See back cover for an English translation of this cover

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91171M

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SUPERVISOR'S USE ONLY

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 koe i tuhi kōrero ki tēnei pukapuka

Mātai Ahupūngao, Kaupae 2, 2022

91171M Te whakaatu māramatanga ki te pūhanga manawa

Ngā whiwhinga: E ono

Paetae	Kaiaka	Kairangi
Te whakaatu māramatanga ki te pūhanga manawa.	Te whakaatu i te hōhonu o te māramatanga ki te pūhanga manawa.	Te whakaatu i te tōtōpū o te māramatanga ki te pūhanga manawa.

Tirohia kia kitea ai 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 kia kitea ai kei a koe te Pukapuka Rauemi L2–PHYSMR.

I ō tuhinga, whakaatuhia kia mārama ngā whiriwhiringa tohutau, ngā kupu, ngā hoahoa hoki/rānei, ki ngā wāhi me pērā.

Me hoatu te wae tika o te Pūnaha o te Ao (SI) ki ngā whakautu tohutau.

Mēnā ka hiahia whārangi atu anō koe mō ō tuhinga, whakamahia ngā whārangi wātea kei muri o tēnei pukapuka.

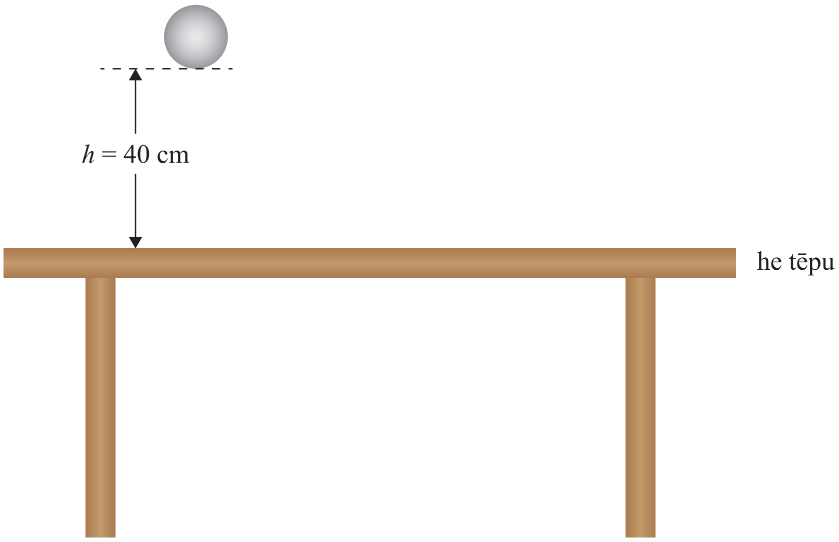
Tirohia kia kitea ai e tika ana te raupapatanga o ngā whārangi 2–19 kei roto i tēnei pukapuka, ka mutu, kāore tētahi o aua whārangi i te takoto kau.

Kaua e tuhi ki tētahi wāhi e kitea ai te kauruku whakahāngai (). Ka poroa pea taua wāhanga ka mākahia ana te pukapuka.

HOATU TĒNEI PUKAPUKA KI TE KAIWHAKAHAERE Ā TE MUTUNGA O TE WHAKAMĀTAUTAU.

TE TŪMAHI TUATAHI: TE MĀTAI NEKEHANGA ME TE ARA WHIU

E tārewatia ana tētahi pōro maitai kia 40 cm i runga o te tēpu. Ka tukuna te pōro, ka inea ai te roa o te takanga ki te tēpu.



