91171M

911715

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

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KIA NOHO TAKATŪ KI TŌ ĀMUA AO!

2

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Ahupūngao, Kaupae 2, 2018

91171M Te whakaatu māramatanga ki te pūhanga manawa

9.30 i te ata Rāmere 9 Whiringa-ā-rangi 2018
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 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– 19 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.

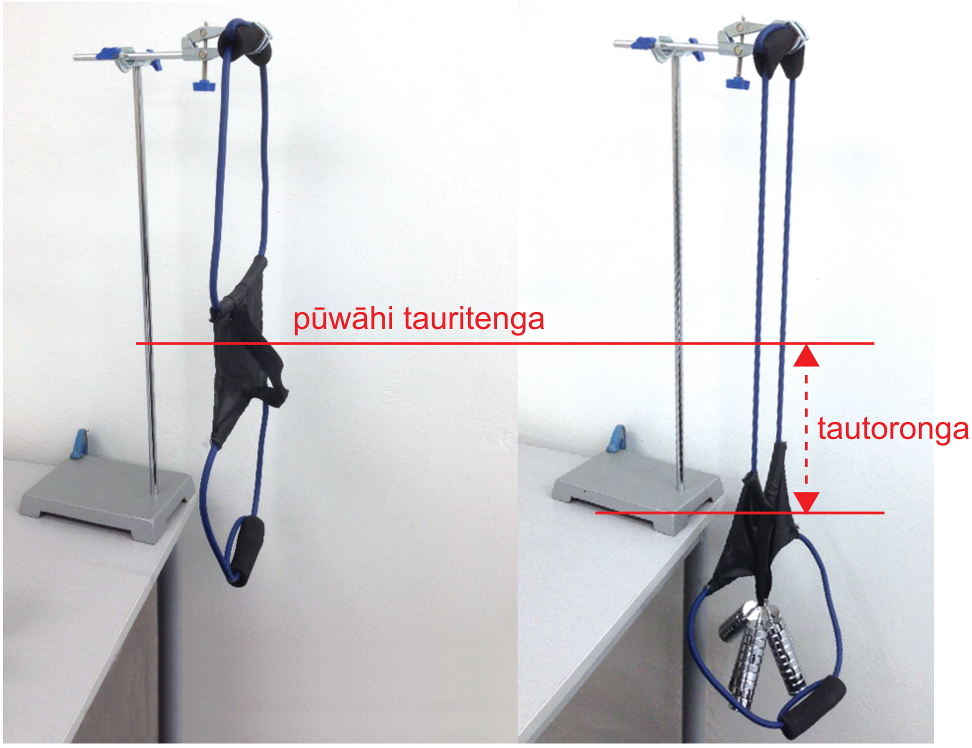
TAPEKE

MĀ TE KAIMĀKA ANAKE

MĀ TE KAIMĀKA ANAKE

TŪMAHI TUATAHI: TE WHAKAREWA POIHAU WAI

Ka mahia tētahi whakarewa poihau wai mai i ngā rapa makoha e kauāwhiwhi ana i tētahi pūniko, e ai ki ngā whakaahua i raro.

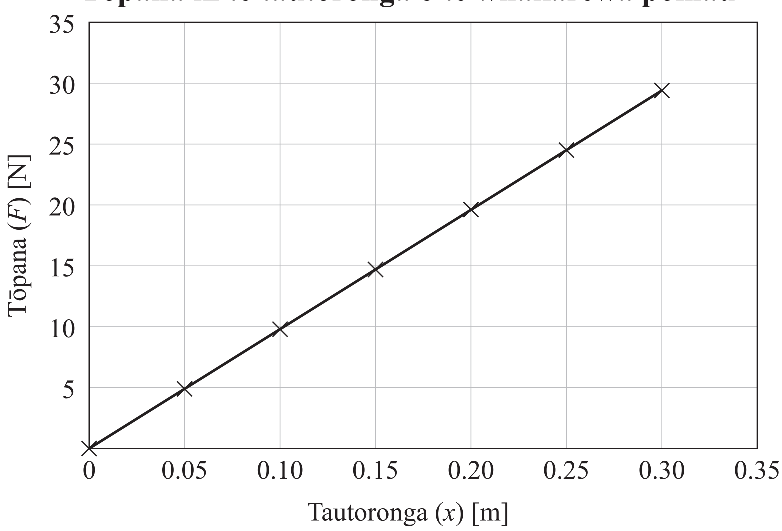


Hei whakatau i te pūmau pūniko i inea e Oliver, he ākonga tau 12, te tawhiti o te tautoro atu i tētahi taha o te rapa, i te wā e piri ana ētahi papatipu rerekē.

Kei te tūtohi me te kauwhata i raro ana hua e whakaaturia ana.

