See back cover for an English translation of this cover

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91524M

915245

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NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

Ahupūngao, Kaupae 3, 2014

91524M Te whakaatu māramatanga ki ngā pūnaha pūkahakaha

2.00 i te ahiahi Rātū 25 Whiringa-ā-rangi 2014
Whiwhinga: Ono

Paetae	Kaiaka	Kairangi
Te whakaatu māramatanga ki ngā pūnaha pūkahakaha.	Te whakaatu māramatanga hōhonu ki ngā pūnaha pūkahakaha.	Te whakaatu māramatanga matawhānui ki ngā pūnaha pūkahakaha.

Tirohia mehemea e ōrite ana te Tau Ākonga ā-Motu (NSN) kei tō pepa whakauru ki te tau kei runga ake nei.

Me whakautu e koe ngā pātai KATOA kei roto i te pukapuka nei.

Tirohia mēnā kei a koe te Rau Rauemi L3–PHYSMR.

Ki roto i ō whakautu, whakamahia ngā whiriwhiringa tohutau mārama, ngā kupu, ngā hoahoa hoki / rānei ki hea hiahiatia ai.

Me hōmai te whakautu me tētahi waeine o te Pūnaha Waeine ā-Ao (SI) ki ngā tau tika o ngā tau tāpua.

Ki te hiahia koe ki ētahi atu wāhi hei tuhituhi whakautu, whakamahia ngā whārangi kei muri i te pukapuka nei.

Tirohia mehemea kei roto nei ngā whārangi 2–15 e raupapa tika ana, ā, kāore hoki he whārangi wātea.

HOATU TE PUKAPUKA NEI KI TE KAIWHAKAHAERE HEI TE MUTUNGA O TE WHAKAMĀTAUTAU.

TAPEKE

MĀ TE KAIMĀKA ANAKE

MĀ TE KAIMĀKA ANAKE

PĀTAI TUATAHI: NEKEHANGA HURIHURI

Ko te uara pūmau tō ā-papa tukupū = 6.67×10^{-11} N m^2 kg^{-2}

(a) Ko te pūtoro o te Rā he 6.96×10^8 m. Ka hurihuri te weheruatanga o te Rā ki te pāpātanga o te 14.7 putu i te rā.

(i) Whakaaturia ko te wā hurihuringa o tētahi korakora kei te weheruatanga o te Rā he 2.12×10^6 s.

(ii) Tātaihia te tere rārangi o tētahi korakora kei te weheruatanga o te Rā.

(b) Ka heke haere pea te iho pū hurihuri o te Rā ki tētahi pūtoro iti ake nā te tō ā-papa.

Whakamāramahia he pēhea te pānga o tēnei ki te tere koki o te iho pū.

QUESTION ONE: ROTATIONAL MOTION

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Universal gravitational constant = 6.67×10^{-11} N m^2 kg^{-2}

(a) The radius of the Sun is 6.96×10^8 m. The equator of the Sun rotates at a rate of 14.7 degrees per day.

(i) Show that the period of rotation of a particle located on the equator of the Sun is 2.12×10^6 s.

(ii) Calculate the linear speed of a particle at the Sun's equator.

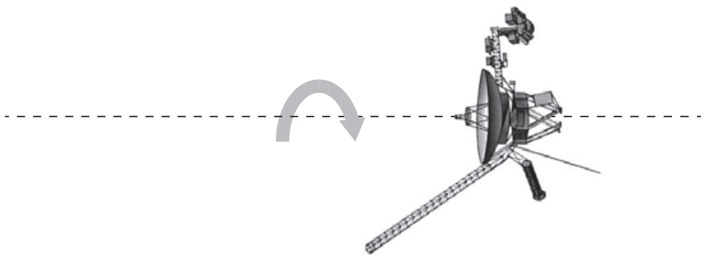
(b) Gravity may cause the rotating inner core of the Sun to collapse down to a much smaller radius.