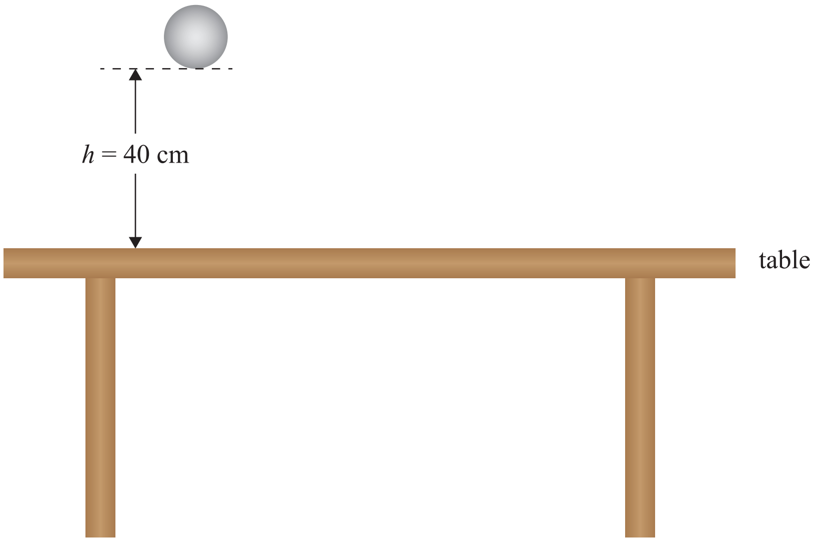
(a) Tātaihia te roa o te takanga o te pōro ki te tēpu.

(b) I toaitia te whakamātautau mā te whakamahi i tētahi atu pōro e ōrite ana te rahi, heoi, e haurua ana te papatipu.

I runga i te aro kore ki te awenga o te ātetenga hau, whakamahia ngā mātāpono ā-mātai ahupūngao hei whakataurite i te roa o te taka o tēnei pōro tuarua ki te roa o te taka o te pōro tuatahi.

QUESTION ONE: KINEMATICS AND PROJECTILE MOTION

A steel ball is held 40 cm above a table. The ball is released, and the time for it to fall to the table is measured.

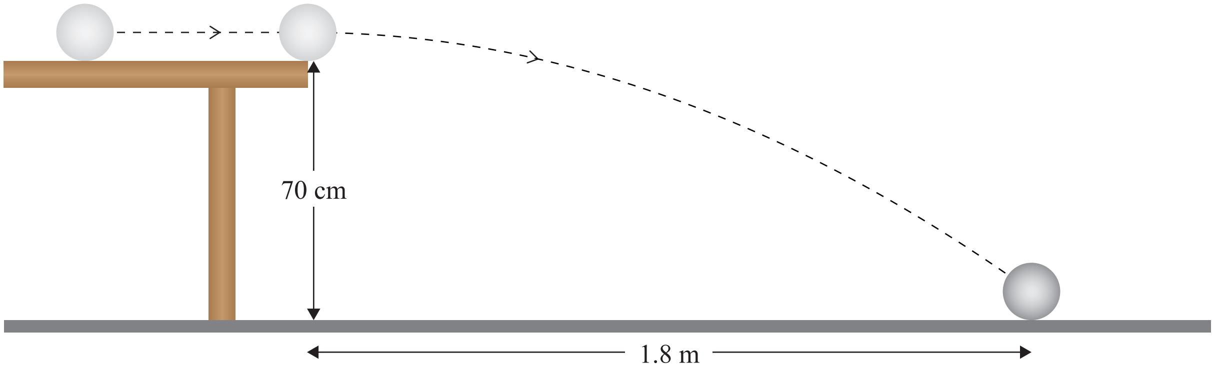


(a) Calculate the time it takes for the ball to fall to the table.

(b) The experiment was repeated with another ball of the same size, but half the mass.

Ignoring any effects of air resistance, use physics principles to explain how the time for this second ball to fall compares to the time for the first ball to fall.

(c) Ināianei ka pīroritia te pōro maitai i te tēpu kia taka i te tapa, pēnei i tā te pikitia e whakaatu nei. E 70 cm te teitei o te tēpu, ā, ka 1.8 m te tawhiti o te taunga o te pōro ki te papa, i te tapa o te tēpu.



