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91524M

915245

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

Ahupūngao, Kaupae 3, 2016

91524M Te whakaatu māramatanga ki ngā pūhanga manawa

2.00 i te ahiahi Rātū 15 Whiringa-ā-rangi 2016
Whiwhinga: Ono

Paetae	Kaiaka	Kairangi
Te whakaatu māramatanga ki ngā pūhanga manawa.	Te whakaatu māramatanga hōhonu ki ngā pūhanga manawa.	Te whakaatu māramatanga matawhānui ki ngā 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 Pukapuka Rauemi L3–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, ki ngā tau tika o ngā tau tāpua.

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

Tirohia mēnā e tika ana te raupapatanga o ngā whārangi 2–15 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

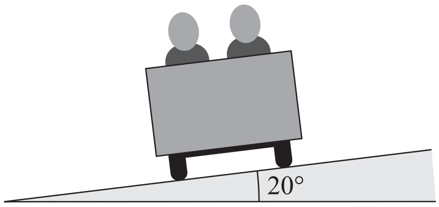
MĀ TE KAIMĀKA ANAKE

© Mana Tohu Mātauranga o Aotearoa, 2016. Pūmau te mana.
Kia kaua rawa he wāhi o tēnei tuhinga e whakahuatia ki te kore te whakaaetanga tuatahi a te Mana Tohu Mātauranga o Aotearoa.

MĀ TE KAIMĀKA ANAKE

TŪMAHI TUATAHI: NEKEHANGA POROHITA

Kei te eke a Alice i tētahi waka i tētahi pāka whakangahau. Ka haere te waka i tētahi ara porohitahita kei te tītaha, e ai ki te hoahoa i raro.



(a) Ki te hoahoa i runga, tātuhia ngā pere whai tapanga e whakaatu ana i ngā tōpana e rua e pā ana ki te waka.

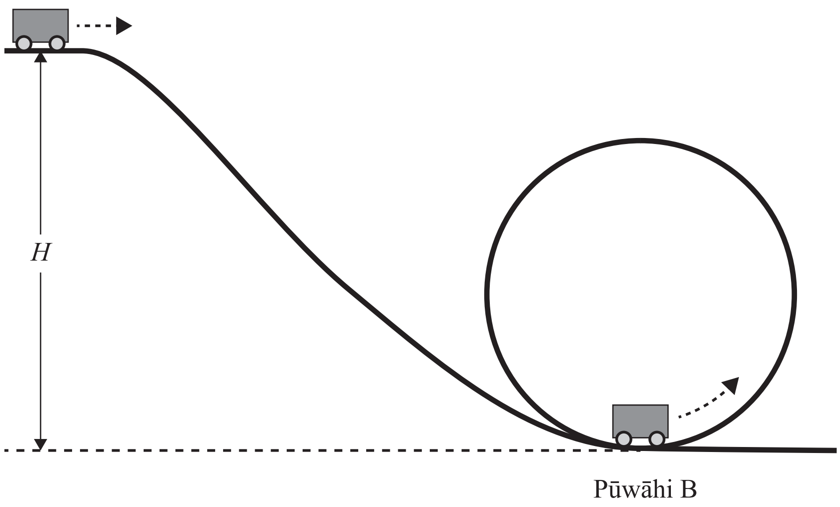
Ko te whakapae he kore noa iho te waku.

(b) Ko te papatipu o te waka me ngā pāhīhī he 9.60×10^2 kg. Ko te koki e tītaha ana te ara he 20°.

Whakamahia he hoahoa pere hei tātai i te rahi o te tōpana amio whakaroto e pā ana ki te waka.

Hoahoa pere:

E whakaatu ana te hoahoa i raro i tētahi wāhanga o tētahi ara rōnakinaki me te waka ki ngā pūwāhi e rua.



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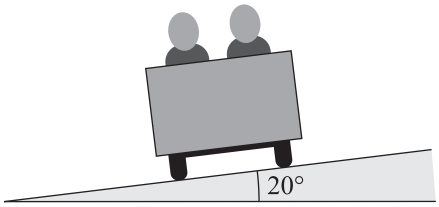
QUESTION ONE: CIRCULAR MOTION

Alice is in a car on a ride at a theme park. The car travels along a circular track that is banked, as shown in the diagram below.