Explain how this will affect the angular speed of the inner core.

(c) Ko te papatipu o Apārangi he 3.30×10^{23} kg. Ko te wā hurihuri o Apārangi he 5.067×10^{6} s.

Whakaaturia mai me noho tētahi amiorangi ki te 2.43×10^{8} m mai i te pokapū o Apārangi kia noho whakapahoho mai i te tirohanga atu o tētahi kaimātaki i taua aorangi.

(d) Ka hurihuri tētahi pōkai ātea i tētahi tuaka, e ai ki te hoahoa i raro.



Ka makere mai tētahi utauta mai i te pōkai ātea.

Whakamāramahia te take kāore he pānga o te ngaronga o tēnei papatipu ki te tere koki o te pōkai ātea.

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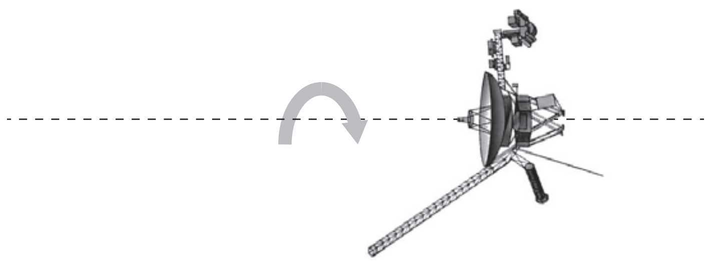
(c) The mass of Mercury is 3.30×10^{23} kg. Mercury has a period of rotation of 5.067×10^{6} s.

Show that a satellite needs to be positioned 2.43×10^{8} m from the centre of Mercury so that it remains stationary from the point-of-view of an observer on that planet.

(d) A space probe spins around an axis, as shown below.



An instrument comes loose from the space probe.

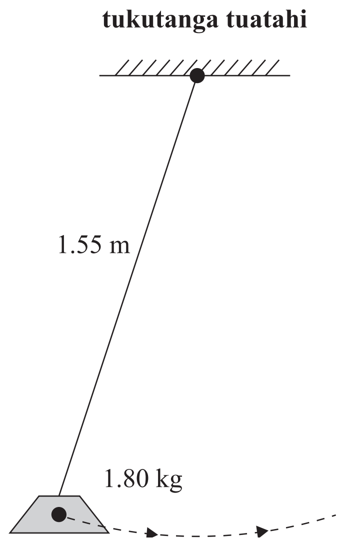
Explain why this loss of mass will have no effect on the angular speed of the space probe.

MĀ TE KAIMĀKA ANAKE

PĀTAI TUARUA: TE TAUTAU

Ko te whakaterenga nā te tō ā-papa o Papatūānuku = 9.81 m s^{-2}.

Ka whakatūhia tētahi tautau, e ai ki te hoahoa i raro. Ko te roa o te taura ki te taumaha he 1.55 m. Ko te papatipu o te taumaha he 1.80 kg.



(a) Tātaihia te wā e tārere ana te taumaha o te tautau mai i tētahi taha ki tētahi.

(b) Whakamāramahia he pēhea te whakarerekē nā ngā tōpana kei te pā ki te taumaha i te tere o te taumaha i te wā ka rere mai i te pūwāhi i tukuna ki te pokapū.

QUESTION TWO: THE PENDULUM

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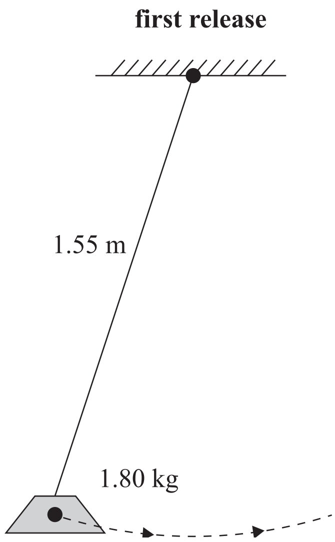
Acceleration due to gravity of Earth = 9.81 m s^{-2}.

