3

91524M

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NZQA
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 he tuhituhi i roto i tēnei pukapuka

Ahupūngao, Kaupae 3, 2020

91524M Te whakaatu māramatanga ki ngā pūhanga manawa

2.00 i te ahiahi Rāapa 2 Hakihea 2020
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 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 te wāhi wātea kei muri i te pukapuka nei.

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

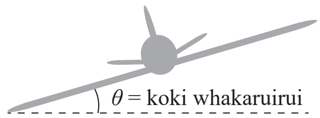
MĀ TE KAIMĀKA ANAKE

TŪMAHI TUATAHI: TE WAKA RERERANGI O TAMA

Hautū ai a Tama i tētahi Boeing 737-800, he waka rererangi rahinga toharite tēnei me te papatipu rere atu o te 7.50×10^4 kg. I ētahi wā ka rere huapae ia i te rārangi torotika, ā, i ētahi wā ka whai ia i te ara porowhita kia whakaruirui ai te waka rererangi i te koki ki te huapae.

E whakaatu ana ngā hoahoa i raro i ēnei āhuatanga e rua.

(a) Tātuhia te tōpana ki te waka rererangi nā te tō-ā-papa me te tōpana hiki e pā ana ki ngā āhuatanga e rua kei raro nei.



Ki te hiahia koe ki te tātuhi anō i tō urupare, whakamahia te hoahoa i te whārangi 12.

(b) Whakatauritea te rahinga o te tōpana nā te tō-ā-papa me te tōpana hiki e pā ana ki te waka rererangi, ina rere huapae ki te rārangi torotika, ina whai anō hoki i te ara porowhita huapae kia whakaruirui ai i te koki.

Homai ngā take he aha i ōrite ai, i rerekē ai rānei i ia āhuatanga.

Hei aha ngā whiriwhiringa tohutau.

(c) I tētahi wā ka hautū a Tama i te waka rererangi he 7.50×10^4 kg te papatipu ki te ara porowhita, me te tere o te 54.0 m s^{-1}, ka whakaruirui ki te koki o te $35.0°$ ki te huapae.

Tātaihia te pūtoro o te porowhita ka whakaahuatia e te waka rererangi.

Whakamāramahia mai ō mahinga mā te tātai i te pūtoro o te ara porowhita e whakaahuatia ana e te waka rererangi.

Mā te hoahoa pea tō whakamāramatanga e āwhina.

MĀ TE KAIMĀKA ANAKE

(d) Kātahi ka hautū a Tama i tōna waka rererangi ki te 1.28×10^4 m te teitei i runga ake o te mata o Papatūānuku.

Tātaihia te kaha o te whaitua tō ā-papa i te teitei e hautū ai i a Tama te waka rererangi.

Papatipu o Papatūānuku	$= 5.98 \times 10^{24}$ kg
Pūtoro o Papatūānuku	$= 6.37 \times 10^6$ m

QUESTION ONE: TOM'S PLANE

ASSESSOR'S USE ONLY

Tom flies a Boeing 737-800, which is an averaged-sized plane with a take-off mass of 7.50×10^4 kg. There are times when he flies it horizontally in a straight line, and there are times when he has to take a circular path such that the plane is banked at an angle to the horizontal.

The diagrams below represent these two situations.

(a) Draw the force due to gravity and the lift force on the plane in the two situations below.

If you need to redraw your response, use the diagram on page 13.

(b) Compare the size of the force due to gravity and lift force on the plane when Tom flies it horizontally in a straight line, and when he flies it in a horizontal circle banked at an angle.

Give reasons why they are similar or different in each situation.

Numerical working is not necessary.

(c) On one occasion Tom flies the plane of mass 7.50×10^4 kg in a circular path, with a speed of 54.0 m s^{-1}, banked at an angle of 35.0° to the horizontal.

Calculate the radius of the circle that the plane describes.

Explain your working for calculating the radius of the circular path the plane describes.

A diagram may assist your explanation.

ASSESSOR'S USE ONLY

(d) Tom then flies his plane at a height of 1.28×10^4 m above the surface of the Earth.

