See back cover for an English translation of this cover

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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!

SUPERVISOR'S USE ONLY

Tohua tēnei pouaka mēnā KĀORE koe i tuhituhi i roto i tēnei pukapuka

Ahupūngao, Kaupae 2, 2021

91171M Te whakaatu māramatanga ki te pūhanga manawa

Ngā 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 Puka 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 o te Ao (SI) ki ngā whakautu tohutau.

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 2–19 kei roto i tēnei pukapuka, ka mutu, kāore tētahi o aua whārangi i te takoto kau.

Kaua e tuhi ki roto i tētahi wāhi kauruku whakahāngai ( ). Ka tapahia pea tēnei wāhi ina mākahia te pukapuka.

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

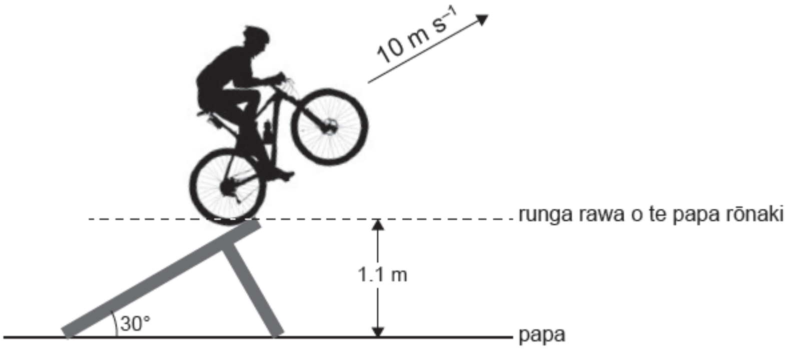
TŪMAHI TUATAHI: TE PAPA RŌNAKI

E whakaatu ana te pikitia kei te taha matau i tētahi kaieke pahikara e haere ana mā runga papa rōnaki.

Ko te tere o te kaieke i te wāhi runga rawa o te papa rōnaki he 10 m s^{-1}.

Ko te koki i waenga i te papa rōnaki me te papa he 30°.

Ko runga rawa o te papa rōnaki he 1.1 m i runga ake o te papa.



(a) Me whakaatu ko te tere poutū o te kaieke i te wā tonu ka wehe ia i te wāhi runga rawa o te papa rōnaki he 5 m s^{-1}.

(b) Tātaihia te teitei mōrahi ka eke i te kaieke i runga ake o te **papa**.

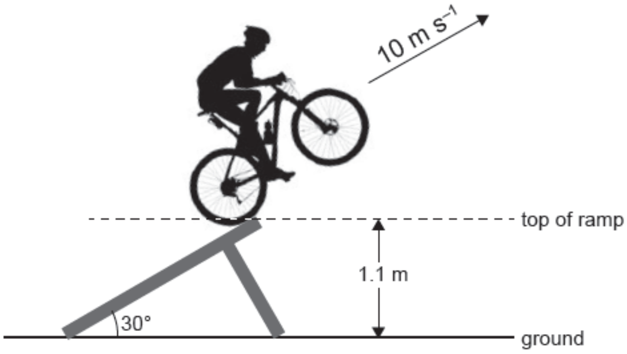
QUESTION ONE: THE RAMP

The picture on the right shows a bike rider going over a ramp.

The rider's speed at the top of the ramp is 10 m s^{-1}.

The angle between the ramp and the ground is 30°.

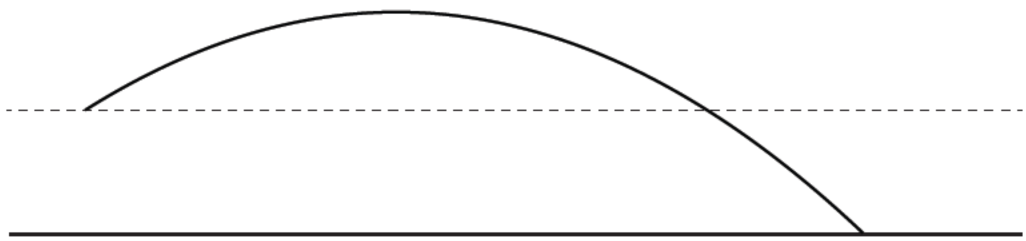
The top of the ramp is 1.1 m above the ground.



