91523M

915235

NZQA

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

QUALIFY FOR THE FUTURE WORLD
KIA NOHO TAKATŪ KI TŌ ĀMUA AO!

3

SUPERVISOR'S USE ONLY

Ahupūngao, Kaupae 3, 2017

91523M Te whakaatu māramatanga ki ngā pūnaha ngaru

2.00 i te ahiahi Rāhina 20 Whiringa-ā-rangi 2017
Whiwhinga: Whā

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

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 2–19 kei roto i tēnei pukapuka, ka mutu, kāore tētahi o aua whārangi i te takoto kau.

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

TAPEKE

MĀ TE KAIMĀKA ANAKE

TŪMAHI TUATAHI

MĀ TE KAIMĀKA ANAKE

I te tau 1845, i whakaaturia mai e te kaimātai ahupūngao Tatimana a Buys Ballot te pānga Doppler mā te whakarongo ki ngā kaiwhakatangitangi e whakatangi taonga puoro ana i runga tereina i te hipatanga i a ia.

I whakatangihia e tētahi he orotahi i tētahi pūtahoro me te kati i ngā puare mati katoa. Ka taea te pūtahoro te whakatauira mā tētahi paipa tuwhera i tētahi pito me te kati i tētahi pito. Ko te roa o te pūtahoro he 0.613 m.

He 341 m s^{-1} te tere o te oro i roto i te hau.

(a) Ki te hoahoa i raro, tātuhia te ngaru tū hawarite (taketake) tuatahi, ME TE tapa i ngā pona (node) me ngā pūrahi (antinode).

pito kati pito huaki

Ki te hiahia koe ki te tuhi anō i tō urupare, whakamahia te hoahoa kei te whārangi 14.

(b) Ka puta i te pūtahoro te auautanga taketake me ngā hawarite maha.

Whakamāramahia te take e kore e puta i te pūtahoro he hawarite ōrite.

QUESTION ONE

ASSESSOR'S USE ONLY

In 1845, Dutch physicist Buys Ballot demonstrated the Doppler effect by listening to musicians playing their instruments on a train as it passed by him.

One musician played a note on a clarinet with all the finger holes closed. A clarinet can be modelled as a pipe that is open at one end and closed at the other. The length of the clarinet is 0.613 m.

The speed of sound is 341 m s^{-1}.

(a) On the diagram below, draw the 1st harmonic (fundamental) standing wave, AND label the nodes and antinodes.

closed end open end

If you need to redraw your response, use the diagram on page 15.

(b) The clarinet produces the fundamental frequency and several harmonics.

Explain why the clarinet does not produce any even harmonics.

MĀ TE KAIMĀKA ANAKE

(c) I te whakatatahanga atu o te tereina ki a Ballot i te tere o te 5.00 m s^{-1}, i rongo ia i tētahi auautanga o te 139 Hz mai i te pūtahoro.

Whakaaturia mai ko te auautanga o te oro i rongo te kaiwhakatangitangi pūtahoro he 137 Hz.

(d) He kaiwhakatangitangi pūtahoro anō i te tū i te taha o Ballot i te whakatatahanga mai o te tereina. He ōrite anō te auautanga (137 Hz) i puta i a ia ki te kaiwhakatangitangi pūtahoro i runga i te tereina, me te aha i rongo ai a Ballot i ngā taki.

Whakamāramahia mai te take kāore te ngaru oro e tae atu ana ki a Ballot mai i te pūtahoro i te tereina i te whai auautanga o te 137 Hz, ME TE whakamārama i te take i rongo taki a Ballot, ME TE tātai i te auautanga taki.

ASSESSOR'S USE ONLY

(c) When the train was approaching Ballot at a speed of 5.00 m s^{-1}, he heard a frequency of 139 Hz from the clarinet.

Show that the frequency of the sound heard by the clarinet player would have been 137 Hz.

(d) A second clarinet player was standing beside Ballot as the train approached. She produced the same frequency (137 Hz) as the clarinet player on the train, causing Ballot to hear beats.

Explain why the sound wave reaching Ballot from the clarinet on the train did not have a frequency of 137 Hz, AND explain why Ballot heard beats, AND calculate the beat frequency.

TŪMAHI TUARUA

MĀ TE KAIMĀKA ANAKE

Kei te takahi whenua a Mike rāua ko Kate, ā, kei te whakawhiti atu i tētahi piriti whakatārewa. Kātahi ka mōhio rāua mā tētahi momo pekepeke, ka taea e rāua tētahi ngaru tū te kōkiri. He 24.0 m te roa o te piriti.

(a) Whakaahuatia tētahi rerekētanga i waenga i te ngaru tū me tētahi ngaru rere.

(b) Ka taea tētahi piriti te kōpiupiu i ngā hawarite maha.

Whakaaturia mai ko te auautanga o te tauira hawarite tuatoru he: $f = \frac{3v}{2L}$, ina ko L te roanga o te piriti.

(c) Ka kōpiupiu te piriti i te tauira auautanga taketake me te wā o te 1.80 s.