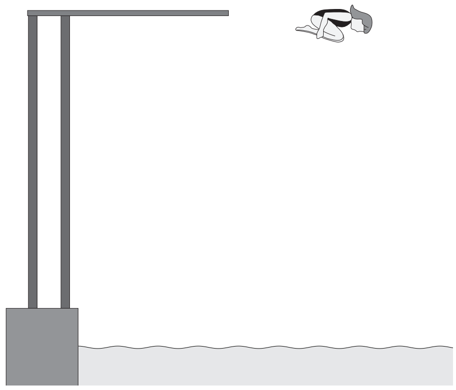
Calculate the gravitational field strength at the height Tom flies the plane.

Mass of Earth $= 5.98 \times 10^{24}$ kg

Radius of Earth $= 6.37 \times 10^6$ m

MĀ TE KAIMĀKA ANAKE

TŪMAHI TUARUA: NGĀ PŌTĒTEKE INA RUKU ANA

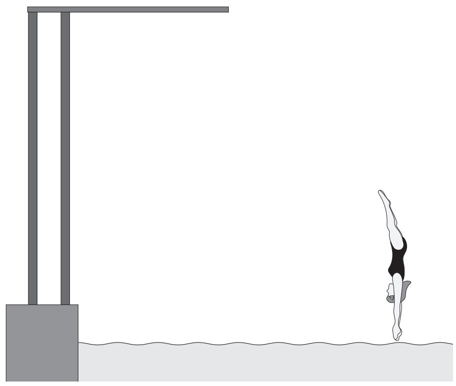


Ka ruku a Sandra mai i tētahi papa ruku he 10.0 m te teitei. Ka kite ia ka taea ngā pōtēteke (takahurihuri) mā te whakapēpeke i tōna tinana. I a ia e whakapēpeke ana, ka taea tōna tinana te whakatauira hei poi rite o te papatipu o te 60.0 kg me te pūtoro o te 0.200 m.

Ka tohua te tūpuku huri o tētahi poi rite mā te $I = \frac{2}{5}mr^2$.

(a) I a ia e whakapēpeke ana, ka ruku (takahuri) ki te tere koki pūmau o te 9.56 rads^{-1}.

Me whakaatu ko tōna torohaki ā-koki he 9.18 kg m^2 s^{-1}.



(b) I mua tonu i tana kuhunga ki te wai, ka whakatorotikahia e ia tōna tinana, kia huri ai tōna tūpuku huri.

Whakamāramahia mai he aha ngā pānga o tēnei ki tōna nekehanga whakahuri.

Me kōrero mō tōna:

- tere koki
- pūngao neke whakahuri.

Hei aha ngā pānga o te waku i a ia i te hau takiwā.

(c) He 0.280 s te roa mō Sandra ki te whakatorotika i tōna tinana i mua tonu i tōna kuhunga ki te wai. Ko tōna tūpuku huri he 4.80 kg m^2.

Tātaihia tana whakapōturi koki i roto i tēnei wā.

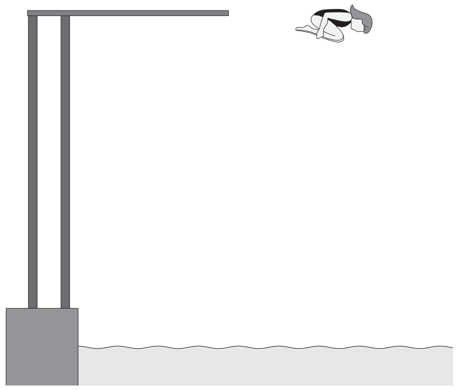
(d) I tētahi rā, ka mātakitaki a Sandra i a Tapu e whakaharatau pōtēteke ana mai i te papa rukuruku. E 2.00 ngā pōtēteke a Tapu i roto i te 1.25 hēkona.

Tātaihia te tere koki toharite a Tapu i a ia e pōtēteke ana.

QUESTION TWO: SOMERSAULTS WHILE DIVING

Sandra dives from a diving board that is 10.0 m high. She finds she can do somersaults (rotations) by tucking her body in. In the tucked position, her body can be modelled as a sphere of mass 60.0 kg and radius 0.200 m.