(a) Show that the vertical velocity of the rider just as they leave the top of the ramp is 5 m s^{-1}.

(b) Calculate the maximum height that the rider will reach above the **ground**.

(c) E whakaatu ana te hoahoa i raro i te ara o te kaieke ina wehe ia i te wāhi runga rawa o te papa rōnaki 30° i te 10 m s^{-1}.



Ki taua hoahoa anō, me te kore whakamahi tātai atu anō, tātuhia te ara o tētahi kaieke ka wehe mai i runga rawa o te papa rōnaki 40° i te 10 m s^{-1}.

Me kī he rite ngā wāhi runga rawa o ngā papa rōnaki.

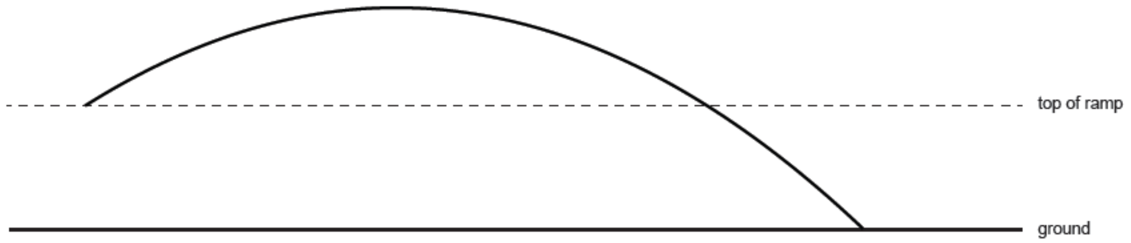
Ki te hiahia koe ki te tuhi anō i tō urupare, whakamahia te hoahoa kei te whārangi 14.

(d) Mō tētahi kaieke e wehe ana i te wāhi runga rawa o tētahi papa rōnaki 30° i te 10 m s^{-1}:

(i) Tātaihia te tere **poutū** o tētahi kaieke ina tau ia ki te papa.

(ii) Tātaihia te tawhiti huapae i haerehia mai i te papa rōnaki ki te taunga o te kaieke ki te papa.

(c) The diagram below shows the path of the rider when they leave the top of the 30° ramp at 10 m s^{-1}.



On the same diagram, and without further calculation, sketch the path of a rider who leaves the top of a 40° ramp at 10 m s^{-1}.

Assume the top of the ramps are in the same place.

If you need to redraw your response, use the diagram on page 15.

(d) For a rider leaving the top of a 30° ramp at 10 m s^{-1}:

(i) Calculate the **vertical** speed of the rider when they land on the ground.

(ii) Calculate the horizontal distance travelled from the ramp to where the rider lands on the ground.

TŪMAHI TUARUA: I TUA O TE KOKI

Ka haere tētahi kaieke i tētahi ānau porohita he 7.0 m te pūtoro i te tere aumou o te 10 m s^{-1}.