(a) On the diagram above, draw labelled vectors showing the two forces acting on the car.

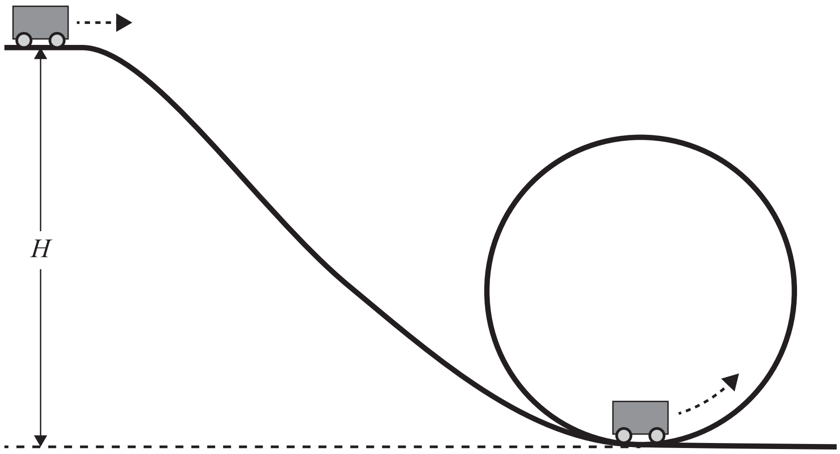
You may assume that friction is negligible.

(b) The mass of the car and passengers is 9.60×10^2 kg. The track is banked at an angle of 20°.

Use a vector diagram to calculate the size of the centripetal force on the car.

Vector diagram:

The following diagram shows part of a roller coaster track with the car at two positions.



(c) Whakatauritea te tōpana ka puta i te ara ki te waka ina tae atu te waka ki runga o te hiwi (Pūwāhi A), me te tōpanga ka puta i te ara ki te waka ina tae atu te waka ki raro o te hiwi, e uru atu ana ki te koropewa (Pūwāhi B).

Whakamāramatia tō tuhinga.

(d) I runga o te koropewa porohitahita ko te tōpana ka puta i te ara ki te waka he kore.

Mā te whakamahi i ngā whakaarohanga pūngao, tātaihia te teitei H, o te hiwi mēnā ko te pūtoro o te koropewa he 5.00 m.

Ko te whakapae he kore noa iho te waku.

(c) Compare the force that the track exerts on the car when the car is at the top of the hill (Position A), with the force that the track exerts on the car when the car is at the bottom of the hill, entering the loop (Position B).

Explain your answer.

(d) At the top of the circular loop the force that the track exerts on the car is zero.

Using energy considerations, calculate the height *H*, of the hill if the radius of the loop is 5.00 m.

You may assume that friction is negligible.

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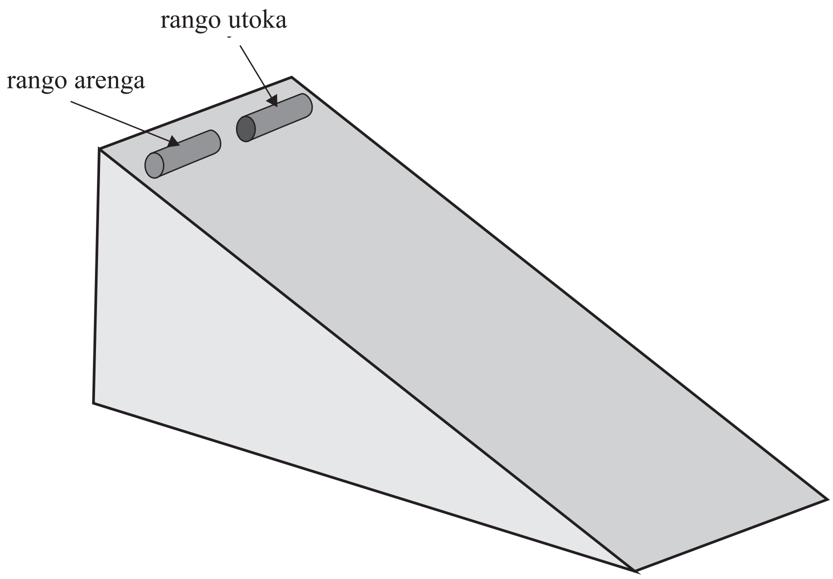
TŪMAHI TUARUA: NEKEHANGA HURIHURI