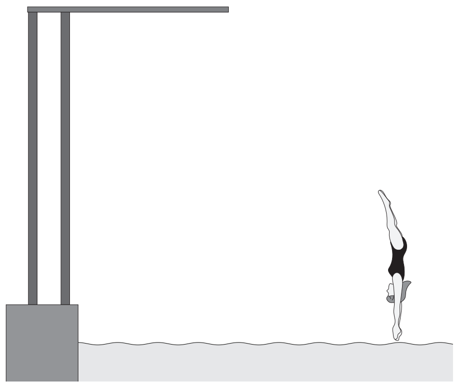
The rotational inertia of a sphere is given by $I = \frac{2}{5}mr^2$.



(a) While in the tucked position, she dives (rotates) with a constant angular velocity of 9.56 rads^{-1}.

Show that her angular momentum is 9.18 kg m^2 s^{-1}.

(b) Just before entering the water, she straightens her body, thereby changing her rotational inertia.



Explain what effect this will have on her rotational motion.

Comment on her:

- angular velocity
- rotational kinetic energy.

You may ignore effects of friction while she is in the air.

ASSESSOR'S USE ONLY

(c) It takes Sandra 0.280 s to straighten her body just before entering the water. Her rotational inertia becomes 4.80 kg m^2.

Calculate her angular deceleration during this time.

(d) One day, Sandra observes Tapu practising somersaults from the diving board. Tapu does 2.00 complete somersaults in 1.25 seconds.

Calculate Tapu's average angular velocity while executing the somersaults.

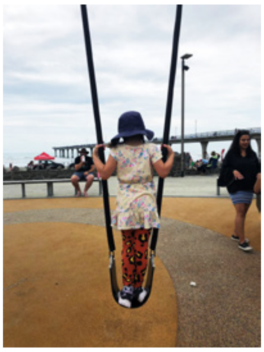
MĀ TE KAIMĀKA ANAKE

TŪMAHI TUATORU: I ROTO I TE PAPATĀKARO

(a) E noho ana a Serena i runga i tētahi tārere torotika he 3.00 m te roa.

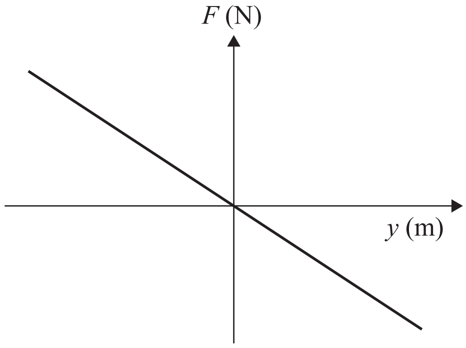
Me whakaatu ko te roa o te wā tārere he 3.50 s.

(b) Whakamāramahia mai, mā te homai i ngā take, he pēhea te whai pānga o te roa o te wā tārere mēnā ka tū a Serena ki te tārere i te wā e tārere noa ana.



(c) E whakaatu ana te kauwhata i raro i te tōpana whakaora, F, e pā ana ki a Serena, ki y, koinei te nekehanga huapae o Serena mai i tōna tūranga taurite.

Whakamāramahia mai he pēhea te whakaatu a ngā mōhiohio kei te kauwhata i raro he tauira te tārere o te nekehanga hawarite māmā (SHM).



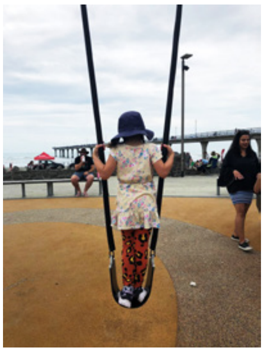
ASSESSOR'S USE ONLY

QUESTION THREE: IN THE PLAYGROUND

(a) Serena sits on a rigid swing that is 3.00 m long.

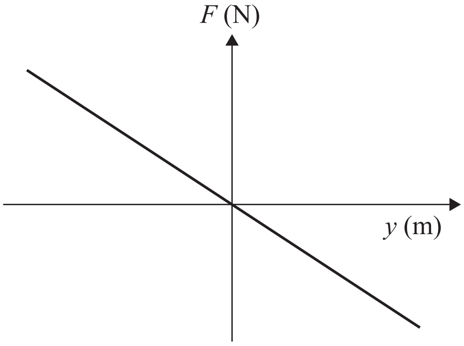
Show that the period of the swing is 3.50 s.