A pendulum is set up, as shown in the diagram. The length of the cord attached to the bob is 1.55 m. The bob has a mass of 1.80 kg.

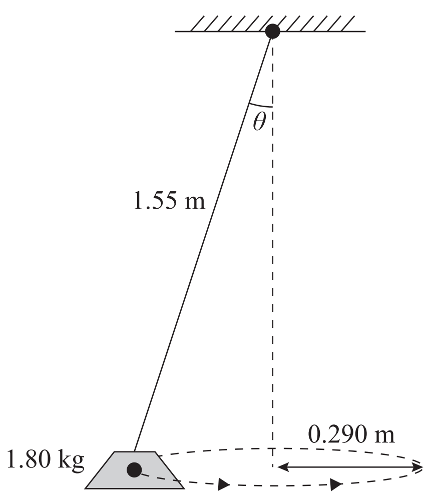


(a) Calculate the time it takes for the pendulum bob to swing from one side to the other.

(b) Explain how the forces acting on the bob change the bob's speed as it travels from the point of release to the centre.

MĀ TE KAIMĀKA ANAKE

(c) Ka tukuna anō te taumaha kia tārere ki tētahi ara porohitahita huapae, me te pūtoro o te 0.290 m, hei tautau koeke.



(i) Mā te tātai i te rahinga o te koki ka puta i te taura ki te poutū, me whakaatu ko te tōpana renarena kei roto i te taura he 18.0 N.

(ii) Tātaihia te tere kua tukuna ki te papatipu i te tukutanga, kia taea ai tētahi ara porohitahita huapae i te pūtoro o te 0.290 m.

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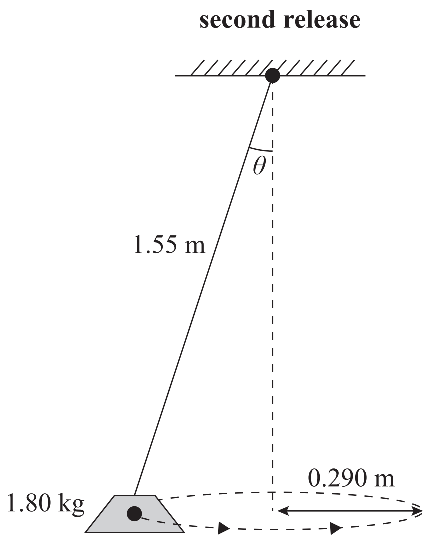
(c) The bob is released again in such a way that it swings in a horizontal circular path, with radius 0.290 m, as a conical pendulum.



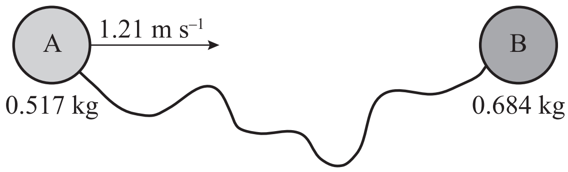
(i) By first calculating the size of the angle that the cord makes with the vertical, show that the tension force in the cord is 18.0 N.

(ii) Calculate the speed that the mass must have been given when released, in order to attain a horizontal circular path at a radius of 0.290 m.