Tōpana *(F)* [N]	**Tautoronga mai i te pūwāhi tauritenga (*x*) [m]**
4.9	0.05
9.8	0.10
14.7	0.15
19.6	0.20
24.5	0.25
29.4	0.30

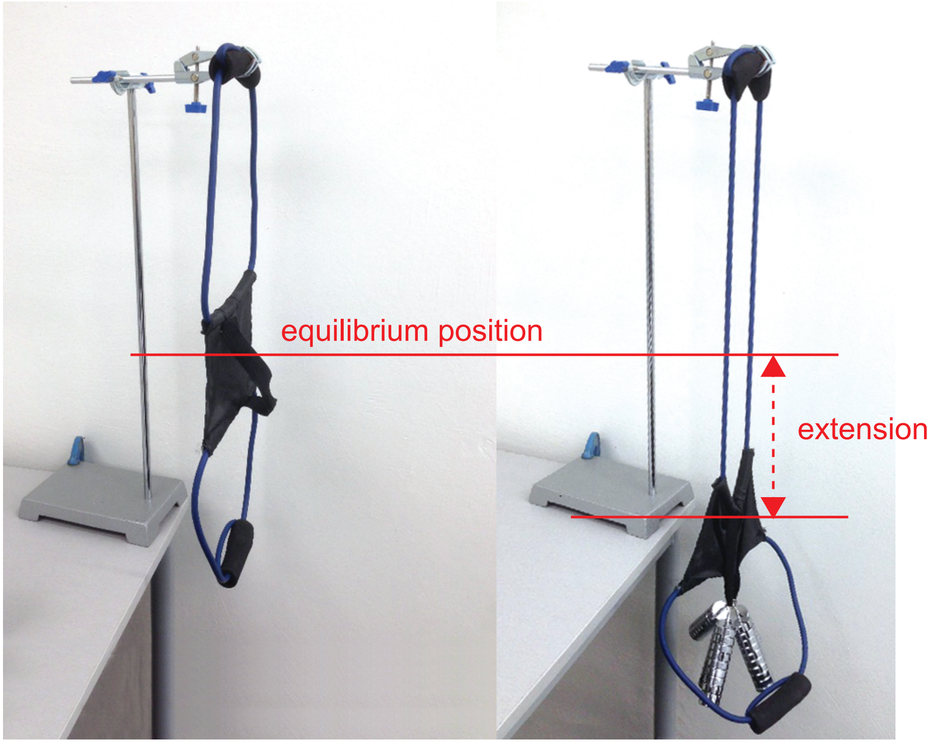
Tōpana ki te tautoronga o te whakarewa poihau



(a) Mā te whakamahi i ngā raraunga, te kauwhata i runga hoki / rānei, whakaaturia ko te pūmau pūniko (k) o tētahi taha o te rapa makoha he 98 N m^{-1}.

QUESTION ONE: THE WATER BALLOON LAUNCHER

A water balloon launcher is made from stretchy rubber that approximates a spring, as shown in the photos below.

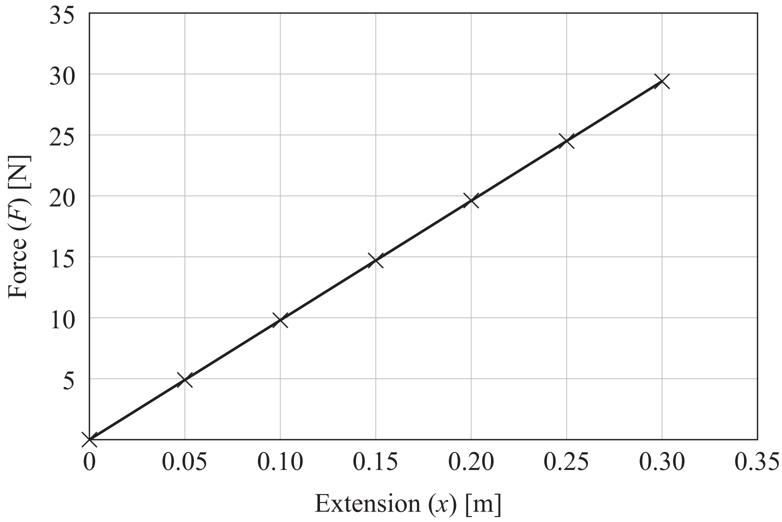


To determine the spring constant, Oliver, a Year 12 pupil, measured the distance that one side of the rubber extended, when various masses were attached to it.

Oliver's results are in displayed in the table and graph below.

Force (F) [N]	Extension from equilibrium position (x) [m]
4.9	0.05
9.8	0.10
14.7	0.15
19.6	0.20
24.5	0.25
29.4	0.30

Force vs extension for the balloon launcher

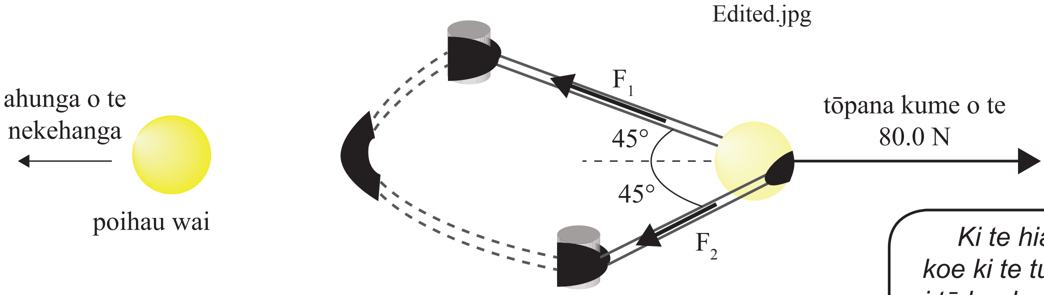


(a) Using the data and / or graph above, show that the spring constant (k) of one side of the stretchy rubber is 98 N m^{-1}.