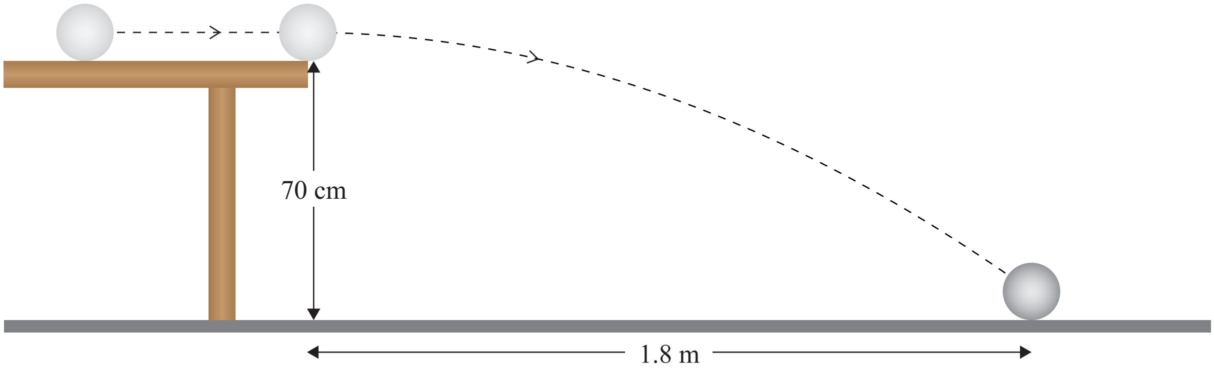
(i) Tātaihia te tere poutū whakamutunga o te pōro.

(ii) He aha te whakapae pūtake kua oti i a koe?

(d) Tātaihia te rahi me te ahunga o te tere o te pōro i mua tata tonu i te taunga ki te papa. Me tīmata koe mā te whakaatu i te tere huapae o te pōro kua 4.8 m s^{-1}.

(c) The steel ball is now rolled along the table and off the edge, as shown.

The height of the table is 70 cm, and the ball hits the ground 1.8 m past the edge of the table.



(i) Calculate the ball's final vertical velocity.

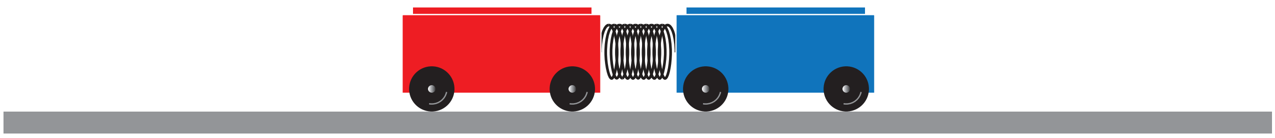
(ii) What assumption have you made?

(d) Calculate the size and direction of the velocity of the ball just before it hits the ground.

You should start by showing the horizontal velocity of the ball is 4.8 m s^{-1}.

TE TŪMAHI TUARUA: TE ĀNGA ME TE KOROWHITI

Kua whakaritea ngā kāta e rua me tētahi pūniko i waenganui. Kua 10 cm te kōpeketia o te pūniko. Ina turupanatia te pūniko, ka tere wehe ngā kāta e rua.



(a) E 250 N m^{-1} te pūmau pūniko o te pūniko.

Tātaihia te pūngao katoa ka puta i te pūniko.

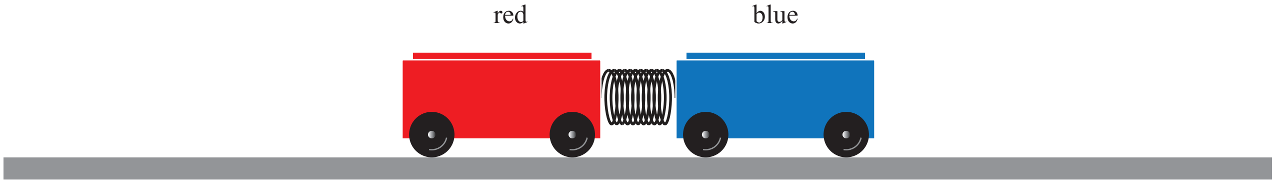
(b) Ko te 0.5 kg te papatipu o te kāta whero, e 2 kg te papatipu o te kāta kahurangi. Ka 0.5 m s^{-1} te tere whakamutunga o te kāta kahurangi.

(i) Tātaihia te tere whakamutunga o te kāta whero.

(ii) He aha tō whakapae pūtake kua oti i a koe, mēnā rā he pērā kei a koe?

QUESTION TWO: MOMENTUM AND IMPULSE

Two carts are set up with a spring between them. The spring is compressed by 10 cm. When the spring is released, the carts rapidly move apart in opposite directions.