Tātaitia te tere o ngā ngaru kei te piriti.

QUESTION TWO

ASSESSOR'S USE ONLY

Mike and Kate are on a tramping trip and are crossing a suspension bridge. They realise that by jumping up and down in a particular way, they can set up a standing wave in the bridge. The bridge is 24.0 m long.

(a) Describe one difference between a standing wave and a travelling wave.

(b) A bridge can oscillate at many harmonics.

Show that the frequency of the 3rd harmonic mode is: $f = \frac{3v}{2L}$, where L is the length of the bridge.

(c) The bridge oscillates at the fundamental frequency mode with a period of 1.80 s.

Calculate the speed of the waves in the bridge.

(d) He 6 m te tawhiti o Mike mai i tētahi pito, he 6 m a Kate mai i tētahi pito.

MĀ TE KAIMĀKA ANAKE

Homai he whakamāramatanga matawhānui me pēhea te mahi a Mike rāua ko Kate ki te whakakōpiupiu i te piriti ki te tauira hawarite tuarua.

I tō whakamāramatanga me:

- tātuhi he hoahoa tapanga o te piriti e kōpiuipiu ana ki te tauira hawarite tuarua
- whakamārama i pēhea tā rāua kōkiri i te ngaru tū
- whakamārama he aha i tū ai rāua ki ngā wāhi kua kīia
- whakamārama i te pānga takanga i waenga i ā rāua kōpiupiu.

Ki te hiahia koe ki te tuhi anō i tō urupare, whakamahia te pouaka kei te whārangi 14.

(d) Mike is 6 m from one end and Kate is 6 m from the other end.

ASSESSOR'S USE ONLY

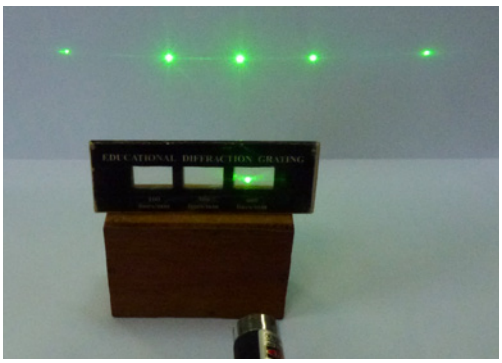
Give a comprehensive explanation of how it is possible for Mike and Kate to cause the bridge to oscillate in the 2nd harmonic mode.

In your explanation you should:

- draw a labelled diagram of the bridge oscillating in the 2nd harmonic mode
- explain how they set up a standing wave
- explain why they choose to stand in the positions stated
- explain the phase relationship between their oscillations.

If you need to redraw your response, use the box on page 15.

TŪMAHI TUATORU



MĀ TE KAIMĀKA ANAKE

Kei te hiahia a Priya ki te ine i te roangaru o tana taiaho kākāriki. Ka whitikia e ia te hihi taiaho mā tētahi tiriata roraha. Ka kite ia i tētahi tauira whakararuraru i te pātū i muri i te tiriata roraha, e ai ki te whakaahua.

He 2.00×10^{-6} m te wehenga o ngā hahae i te tiriata roraha.

He 15.4° te koki i waenga i te rārangi pūrahi (anti-node) pūwaenga me te rārangi pūrahi tuatahi.

(a) Me whakaatu ko te roangaru o te taiaho kākāriki ko te 5.31×10^{-7} m.

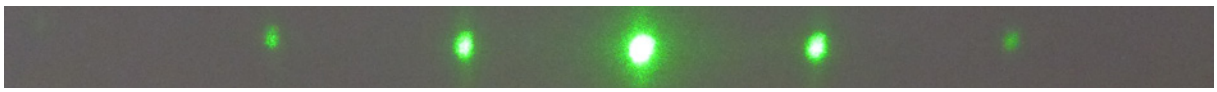
(b) Whakamāramahia he aha i puta ai te wāhi tiaho i te pūrahi tuatahi (mōrahi raupapa tuatahi).

(c) E whakaatu ana te pikitia i runga ake o te whārangi 11 i te tauira e kite ana ia mā te whakamahi i te taiaho kākāriki.

Ka tāruatia e Priya tana whakamātautau mā te whakamahi i tētahi taiaho whero (he iti iho te auautanga o te taiaho whero i te taiaho kākāriki).

Tātuhia te tauira e tūmanako ana ia ka kite ia me te taiaho whero.

Whakamāramahia mai he aha i rerekē ai tēnei tauira i tō te taiaho kākāriki.



MĀ TE KAIMĀKA ANAKE

Ki te hiahia koe ki te tuhi anō i tō urupare, whakamahia te pouaka kei te whārangi 14.

(d) Kātahi ka whitikia e Priya he tūrama mā ki tētahi atu tiriata roraha. E toru ngā tūāwhiorangi whānui o te tūrama kitea ka puta i ia taha o te rārangi pūrahi waenga.