MĀ TE KAIMĀKA ANAKE

Ka rōrahia he rango utoka[1] me tētahi rango arenga[2] e ōrite ana te āhua me te papatipu ki raro i tētahi rōnaki.



(a) Tuhia ngā panoni pūngao ka puta i te wā e rōra haere ana ngā rango i te rōnaki.

Ko te whakapae he kore noa iho te pūngao wera me te oro ka puta.

(b) He 0.058 m te pūtoro o te rango arenga. Ka rōra haere i te rōnaki me te eke ki te tere o te 0.250 m s^{-1} i te taenga ki raro rawa.

Ko te tūpuku hurihuri o te rango arenga he 0.140 kg m^2.

Tātaihia te pūngao neke hurihuri o te rango arenga i raro i te rōnaki.

[1] totoka
[2] hākaro

QUESTION TWO: ROTATIONAL MOTION

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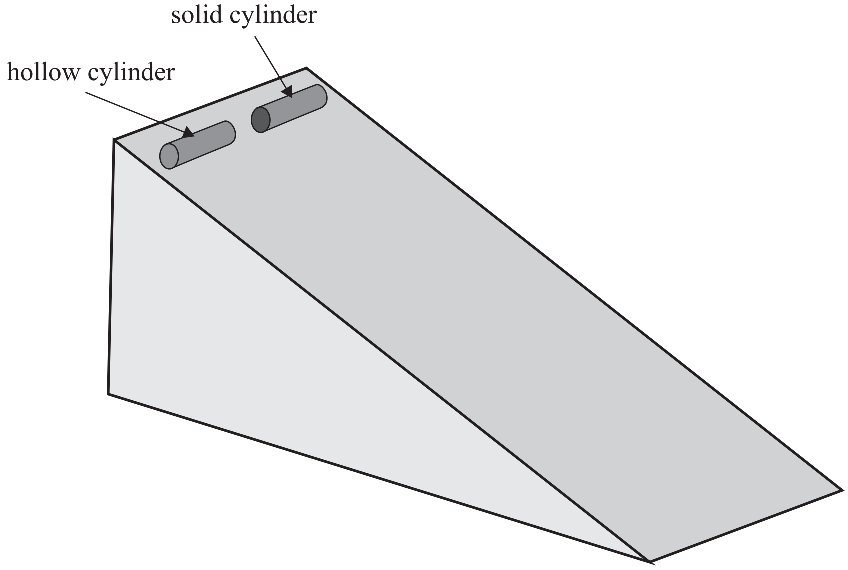
A solid cylinder and a hollow cylinder of the same shape and mass are rolled down a slope.



(a) State the energy changes that take place as the cylinders roll down the slope.

You may assume that there is negligible heat and sound energy produced.

(b) The hollow cylinder has a radius of 0.058 m. It rolls down the slope, and reaches a speed of 0.250 m s^{-1} at the bottom.

The rotational inertia of the hollow cylinder is 0.140 kg m^2.

Calculate the rotational kinetic energy of the hollow cylinder at the bottom of the slope.

MĀ TE KAIMĀKA ANAKE

(c) Ka tīmata te rango arenga mai i te okioki, ā, ko tana whakaterenga koki he 1.72 rad s^{-2}.

Tātaihia te roa i oti tana huringa katoa tuatahi.

(d) Ka tukuna ngā rango utoka, arenga hoki i te wā kotahi mai i runga o te rōnaki.

Whakamāramahia te take i tae tuatahi atu ko te rango utoka ki raro i te rōnaki.

(c) The hollow cylinder starts from rest and has an angular acceleration of 1.72 rad s^{-2}.