(a) The spring has a spring constant of 250 N m^{-1}.

Calculate the total energy released from the spring.

(b) The mass of the red cart is 0.5 kg, and the mass of blue cart is 2 kg. The final velocity of the blue cart is 0.5 m s^{-1}.

(i) Calculate the final velocity of the red cart.

(ii) What assumption, if any, have you made?

I tētahi whakamātautau kē, ka whakaritea te kāta whero me te kāta kahurangi kia tauaro te ahunga, kia ōrite hoki te ānga. Ka tumu te kāta kahurangi i te mutunga o te ara nā tētahi pātū mārō, ā, ka tumu te kāta whero nā tētahi pātū whakapuru.

(c) Whakamahia ngā mātāpono ā-mātai ahupūngao hei whakamārama mēnā ka nui ake te tukitukia o te kāta kahurangi, o te kāta whero rānei i te tumutanga.

(d) E 2 m s^{-1} te tere o te neke o te kāta kahurangi, e 2 kg te taumaha, i 0.02 hēkona ai te roa o te tumu i te tūtukinga ki te pātū mārō.

(i) Tuhia mai te ture neke tuatoru a Niutana i roto i te horopaki o te tūtukinga o te kāta kahurangi ki te pātū mārō.

(ii) Tātaihia te rahi me te ahunga o te tōpana toharite ka rangona e te pātū mārō i te wā o te tūtukinga.

In a different experiment, the red and blue carts are set moving in opposite directions with equal momentum. The blue cart is stopped at the end of the track by a solid board, and the red cart is stopped by a padded wall.

(c) Use physics principles to explain whether the blue cart or the red cart will suffer the most damage as they both stop.

(d) The 2 kg blue cart, moving at 2 m s^{-1}, took 0.02 s to stop when it collided with the solid board.

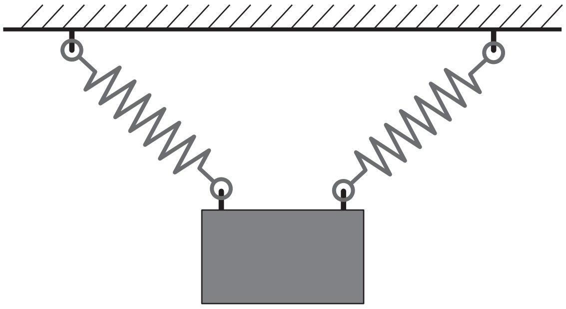
(i) State Newton's third law of forces in the context of the collision of the blue cart and the solid board.

(ii) Calculate the size and direction of the average force experienced by the solid board during this impact.

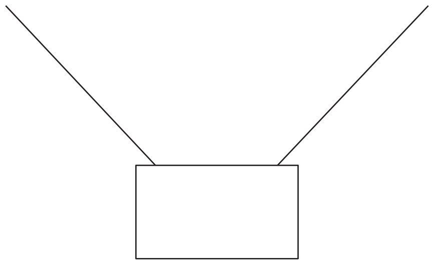
TE TŪMAHI TUATORU: NGĀ TŌPANA

(a) Tātaihia te pūmau pūniko mō tētahi pūniko ka 200 mm te tawhiti o te tautoro ka tārewa ana tētahi taumaha e 2.94 N te nui ki runga i taua pūniko tonu rā.

(b) Ka tūhonoa tētahi paraka ki ngā pūniko e rua e ōrite ana, ka tārewa ai i te tuanui.



(i) Ki te hoahoa o raro nei, āpitihia ngā pere whai tapanga hei whakaatu i ngā tōpana katoa ka pā ki te paraka.



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

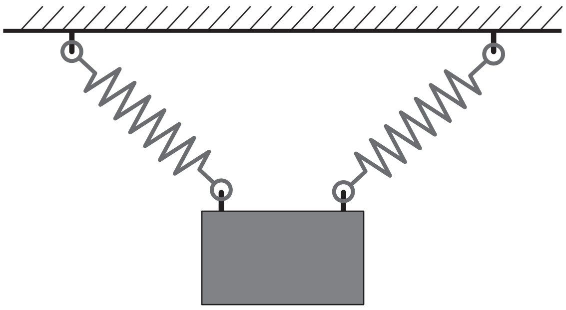
(ii) Tāngia mai he hoahoa pere e whai tapanga ana e whakaatuhia ai te tōpū tahi o ngā tōpana e toru ka pā ki te paraka.

