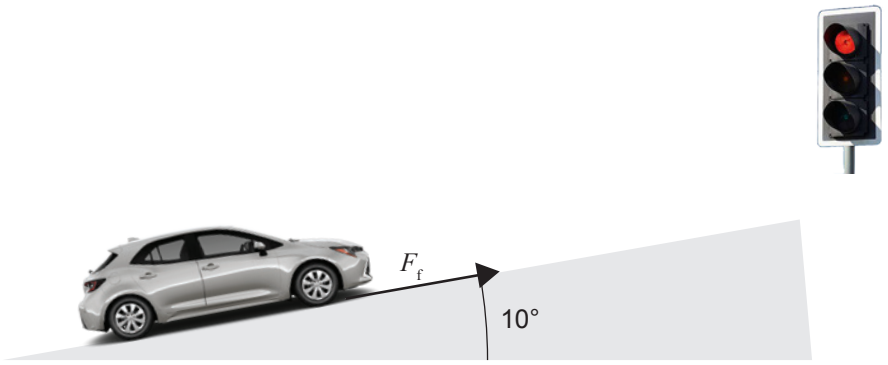
You should start your answer by first determining the spring constant, k.

(ii) What assumption(s) have you made in this calculation?

HE HOAHOA TĀPIRI

MĀ TE KAIMĀKA ANAKE

Ki te hiahia koe ki te tuhi anō i ngā pere whai tapanga ki te Tūmahi Tuatahi (b)(i), whakamahia te hoahoa i raro nei. Kia mārama te tohu ko tēhea te hoahoa ka hiahia koe kia mākahia.



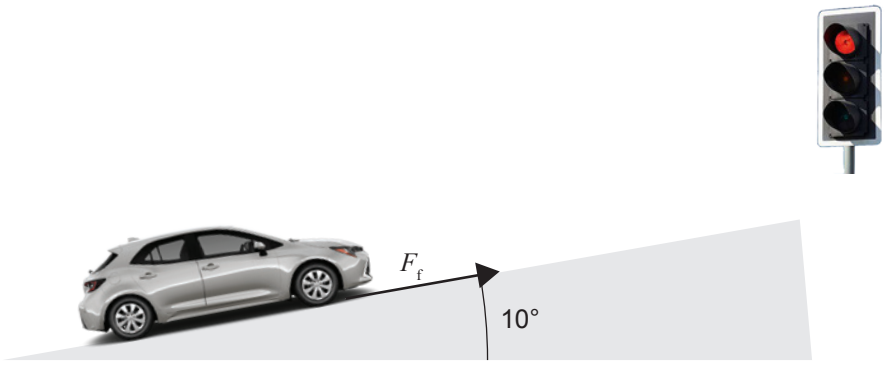
He mea urutau mai: www.auto123.com/en/new-cars/technical-specs/toyota/corolla/2019/hatchback/base/
www.luxreview.com/2016/08/17/smart-traffic-lights-to-talk-to-drivers/

Ki te hiahia koe ki te tuhi anō i tō hoahoa pere mō te Tūmahi Tuatahi (b)(ii), whakamahia te hoahoa i raro nei. Kia mārama te tohu ko tēhea te hoahoa ka hiahia koe kia mākahia.

SPARE DIAGRAMS

ASSESSOR'S USE ONLY

If you need to redraw your labelled arrows for Question One (b)(i), use the diagram below. Make sure it is clear which diagram you want marked.



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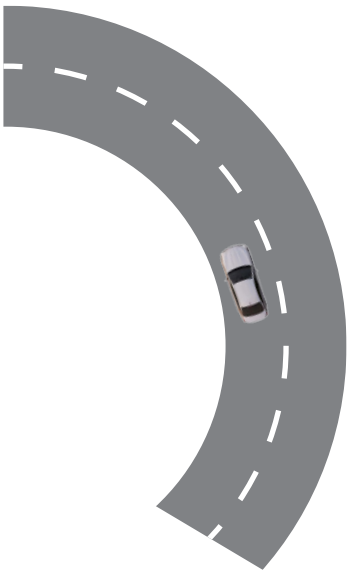
www.luxreview.com/2016/08/17/smart-traffic-lights-to-talk-to-drivers/

If you need to redraw your vector diagram for Question One (b)(ii), use the diagram below. Make sure it is clear which diagram you want marked.

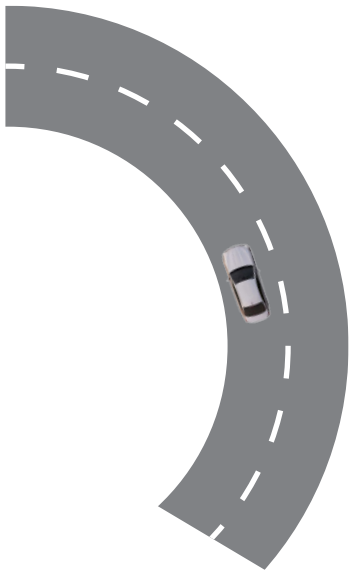
Ki te hiahia koe ki te tuhi anō i te pere ki te Tūmahi Tuarua (a), whakamahia te hoahoa i raro nei. Kia mārama te tohu ko tēhea te hoahoa ka hiahia koe kia mākahia.

MĀ TE KAIMĀKA ANAKE



If you need to redraw your arrow for Question Two (a), use the diagram below. Make sure it is clear which diagram you want marked.

ASSESSOR'S USE ONLY



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

TAU TŪMAHI

MĀ TE KAIMĀKA ANAKE

Extra paper if required.
Write the question number(s) if applicable.

QUESTION NUMBER

ASSESSOR'S USE ONLY

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

TAU TŪMAHI

MĀ TE KAIMĀKA ANAKE

Extra paper if required.
Write the question number(s) if applicable.

QUESTION NUMBER

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English translation of the wording on the front cover

Level 2 Physics 2020

91171 Demonstrate understanding of mechanics

9.30 a.m. Monday 16 November 2020
Credits: Six

91171M

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of mechanics.	Demonstrate in-depth understanding of mechanics.	Demonstrate comprehensive understanding of mechanics.

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 Resource Sheet L2–PHYSMR.

In your answers use clear numerical working, words, and / or diagrams as required.

Numerical answers should be given with an appropriate SI unit.

If you need more space for any answer, use the page(s) provided at the back of this booklet and clearly number the question.

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.