MĀ TE KAIMĀKA ANAKE

(b) Kātahi ka honoa e Oliver ngā taha e rua o te whakarewa poihau wai, e whakaaturia ana i raro. I pupuri te whakarewa kia tū noa me te tōpana kume o te 80.0 N. E whakaaturia ana te hoahoa tōpana mea-tūtahi i raro.

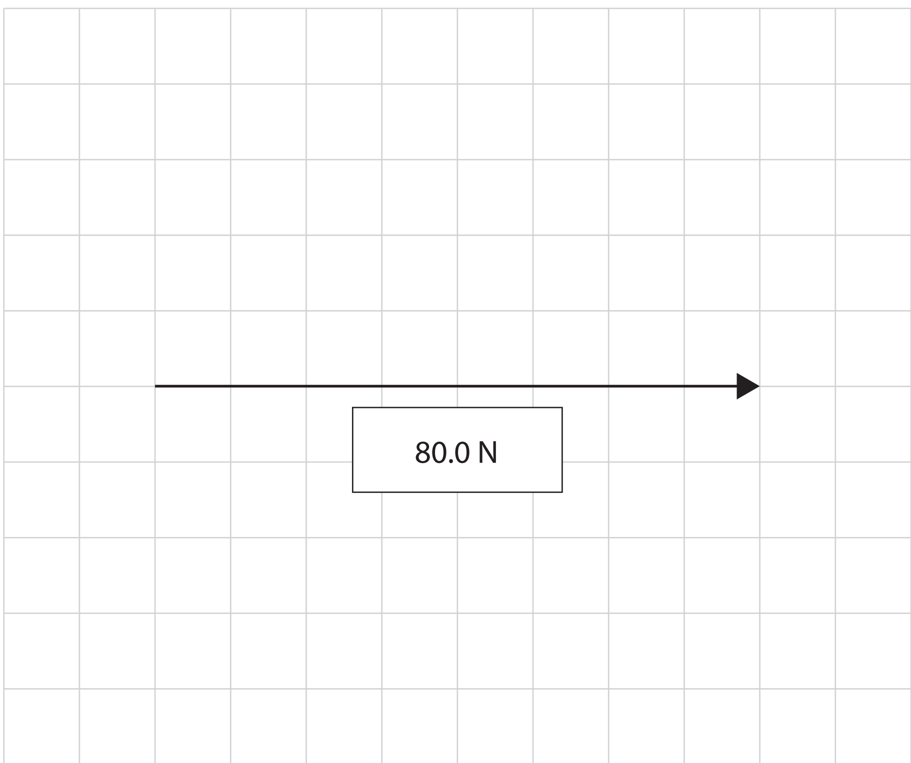
https://frugalfun4boys.com/wp-content/uploads/2016/07/Water-Balloon-Launcher-4-Edited.jpg



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

Tātuhia he hoahoa pere **ā-āwhata** whai tapanga, he mea kati, ki te tukutuku i raro.

Kua tātuhia kētia te pere tōpana huapae 80.0 N mōu.



Āwhata: 1 wehenga = 10 N

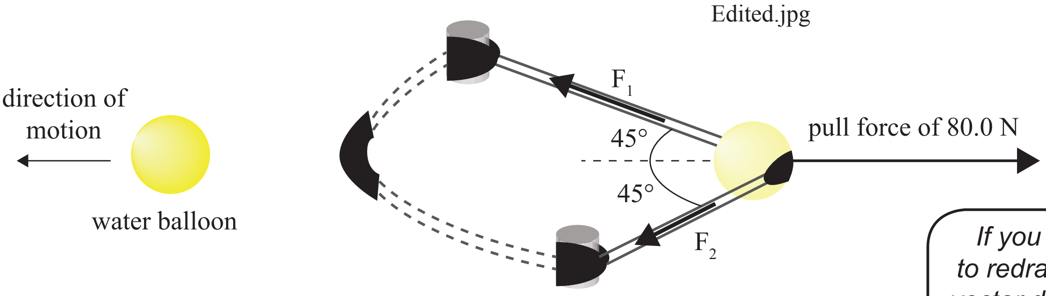
Mā te whakamahi i te tukutuku i runga, tētahi atu tikanga rānei, tātaitia te nunui o te tōpana F_1.

F_1 = ______________________________

ASSESSOR'S USE ONLY

(b) Oliver then connected both sides of the water balloon launcher as shown below. The launcher was held stationary with an 80.0 N pull force. The free body force diagram of the launcher is shown below.