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

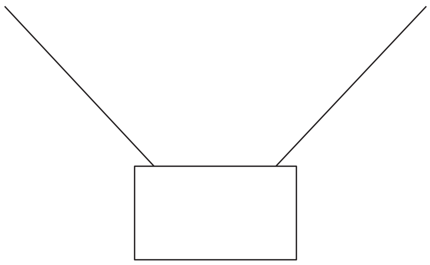
QUESTION THREE: FORCES

(a) Calculate the spring constant for a spring that extends 200 mm when a 2.94 N weight is hung on it.

(b) A block is attached to two identical springs and hung from the ceiling.



(i) On the diagram below, add labelled arrows to show all the forces acting on the block.



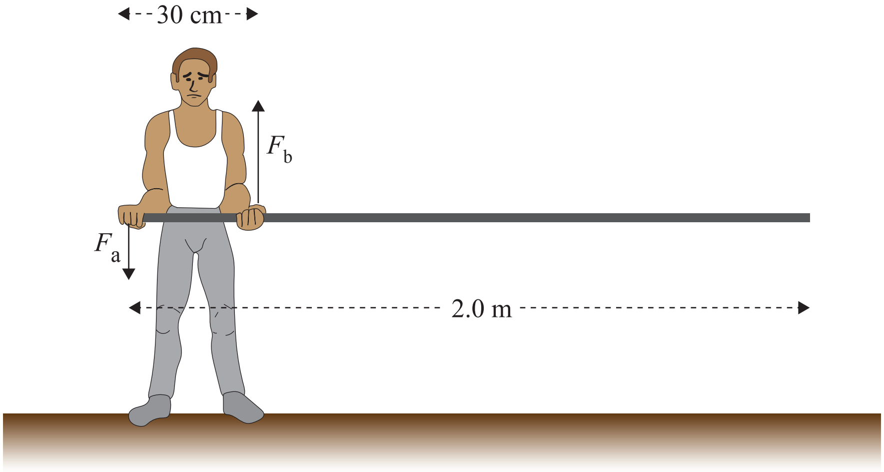
If you need to redraw your response, use the diagram on page 17.

(ii) Draw a labelled vector diagram to show how the three forces acting on the block add together.

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

(c) I a ia e whakangungu ana, ka pupuri tētahi kaipara i tētahi matire kanorite e 2.0 m te roa kia whakaroau, kia huapae.

E 3.0 kg te papatipu o te matire.

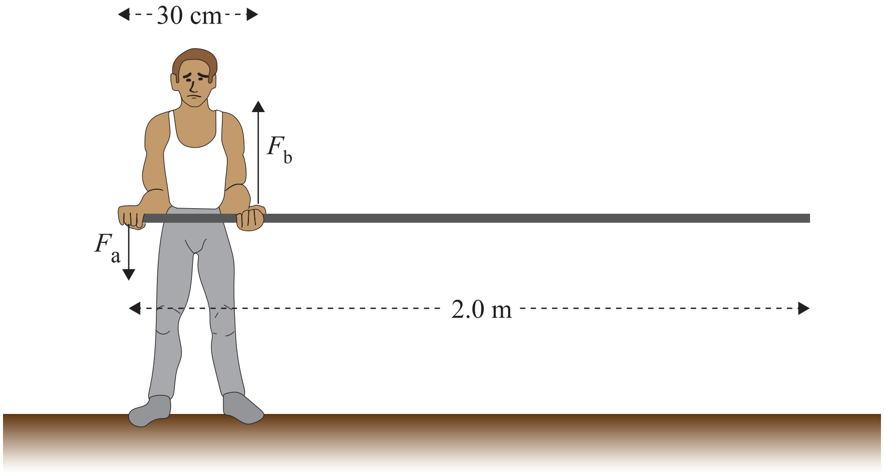


Tātaihia ngā tōpana o te F_a me te F_b me taea e ngā ringaringa o te kaipara e puritia ai te matire kia whārite, kia huapae.