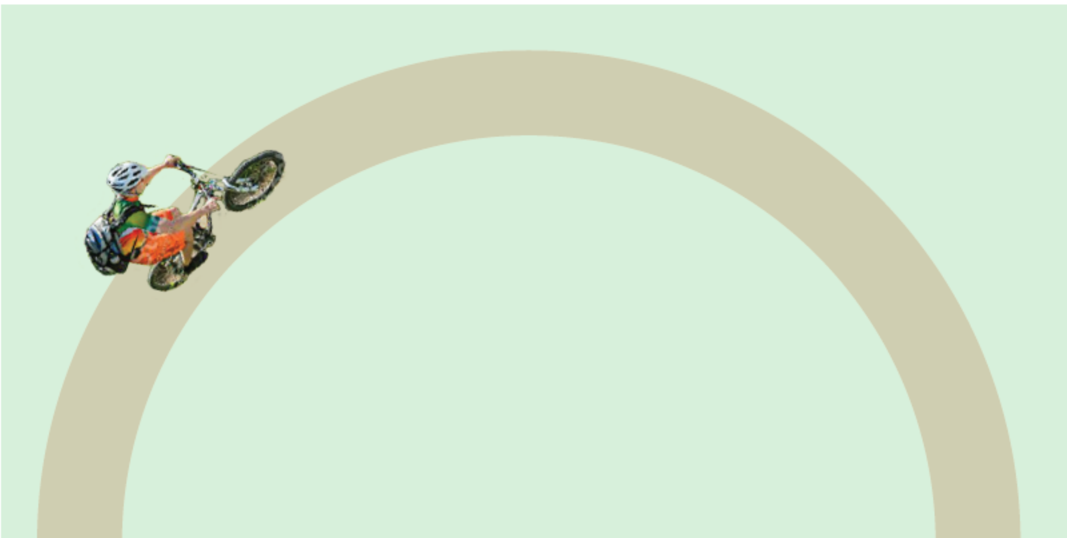
Mātāpuna: https://nsmb.com/articles/cure-your-2006-posture-cone-training/

(a) Mēnā he 90 kg te papatipu tōpū o te kaieke me te pahikara, tātaihia te tōpana amio whakaroto e hiahiatia ana.

(b) Ina tae te kaieke ki te tūnga i raro, ka eke ia i tana pahikara mā tētahi wāhanga **tino** māniania o te ara.

Whakamahia ngā mātāpono ahupūngao hei whakamārama i te ara ka haerehia e te pahikara mā te wāhi tino māniania o te ara.

Whakaaturia tēnei ara ki te hoahoa mā tētahi pere.



Ki te hiahia koe ki te tuhi anō i tō urupare, whakamahia te hoahoa kei te whārangi 14.

QUESTION TWO: AROUND THE BEND

A rider rides around a circular bend of radius 7.0 m at a constant speed of 10 m s^{-1}.

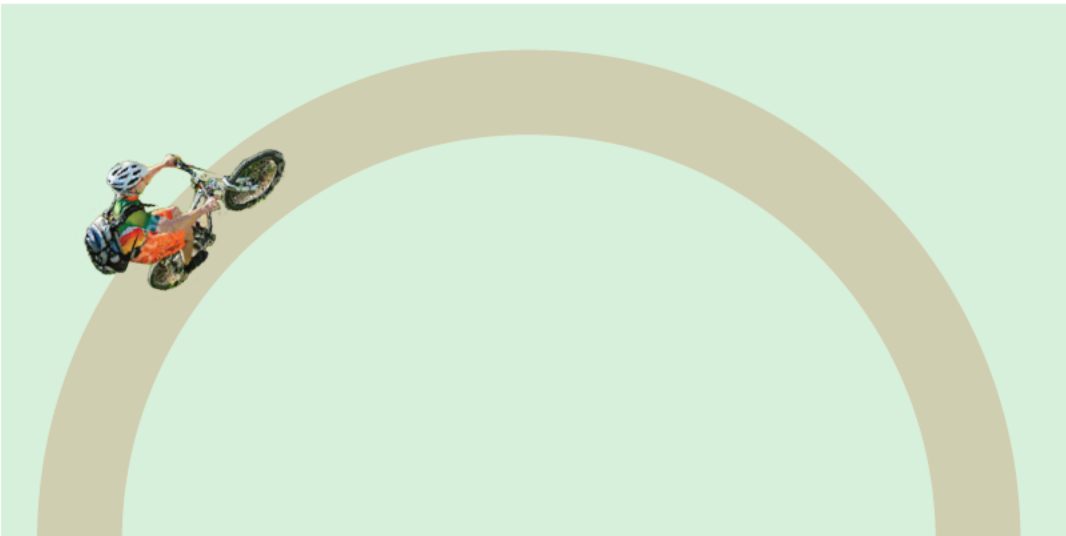
Source: https://nsmb.com/articles/cure-your-2006-posture-cone-training/

(a) If the combined mass of the rider and bike is 90 kg, calculate the centripetal force required.