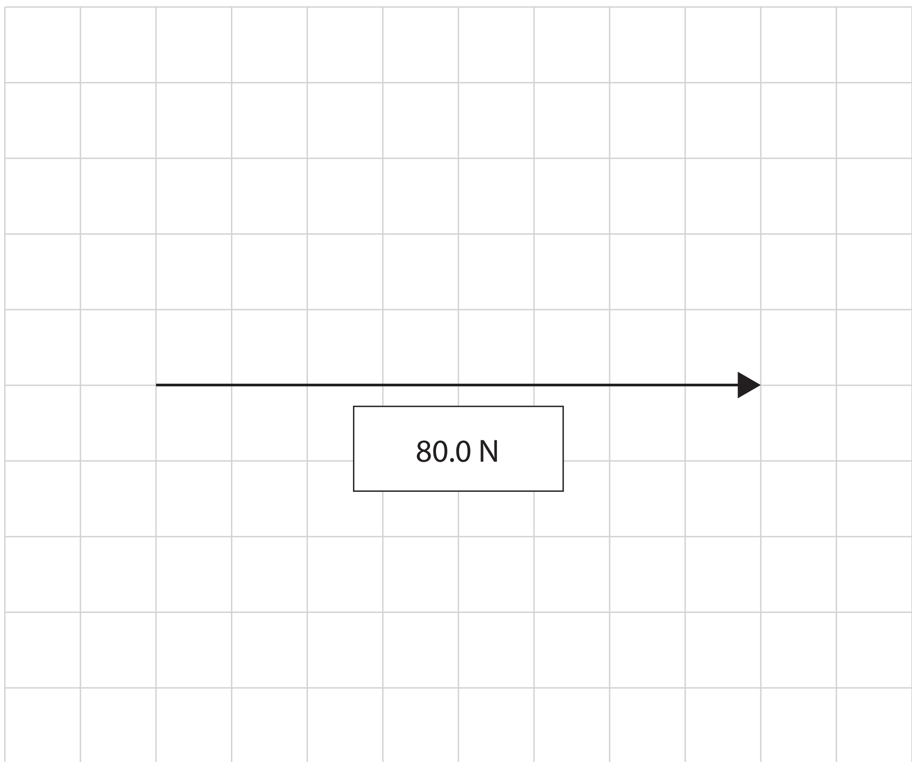
https://frugalfun4boys.com/wp-content/uploads/2016/07/Water-Balloon-Launcher-4-Edited.jpg



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

Draw a closed labelled **scale** vector diagram on the grid below.

The 80.0 N horizontal force vector has been drawn for you.



Scale: 1 division = 10 N

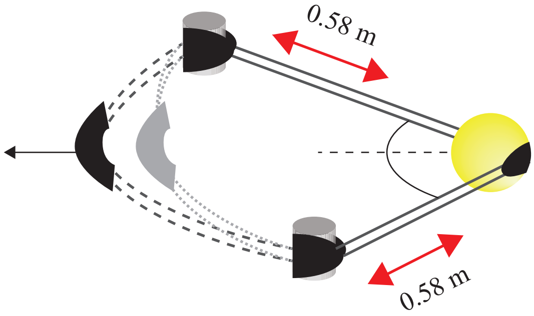
Using the above grid or another method, calculate the magnitude of force F_1.

F_1 = ______________________________

MĀ TE KAIMĀKA ANAKE

(c) Ka kumea whakamuritia mai te whakarewa poihau wai kia **tautoroa** ia rapa takirua mā te tawhiti o te 0.58 m.

Tātaitia te pūngao moe roroha **katoa** e putu ana i ngā taha e rua o te rapa makoha.



(d) (i) Mā te whakamahi i ngā mōhiohio kua tātai kētia i runga ake, me whakaahua me pēhea te tātai i te tere whakarewa o te poihau.

Kāore e hiahiatia ana he tātaitanga.

(ii) Whakaahuahia ngā hūringa e RUA ka taea hei whakapiki i te tere whakarewa o te poihau wai, me te tuhi i ngā whakapae.

Matapakitia te take ka eke aua huringa ki tērā e tūmanakohia ana.

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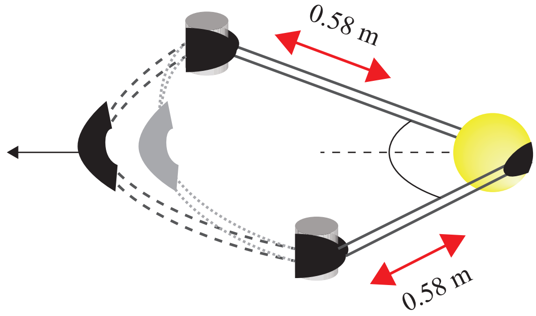
(c) The water balloon launcher is pulled back so each stretchy rubber pair is **extended** by a distance of 0.58 m.



Calculate the **total** elastic potential energy stored in the two sides of stretchy rubber.

(d) (i) Using the information already calculated above, describe how to calculate the launch speed of the balloon.

No calculations are required.

(ii) Describe TWO changes that could be made to increase the launch speed of the water balloon, stating any assumptions.

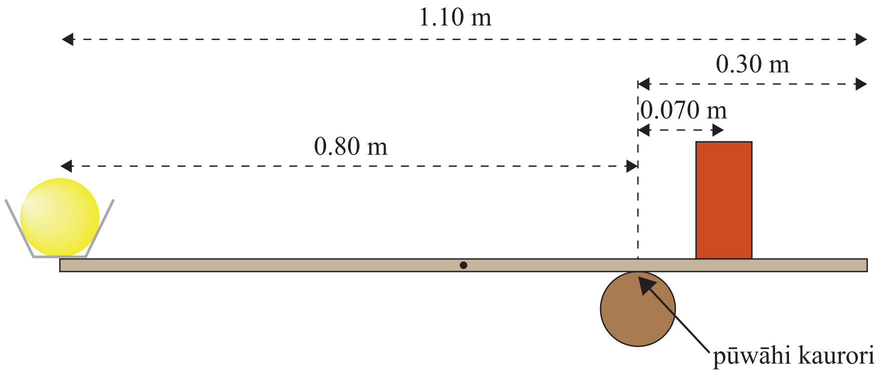
Discuss why these changes would give the desired effect.