MĀ TE KAIMĀKA ANAKE

PĀTAI TUATORU: NEKEHANGA WHAKAWHITINGA

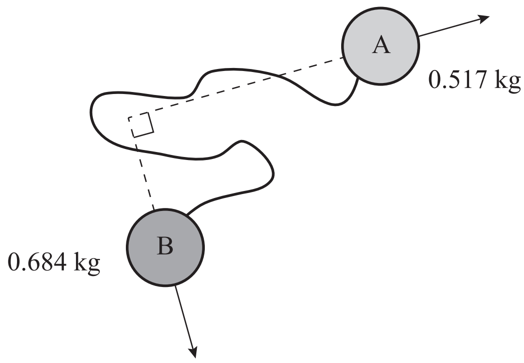
E rua ngā porotiti o tētahi pūnaha, A me B, e herea tētahi ki tētahi mā tētahi taura māmā. Ka reti haere ngā porotiti i tētahi mata wakukore. Ko te papatipu o te porotiti A he 0.517 kg, ā, ko te papatipu o te porotiti B he 0.684 kg. Kei te noho noa a porotiti B, ā, kei te neke atu te porotiti A ki te porotiti B me te tere o te 1.21 m s^{-1}.



(a) Me whakaatu ko te tere o te pokapū o te papatipu o te pūnaha he 0.521 m s^{-1}.

Whakaaturia ō mahinga katoa.

(b) Ka tuki ngā porotiti, ā, i muri i te tukinga kei te neke kia koki hāngai tētahi ki tētahi. Ka whiwhi te porotiti A i tētahi tōpana whakahāngai o te 0.250 N s.



(i) Me whakaatu ko te tere o te porotiti B whai muri i te tukinga he 0.365 m s^{-1}.

Whakamāramahia ō whakaaro whaitake.

(ii) Whakatauhia te rahinga o te torohaki o te porotiti A whai muri i te tukinga.

(c) Ka reti haere tonu ngā porotiti kia tino totoro te taura. Ina pēnei, ka huri te tere me te ahunga o ngā porotiti e rua.

Mā te whai whakaaro ki te/ngā tōpana ka pā ki ngā porotiti, whakamāramahia te take me pūmau rawa te torohaki o te pūnaha.

MĀ TE KAIMĀKA ANAKE

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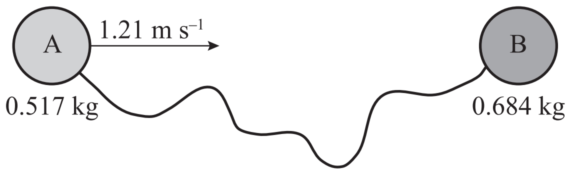
QUESTION THREE: TRANSLATIONAL MOTION

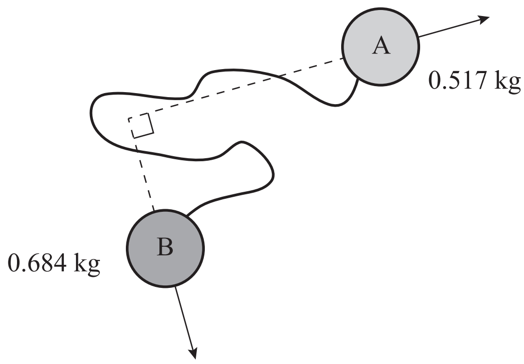
A system consists of two discs, A and B, attached together with a light cord. The discs slide across a frictionless surface. Disc A has mass 0.517 kg and disc B has mass 0.684 kg. Disc B is stationary, and disc A is moving towards disc B with a speed of 1.21 m s^{-1}.



(a) Show that the speed of the centre of mass of the system is 0.521 m s^{-1}.

Show all your working.

(b) The discs collide and after the collision they are moving at right angles to each other. Disc A receives an impulse of 0.250 N s.



(i) Show that the speed of disc B after the collision is 0.365 m s^{-1}.

Explain your reasoning.

(ii) Determine the size of the momentum of disc A after the collision.

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(c) The discs continue to slide until the cord is fully extended. When this happens, both discs change their speed and direction.

By considering the force(s) that act on the discs, explain why the momentum of the system must be conserved.

He puka anō mēnā ka hiahiatia.
Tuhia te (ngā) tāu pātai mēnā e hāngai ana.

TAU PĀTAI

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

91524M

Level 3 Physics, 2014

91524 Demonstrate understanding of mechanical systems

2.00 pm Tuesday 25 November 2014
Credits: Six

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.