(b) When the rider is in the position below, they bike across a **very** slippery part of the track.

Use physics principles to explain the path the rider takes when they bike across the very slippery part of the track.

Show this path on the diagram with an arrow.



If you need to redraw your response, use the diagram on page 15.

(c) He pūnaha pūnikoniko ō ētahi pahikara paparahi.

Ko te aumou pūniko he 40 000 N m^{-1}.

Ka noho tētahi kaieke 80 kg te papatipu ki runga i tōna pahikara, ā, ka kurutē te pūniko.

Mātāpuna: www.bikeradar.com/features/shock-talk-the-coil-sprung-comeback/

Tātaihia e hia te pūngao e rokirokitia ana i roto i te pūniko kurutē.

(d) Ina tau te kaieke mai i te peketanga, me kī kei te tuki ia ki te papa.

Whakamahia ngā mātāpono ahupūngao hei whakamārama he pēhea te whakahaumaru a tētahi pūnaha pūnikoniko i te pahikara kia pai ai mō te taunga.

(c) Some trail bikes have a spring suspension system.

The spring constant is 40 000 N m^{-1}.

A rider of mass 80 kg sits on the bike, causing the spring to compress.

Source: www.bikeradar.com/features/shock-talk-the-coil-sprung-comeback/

Calculate how much energy is stored in the compressed spring.

(d) When a rider lands after a jump, they essentially have a collision with the ground.

Use physics principles to explain fully how a suspension system makes a bike safer for landing.

TŪMAHI TUATORU: PŪNGAO

Ka piki tētahi kaieke me tōna pahikara he 85 kg te papatipu tōpū kia 4.0 m te poutū i roto i te 3.0 s i tētahi ara.

Mātāpuna: www.singletracks.com/mtb-trails/keystone-bike-park-has-something-for-everyone/

(a) Tātaihia te kaha toharite e hiahiatia ana.

Ka haere te kaieke mā tētahi piriti 4.0 m te roa, ā, ka tū i te 3.0 m mai i te pito.

Ko te papatipu papatahi o te piriti he 700 kg.

E 85 kg te papatipu tōpū o te kaieke me te paihikara.

Mātāpuna: www.visitnsw.com/destinations/hunter/barrington-tops/gloucester/attractions/the-steps-barrington-mountain-bike-park

(b) Tuhia ngā āhuatanga e hiahiatia ana kia taurite ai te piriti.

QUESTION THREE: ENERGY

A rider and bike with combined mass of 85 kg climb 4.0 m vertically in 3.0 s while biking up a track.

Source: www.singletracks.com/mtb-trails/keystone-bike-park-has-something-for-everyone/

(a) Calculate the average power required.

The rider bikes over a 4.0 m-long bridge and stops 3.0 m from the end.

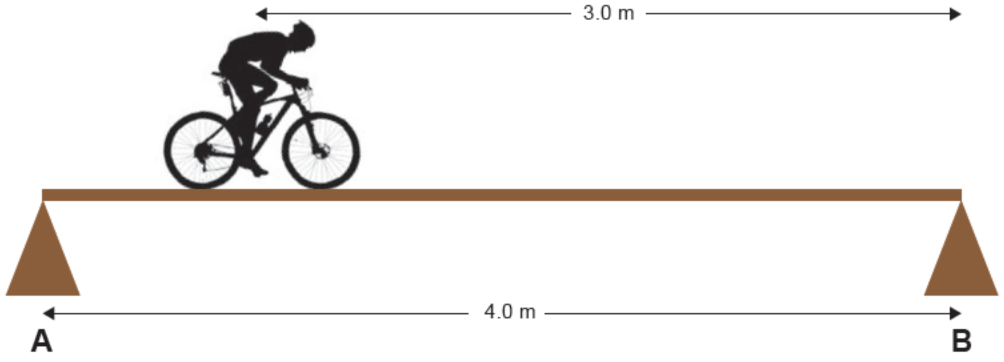
The bridge has a uniform mass of 700 kg.