MĀ TE KAIMĀKA ANAKE

TŪMAHI TUARUA: NGĀ WHAKAREWA REREKĒ

I hiahia anō te taina a Jimmy ki te whakarewa poihau wai. I mahia e ia he whakarewa mai i tētahi kurupae paparite 1.10 m te roa, ā, he 0.30 kg te papatipu. I raua e ia tana poihau wai ki tētahi kopa, ā, he 0.19 kg te papatipu tōpū i te taha mauī rawa o te kurupae, he 0.80 m mai i te pūwāhi kaurori. Kia tautika ai te whakarewa (āhua tauritenga), i tāpirihia e ia he pereki ki te taha matau o te pūwāhi kaurori.

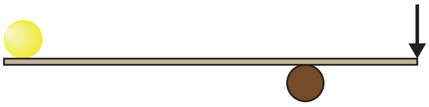
(a) Ki te hoahoa i raro, me tātuhi ka whakaingoa i ngā tōpana KATOA ka pā ki te kurupae.



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

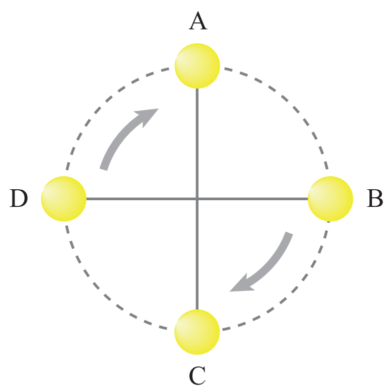
(b) Tātaihia te papatipu o te pereki kei te taha matau e hiahiatia ana kia tautika ai te kurupae.

(c) Kātahi ka whakarewahia e Jimmy tana poihau mā te peke atu ki runga i te taha matau o te kurupae. He 0.140 hēkona te roa hei whakarewa i tētahi poihau wai 0.180 kg. Ko te tōpana toharite ka pā ki te poihau he 20.0 N.



Mā te whakaatu ko te huringa torohaki (tupana) o te poihau he 2.8 kg m s^{-1}, tātaihia te tere o te poihau i te wā tonu e wehe ana i te whakarewa.

(d) I tētahi wā i muri mai, i whakamātau a Oliver ki te whakarewa i tētahi poihau wai mā te hono ki tētahi aho me te kōpiupiu haere huri noa i tōna māhunga kia porotiti whakatehuapae i tētahi tere pūmau, ā, ka tuku.



Jimmy

(i) Ko hea te wāhi me tuku a Oliver i te aho, kia torotika ai te rere o te poihau ki te taha matau?

(ii) Kei te hiahia a Jimmy, kei te taha matau o te porowhita e tū ana, ki te hopu i te poihau wai e tere ana te rere me te kore e pakaru.

Whakamāramahia mai, mā ngā mātāpono ahupūngao, he aha i kumea whakamuritia mai ai e Jimmy tōna ringa i a ia e hopu ana i te poihau wai.

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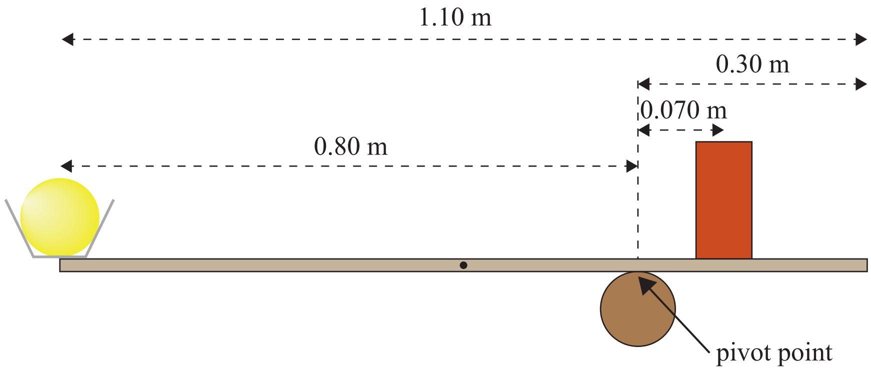
QUESTION TWO: ALTERNATIVE LAUNCHERS

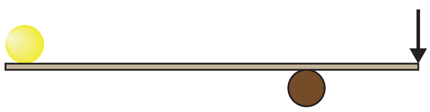
Oliver's brother Jimmy also wanted to launch water balloons. He made a launcher using a uniform 1.10 m long wooden beam that has a mass of 0.30 kg. He placed his water balloon in a holder that had a combined mass of 0.19 kg on the far left-hand end of the beam, 0.80 m from the pivot point. To get the launcher level (state of equilibrium), he added a brick to the right-hand side of the pivot point.

(a) In the diagram below, draw and label ALL forces acting on the wooden beam.



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

(b) Calculate the mass of the brick on the right side required for the beam to be level.