Calculate the time taken to complete the first full rotation.

(d) The solid and the hollow cylinders are both released at the same time from the top of the slope.

Explain why the solid cylinder reaches the bottom of the slope first.

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MĀ TE KAIMĀKA ANAKE

TŪMAHI TUATORU: NEKEHANGA HAWARITE MĀMĀ

Ka tāwēwē tētahi pī rorohū mai i tētahi pūniko e tārere mai ana i te tuanui o te taiwhanga. Ka kumea e Tom te pī kia 10.0 cm ki raro i te tauritenga kātahi ka tukuna e ia. Ka neke te pī ki ngā nekehanga hawarite māmā.

(a) Tuhia ngā āhuatanga e rua e hiahiatia ana mō te nekehanga hawarite māmā.

(b) Ko te wā kōpiupiutanga o te pī rorohū he 1.57 s.

Tātaihia te whakaterenga o te pī i te wā $t = 0.25$ s i muri i te tukutanga a Tom i te pī mai i te pūwāhi o raro rawa.

(c) Ka peia e Tom te pī rorohū mā tētahi tōpana iti i ngā wā auau (ia wā, ia wā), nāwai rā kei te piki me te heke tana nekehanga me tētahi teitei ngaru nui anō.

Tuhia te ingoa o tēnei tītohunga.

Whakamāramahia mai i pēhea te puta kia nui te teitei ngaru mai i te nekehanga o te pī rorohū.

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QUESTION THREE: SIMPLE HARMONIC MOTION

A toy bumble bee hangs on a spring suspended from the ceiling in the laboratory. Tom pulls the bumble bee down 10.0 cm below equilibrium and releases it. The bumble bee moves in simple harmonic motion.

(a) State the two conditions necessary for simple harmonic motion.

(b) The bumble bee's oscillation has a period of 1.57 s.

Calculate the bumble bee's acceleration at time $t = 0.25$ s after Tom releases the bumble bee from the lowest point.

(c) Tom pushes the toy bumble bee with a very small force at regular intervals of time (periodically), so that eventually it is moving up and down with a very large amplitude.

State the name of this phenomenon.

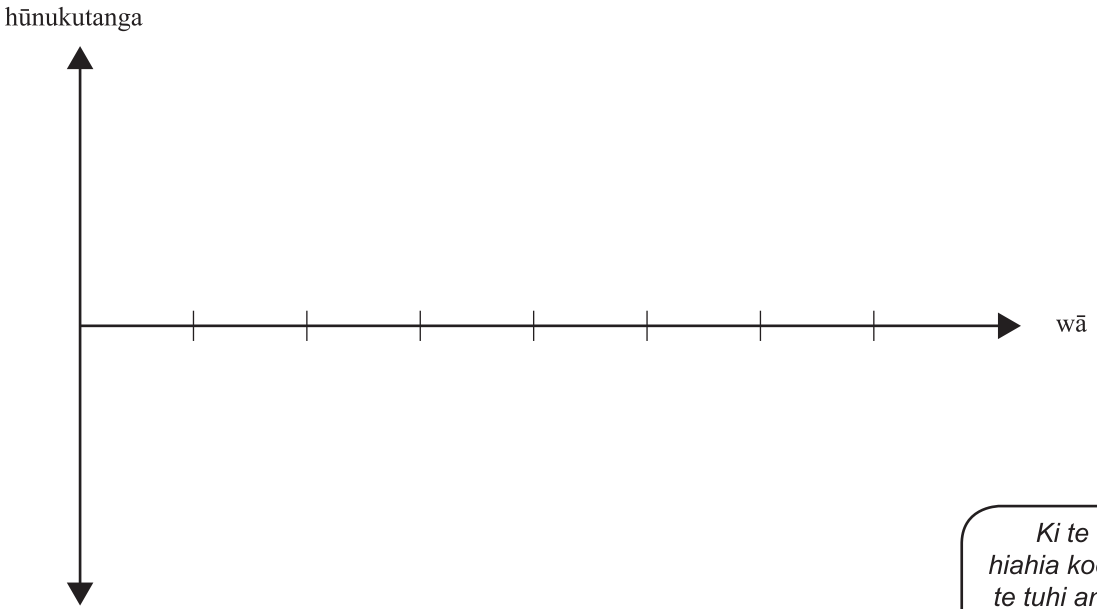
Explain how the bumble bee's motion develops a very large amplitude.