The combined mass of the rider and bike is 85 kg.

Source: www.visitnsw.com/destinations/hunter/barrington-tops/gloucester/attractions/the-steps-barrington-mountain-bike-park

(b) State the conditions required for the bridge to be in equilibrium.

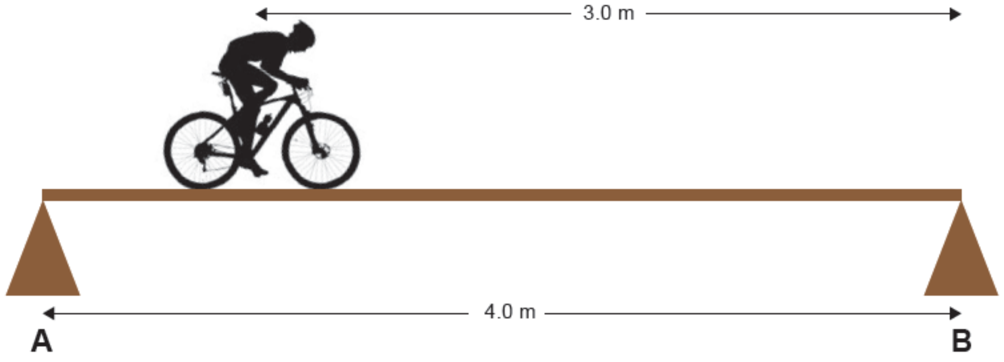
(c) Tātuhia ngā pere whai tapanga hei whakaatu i ngā tōpana katoa e pā ana ki te piriti.



Ki te hiahia koe ki te tuhi anō i tō urupare, whakamahia te hoahoa kei te whārangi 16.

(d) Tātaihia ngā uara o ngā tōpana KATOA ka pā ki te piriti.

(c) Draw labelled arrows to represent all the forces acting on the bridge.

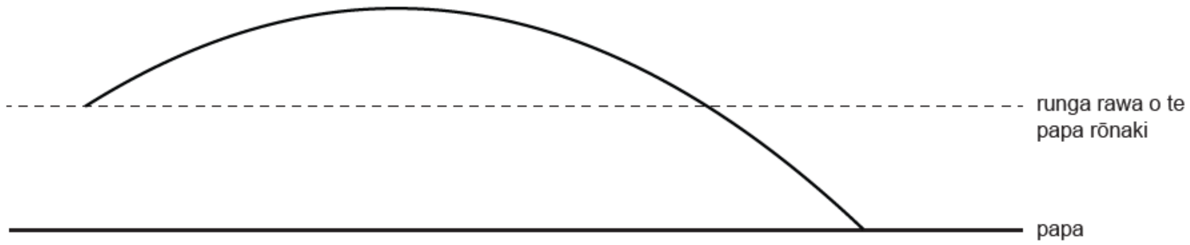


If you need to redraw your response, use the diagram on page 17.