(b) Explain, giving reasons, how the period of the swing will be affected if Serena stands up on the swing while it is swinging freely.



(c) The graph below is that of the restoring force, F, on Serena, against y, which is the horizontal displacement of Serena from her equilibrium position.

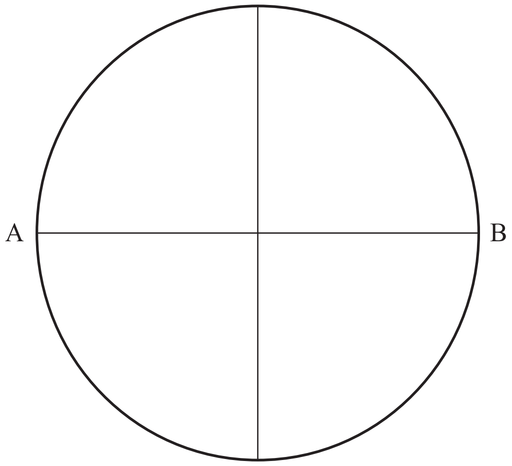
Explain how the information in the graph below shows that the swing is an example of SHM.

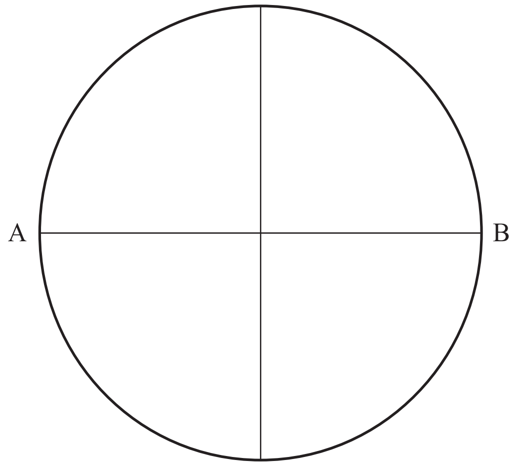


MĀ TE KAIMĀKA ANAKE

(d) Ka tārere a Serena mai i te pito A ki te pito B me te roanga tārere o te 1.50 m, me te roanga wā tārere o te 3.50 s.

Mā te whakamahi i ngā porowhita tohutoro i raro, tētahi atu huarahi rānei, tātaihia te tere o Serena me te tārere i te wā e 0.500 m mai i te pito B.



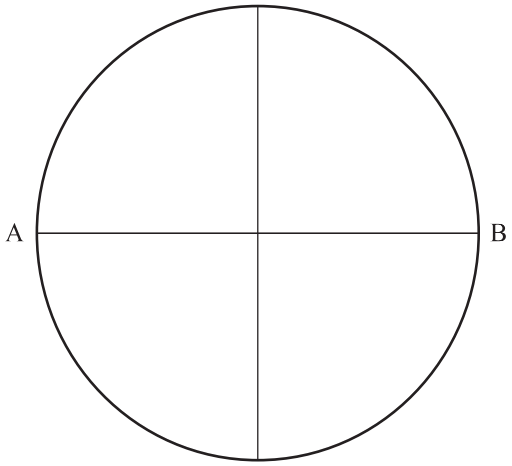


HOAHOA WĀTEA

Ki te hiahia koe kia tuhi anō i ngā tapanga tōpana mai i te Tūmahi Tuatahi (a), tuhia ki raro nei. Kia mārama te tohu ko tēhea te tuhinga ka hiahia koe kia mākahia.

(d) Serena swings from end A to end B with an amplitude of 1.50 m and a period of 3.50 s.

Using the reference circles below or otherwise, calculate the velocity of Serena and the swing when she is 0.500 m from end B.



ASSESSOR'S USE ONLY

SPARE DIAGRAM

If you need to redraw your force labels from Question One (a), draw them 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 2020

91524 Demonstrate understanding of mechanical systems

2.00 p.m. Wednesday 2 December 2020
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.