MĀ TE KAIMĀKA ANAKE

(d) Ka mutu te pei a Tom i te pī rorohū i te wā e 20 cm te hūnukutanga.

Mā te whakamahi i ngā tuaka i raro, tātuhia he kauwhata o te hūnukutanga ki te wā mō ngā kōpiupiutanga tūturu e toru, e tīmata mai ana i te $y = +20$ cm.

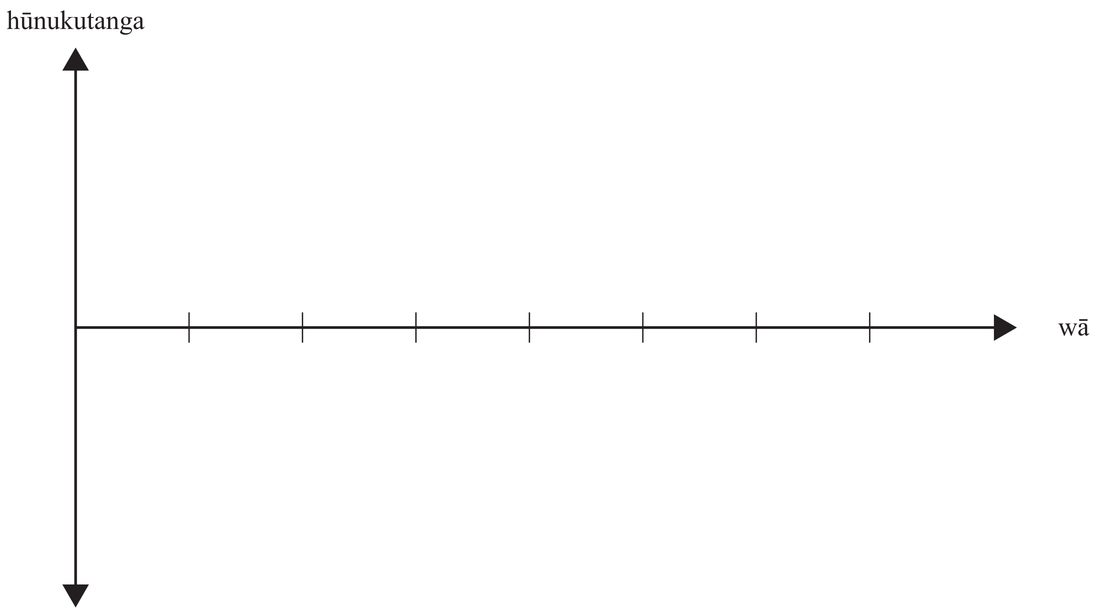
Whakaurua ngā uara tōtika ki ngā tuaka e rua.



Ki te hiahia koe ki te tuhi anō i tō kauwhata, whakamahia te hoahoa i raro nei.