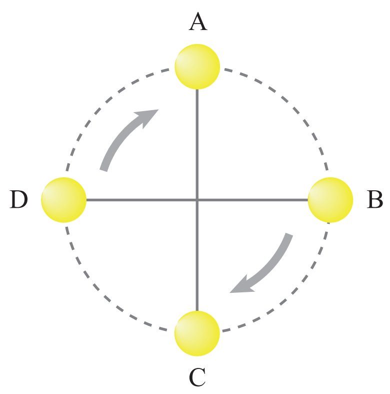


(c) Jimmy decides to launch his balloon by jumping on the right hand end of the wooden beam. It takes a time of 0.140 s to launch a 0.180 kg water balloon. The average force the balloon experiences is 20.0 N.

By first showing the change of momentum (impulse) of the balloon is 2.8 kg m s^{-1}, calculate the speed of the balloon the instant it leaves the launcher.

ASSESSOR'S USE ONLY

(d) At a later time, Oliver tried launching a water balloon by connecting it to a string and swinging it around his head in a horizontal circle at a constant speed, and releasing it.



Jimmy

(i) At which point would Oliver need to release the string, so that the balloon would travel directly to the right?

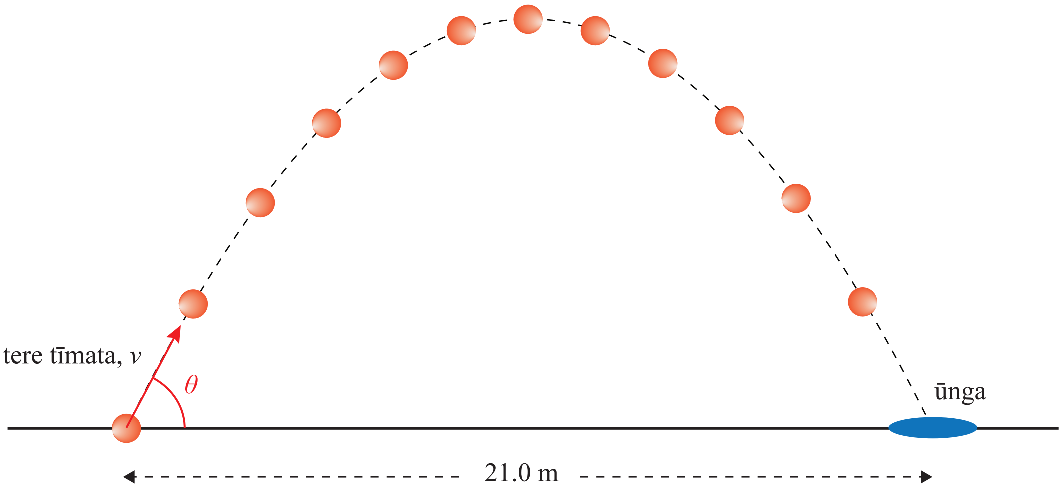
(ii) Jimmy, who is standing to the right of the circle, wants to catch the fast-moving water balloon without it bursting.

Explain, using physics principles, why Jimmy pulls his hand back in the process of catching the water balloon.

MĀ TE KAIMĀKA ANAKE

TŪMAHI TUATORU: NEKEHANGA TĪTERE

Ka whakarewahia he poihau wai, e rere whakatehuapae ana i te 21.0 m te tawhiti. He 2.80 s te roa o te poihau i te takiwā.



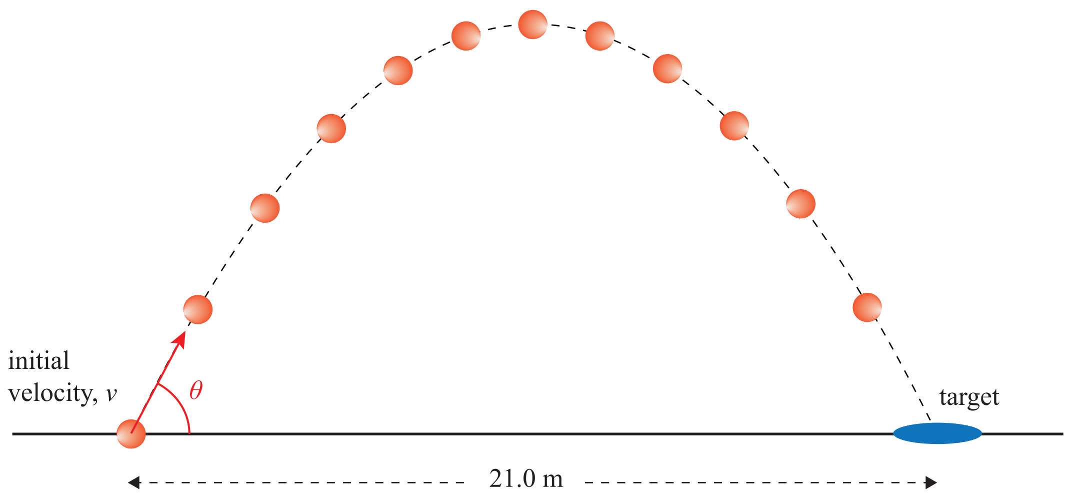
(a) Tātaitia te tere huapae o te poihau.

(b) Whakaaturia ko te tere tīmata o te poihau he 15.6 m s^{-1}.