Tātaihia te wehenga hahae iti rawa kei tēnei tiriata roraha.

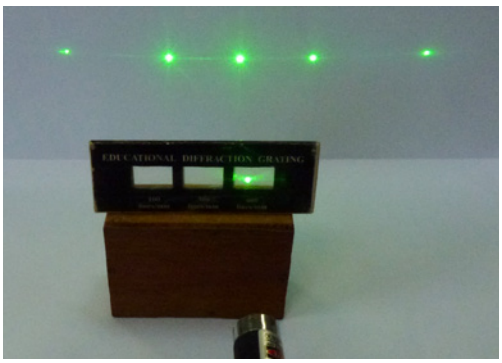
Whakamāramahia ō whakaaro whaitake.

Ko te auautanga o te tūrama tūāpōkere[1] he 7.70×10^{14} Hz.

Ko te auautanga o te tūrama whero he 4.30×10^{14} Hz.

[1] waereti

QUESTION THREE



ASSESSOR'S USE ONLY

Priya wants to measure the wavelength of her green laser. She shines the laser beam through a diffraction grating. She sees an interference pattern on the wall behind the diffraction grating, as shown in the photograph.

The slits in the diffraction grating are 2.00×10^{-6} m apart.

The angle between the central anti-nodal line and the first anti-nodal line is 15.4°.

(a) Show that the wavelength of the green laser is 5.31×10^{-7} m.

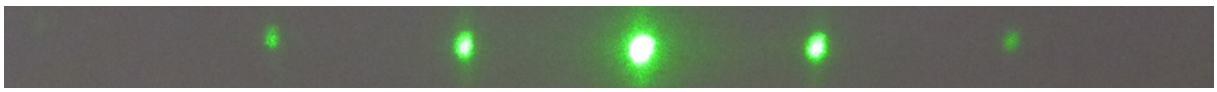
(b) Explain what causes the bright spot at the first antinode (first order maximum).

(c) The picture at the top of page 13 shows the pattern she sees using the green laser.

Priya repeats the experiment using a red laser (red light has a lower frequency than green light).

Draw the pattern she would expect to see with the red laser.

Explain why this pattern is different to the green laser.



ASSESSOR'S USE ONLY

If you need to redraw your response, use the box on page 15.

(d) Priya shines white light through another diffraction grating. There are three complete spectra of visible light produced each side of the central antinodal line.

Calculate the minimum slit separation on this diffraction grating.

Explain your reasoning.

The frequency of violet light is 7.70×10^{14} Hz.

The frequency of red light is 4.30×10^{14} Hz.

HE HOAHOA TĀPIRI

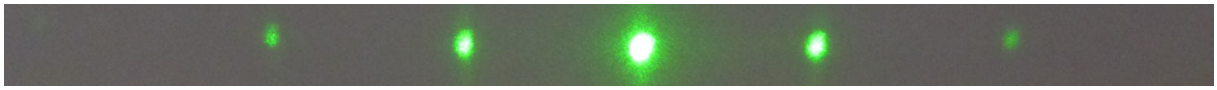
MĀ TE KAIMĀKA ANAKE

Ki te hiahia koe kia tuhia anō tō urupare ki te Tūmahi Tuatahi (a), tuhia ki te hoahoa i raro nei. Kia mārama te tohu ko tēhea te tuhinga ka hiahia koe kia mākahia.

pito kati pito huaki

Ki te hiahia koe kia tuhia anō tō urupare ki te Tūmahi Tuarua (d), tuhia ki te pouaka i raro nei. Kia mārama te tohu ko tēhea te tuhinga ka hiahia koe kia mākahia.

Ki te hiahia koe kia tuhia anō tō urupare ki te Tūmahi Tuatoru (c), tuhia ki te pouaka i raro i te hoahoa o raro. Kia mārama te tohu ko tēhea te tuhinga ka hiahia koe kia mākahia.



SPARE DIAGRAMS

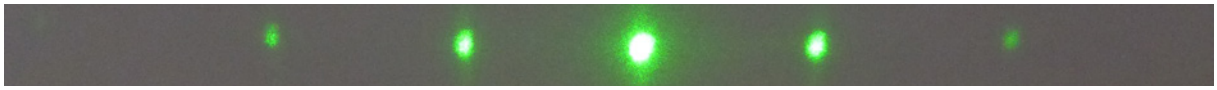
ASSESSOR'S USE ONLY

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

closed end open end

If you need to redraw your response to Question Two (d), draw it in the box below. Make sure it is clear which answer you want marked.

If you need to redraw your response to Question Three (c), draw it in the box under 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

ASSESSOR'S USE ONLY

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

ASSESSOR'S USE ONLY

English translation of the wording on the front cover

Level 3 Physics, 2017

91523 Demonstrate understanding of wave systems

2.00 p.m. Monday 20 November 2017
Credits: Four

91523M

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of wave systems.	Demonstrate in-depth understanding of wave systems.	Demonstrate comprehensive understanding of wave 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–PHYSR.

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 awny 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.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.