Ka rere tonu te Tūmahi Tuatoru i te whārangi e whai ake nei.

(c) An athlete in training holds a uniform rod, 2.0 m long, stationary in a horizontal position.

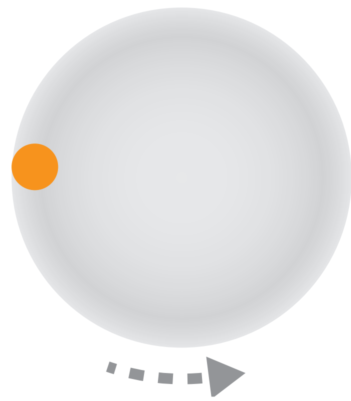
The mass of the rod is 3.0 kg.



Calculate the forces F_a and F_b that are required by the athlete's hands to hold the rod in equilibrium, in the horizontal position.

Question Three continues on the next page.

(d) Ka waiho tētahi tiere ki te tapa o tētahi pereti, ā, ka tīmata te takahuri o te pereti kia porotakataka te haere o te tiere. Ka tere ake te haere o te pereti, ka noho tonu te tiere ki tana tūnga, nāwai rā, ā, ka paheke i te pereti.

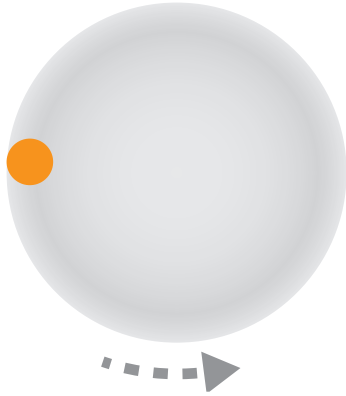


Whakamahia ngā mātāpono ā-mātai ahupūngao hei whakamārama i te take ka noho tonu te tiere ki tana tūnga i te tuatahi, engari, i te tere haeretanga, ka paheke.

Me whakaatu i tō tuhinga:

- ngā ingoa o te/ngā tōpana whaitake
- te āhua o te pānga o te whakapikinga o te tere ki te tūāhua
- te whakaahuatanga o te ara ka whāia e te tiere i te paheketanga.

(d) A jelly is placed on the edge of a plate, and the plate starts to spin so the jelly is moving in a circle. As the plate speed increases, the jelly initially maintains its position at the edge of the plate, until it eventually slides off.



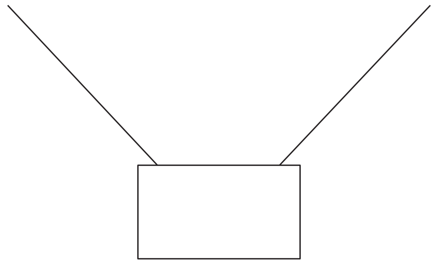
Use physics principles to explain why the jelly initially stays on the plate, but as the speed increases, it slides off.

Your answer should include:

- naming of any relevant force(s) involved
- how increasing the velocity affects the situation
- a description of the path the jelly would take when it first slides off.

HE HOAHOA WĀTEA

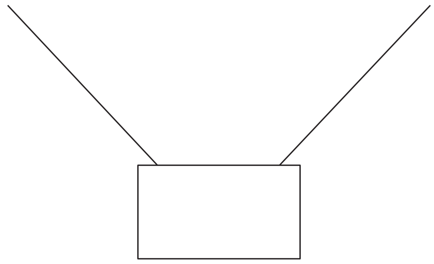
Ki te hiahia koe ki te tā anō i tō urupare ki te Tūmahi Tuatoru (b)(i), whakamahia te hoahoa i raro nei. Kia mārama te tohu ko tēhea te tuhinga ka hiahia koe kia mākahia.



Ki te hiahia koe ki te tā anō i tō urupare ki te Tūmahi Tuatahi (b)(ii), 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 Three (b)(i), use the diagram below. Make sure it is clear which answer you want marked.



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

He whārangi anō ki te hiahiatia.
Tuhia te tau tūmahi mēnā e hāngai ana.

TE 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 2022

91171M Demonstrate understanding of mechanics

Credits: Six

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

91171M

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.