ASSESSOR'S USE ONLY

QUESTION THREE: PROJECTILE MOTION

A water balloon is launched, travelling a horizontal distance of 21.0 m. The water balloon is in the air for 2.80 s.



(a) Calculate the horizontal velocity of the balloon.

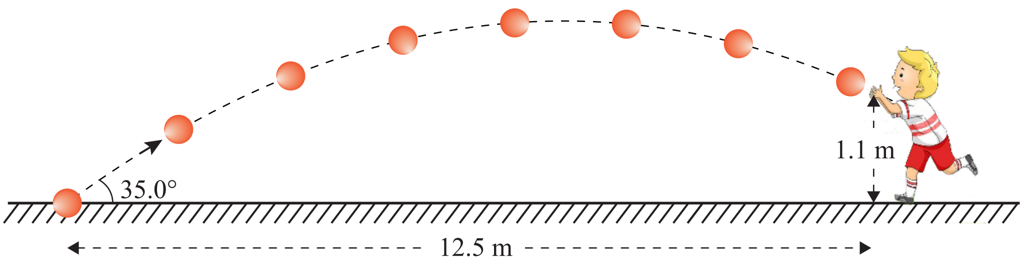
(b) Show that the initial velocity of the water balloon is 15.6 m s^{-1}.

MĀ TE KAIMĀKA ANAKE

(c) Mēnā i whakarewahia ko taua poihau wai anō ki te tere tīmata ōrite i te 'aorangi X' ko te whakaterenga nā te tō-ā-papa (g) he 3.7 m s^{-2}, ka rite anō te tawhiti huapae o te poihau wai?

Āta whakamāramatia tō tuhinga.

(d) Ki runga i a Papa, kei te hiahia a Jimmy ki te hopu i tētahi poihau wai. He 12.5 m te tawhiti o tana tū mai i te wāhi whakarewa, ā, he 1.1 m ōna ringa i runga ake i te whakarewa.



Ka whakarewatia te poihau wai ki tētahi koki o te 35.0° ki te huapae. Ko te wāhanga huapae o te tere he 10.0 m s^{-1}.

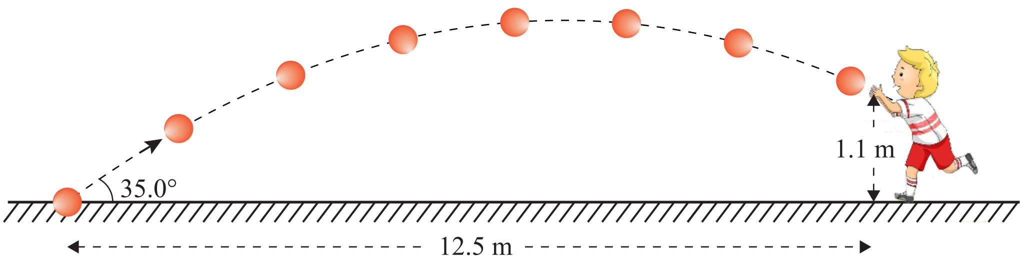
Mā te whakaatu i te tuatahi ko te wāhanga poutū o te tere he 7 m s^{-1}, whakatauhia mēnā ka tae atu te poihau wai ki te wāhi tika hei hopu mā Jimmy.

ASSESSOR'S USE ONLY

(c) If the same water balloon was launched at the same initial velocity on 'planet X' where the acceleration due to gravity (g) was 3.7 m s^{-2}, would the water balloon go the same horizontal distance?

Clearly explain your answer.

(d) Back on earth, Jimmy wants to catch a water balloon. He stands 12.5 m from the launch position, and his hands are 1.1 m above the top of the launcher.

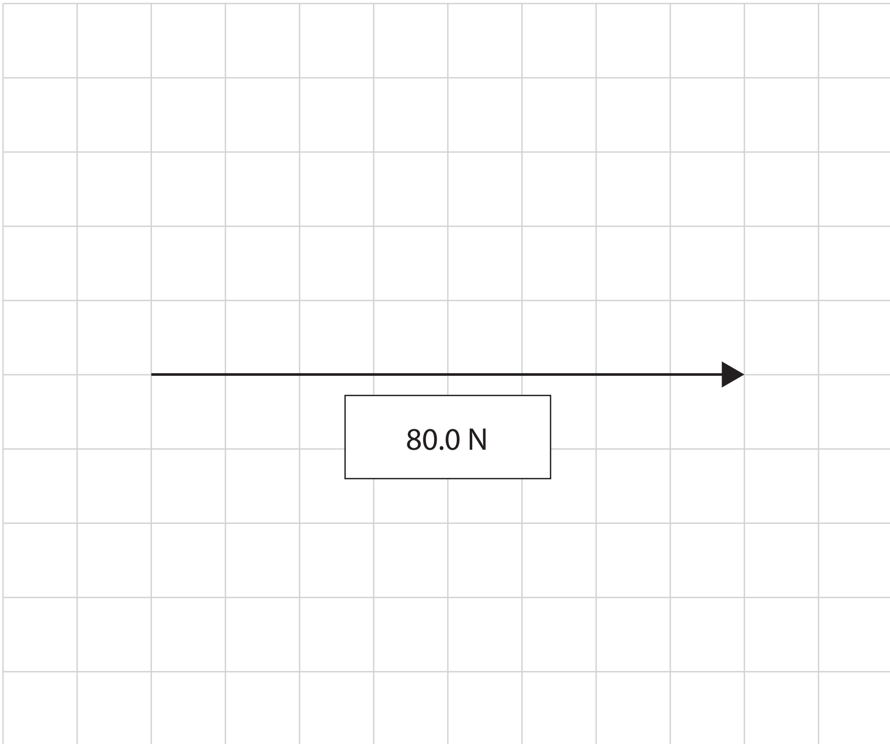


The water balloon is launched at an angle of 35.0° to the horizontal. The horizontal component of the velocity is 10.0 m s^{-1}.