HOAHOA WĀTEA

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



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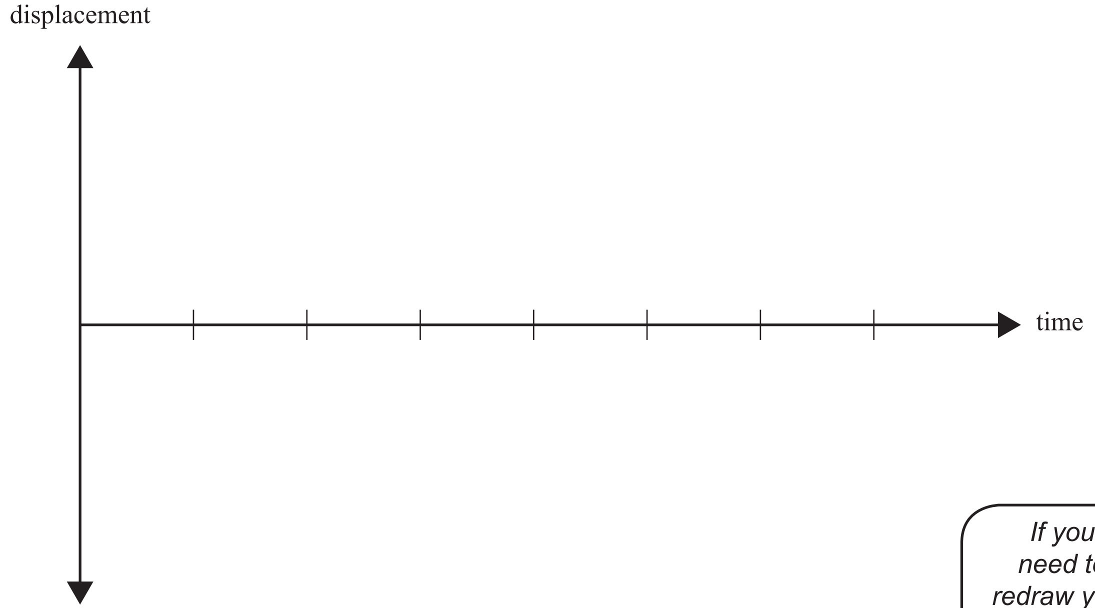
(d) Tom stops pushing the bumble bee when its displacement is 20 cm.

Using the axes given below, draw a graph of displacement against time for three complete oscillations, starting from $y = +20$ cm.

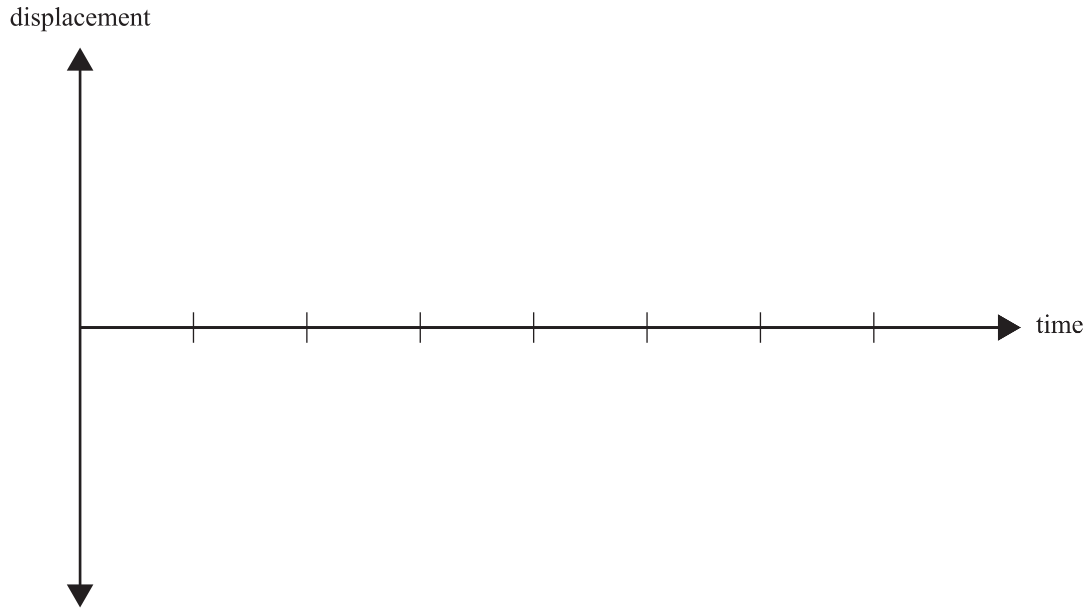
Include appropriate values on both axes.



If you need to redraw your response, use the diagram below.

SPARE DIAGRAM

If you need to redraw your response to Question Three (d), 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

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 3 Physics, 2016

91524 Demonstrate understanding of mechanical systems

2.00 p.m. Tuesday 15 November 2016
Credits: Six

91524M

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

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 Booklet L3–PHYSMR.

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

Numerical answers should be given with an SI unit, to an appropriate number of significant figures.

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 – 15 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.