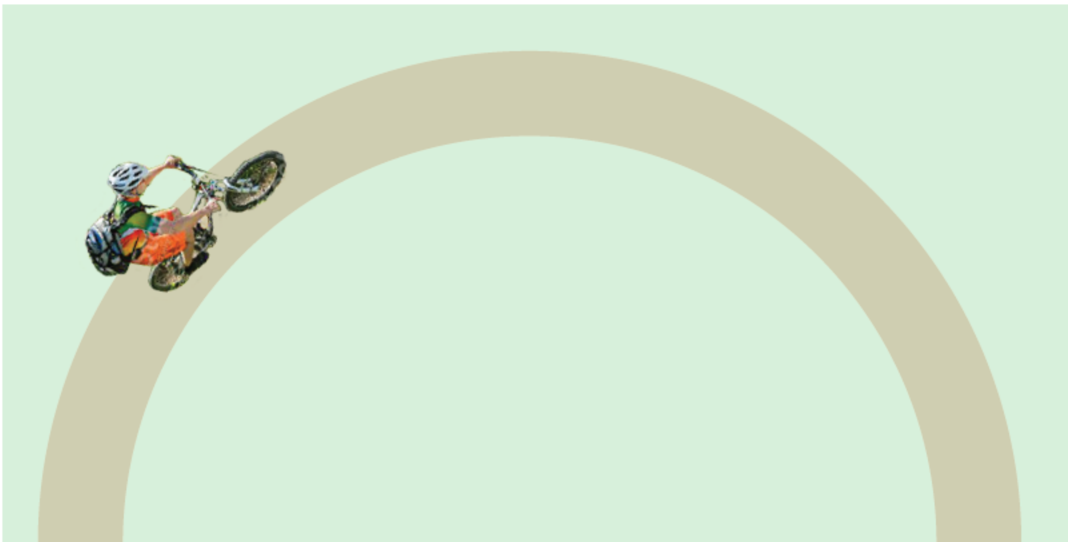
(d) Calculate the values of ALL the forces acting on the bridge.

HE HOAHOA WĀTEA

Ki te hiahia koe ki te tātuhi anō i tō urupare ki te Tūmahi Tuatahi (c), whakamahia te hoahoa i raro nei. Kia mārama te tohu ko tēhea te tuhinga ka hiahia koe kia mākahia.

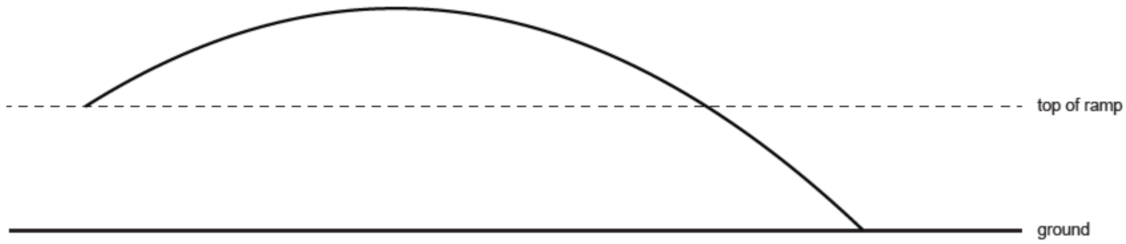


Ki te hiahia koe ki te tātuhi anō i tō urupare ki te Tūmahi Tuarua (b), whakamahia te hoahoa i raro nei. Kia mārama te tohu ko tēhea te tuhinga ka hiahia koe kia mākahia.