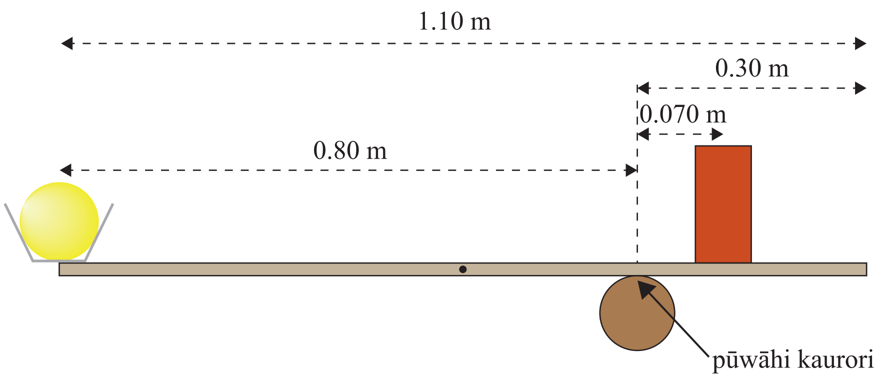
By first showing that the vertical component of the velocity is 7 m s^{-1}, determine if the water balloon will arrive at the right position for Jimmy to catch it.

HE HOAHOA TĀPIRI

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



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



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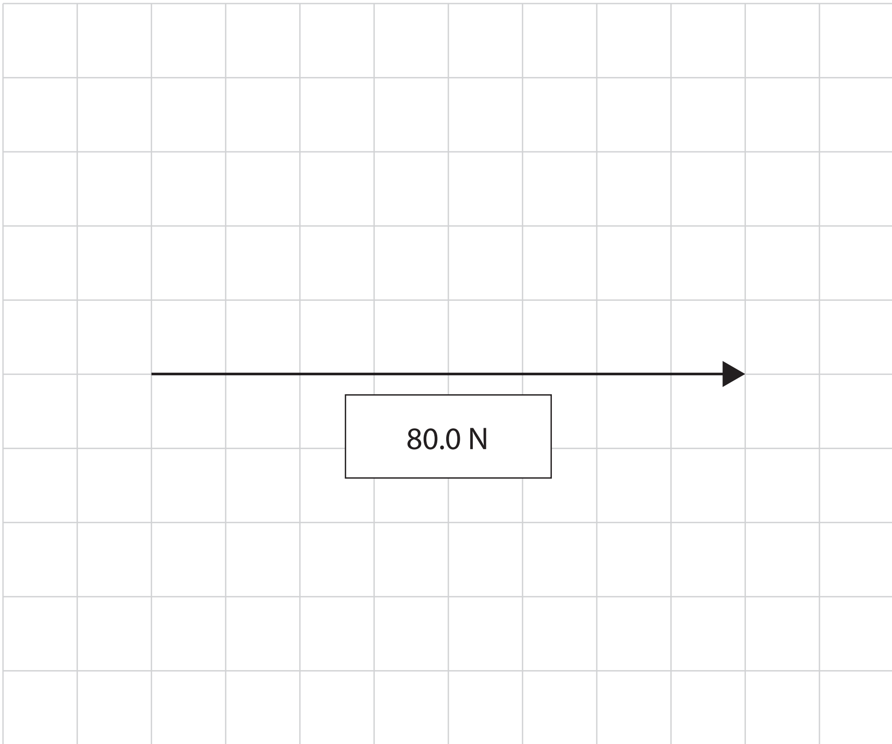
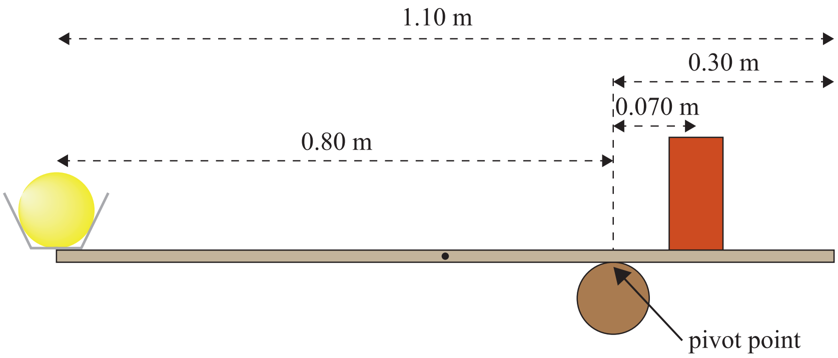
SPARE DIAGRAMS

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



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



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, 2018

91171 Demonstrate understanding of mechanics

9.30 a.m. Friday 9 November 2018
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–PHYSR.

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 – 19 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.