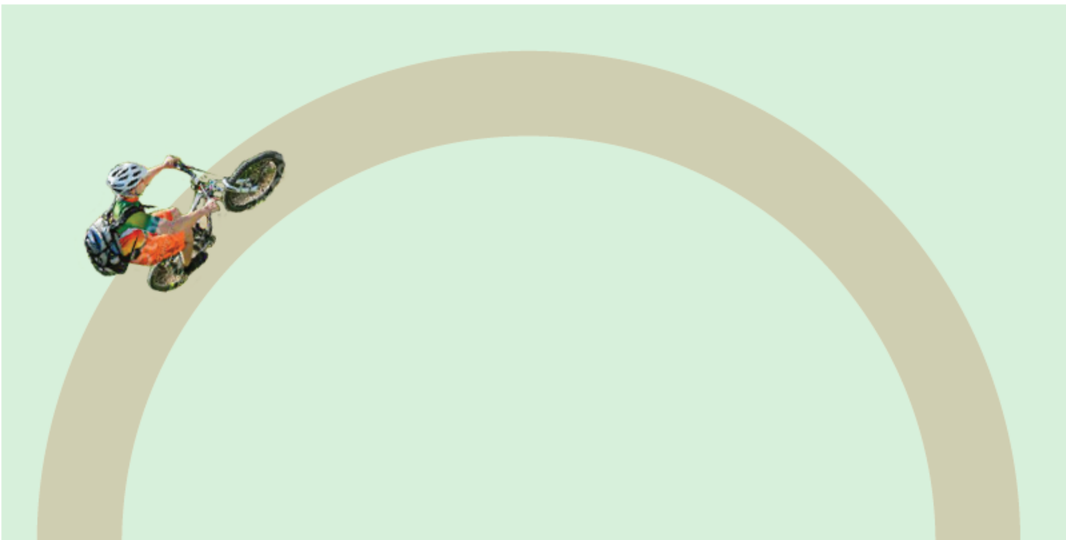


SPARE DIAGRAMS

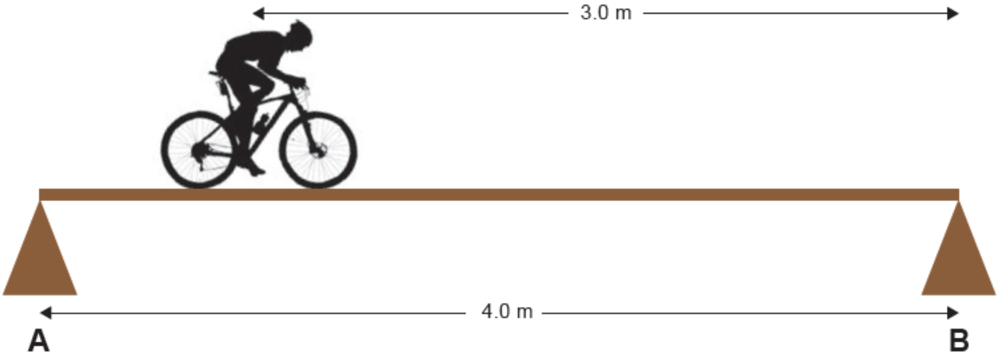
If you need to redraw your response to Question One (c), use the diagram below. Make sure it is clear which answer you want marked.



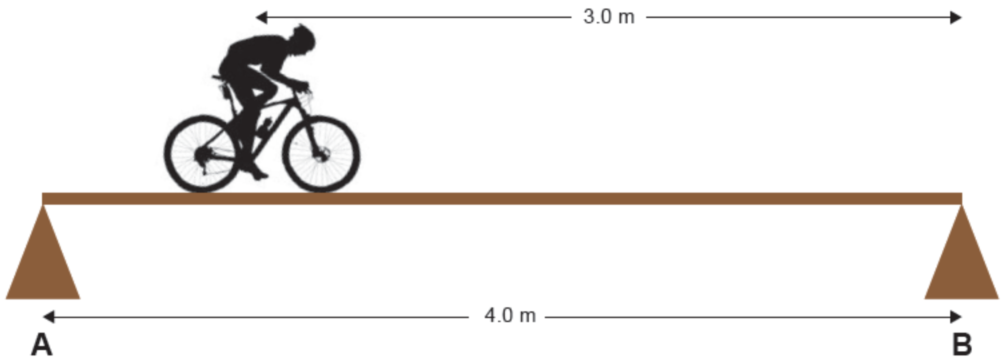
If you need to redraw your response to Question Two (b), use the diagram below. Make sure it is clear which answer you want marked.



Ki te hiahia koe ki te tātuhi anō i tō urupare ki te Tūmahi Tuatoru (c), whakamahia te hoahoa i raro nei. Kia mārama te tohu ko tēhea te tuhinga ka hiahia koe kia mākahia.



If you need to redraw your response to Question Three (c), use the diagram below. Make sure it is clear which answer you want marked.



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

TAU TŪMAHI

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

QUESTION NUMBER

English translation of the wording on the front cover

Level 2 Physics 2021

91171M Demonstrate understanding of mechanics

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

Check that this booklet has pages 2–19 in the correct order and that none of these pages is blank.

Do not write in any cross-hatched area ( ). This area may be cut off when the booklet is marked.

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