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, 2016

91523M Te whakaatu māramatanga ki ngā pūnaha ngaru

2.00 i te ahiahi Rātū 15 Whiringa-ā-rangi 2016
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 2–15 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: NGĀ PŪTORINO PANE

MĀ TE KAIMĀKA ANAKE

Ko te whakapae he 343 m s^{-1} te tere o te oro i roto i te hau.

He taonga puoro te pūtorino pane ka mahia mai i ētahi paipa e kati ana ngā pito o tētahi taha. Ka whakatangihia e Maria ngā oro auau rerekē mā te pupuhi hau ki runga i ngā paipa rerekē.

Kei te whakatangi a Maria i te auautanga taketake (hawarite tuatahi) ki tētahi paipa.

(a) Ki te hoahoa i raro tātuhia te ngaru tū kei te whakatangihia e Maria i roto i te paipa.

Tapaina ngā pona (node) me ngā pūrahi (antinode) nekeneke o te ngaru.

(b) Ka pupuhi a Maria i tētahi paipa, ā, ka puta te auautanga taketake o te 350 Hz. Ka puta anō i tētahi paipa tuarua te auautanga taketake o te 395 Hz.

Whakamāramahia mai ko tēhea te paipa roa ake.

QUESTION ONE: PAN FLUTES

ASSESSOR'S USE ONLY

Assume the speed of sound in air is 343 m s^{-1}.

A pan flute is a musical instrument made of a set of pipes that are closed at one end. Maria produces different frequency notes by blowing air across the top of different pipes.

Maria is producing the fundamental frequency (first harmonic) in one pipe.

(a) On the diagram below draw the standing wave Maria is producing in the pipe.

Label the displacement nodes and antinodes.

(b) Maria blows across one pipe and a fundamental frequency of 350 Hz is produced. A second pipe produces a fundamental frequency of 395 Hz.

Explain which pipe is longer.

Ka pupuhi a Maria i tētahi o ana paipa kia puta he hawarite tuatoru me te auau o te 762 Hz. I taua wā anō, ka pupuhi tōna hoa a Sophie i tētahi paipa ōrite ka puta anō he hawarite tuatoru. Ka rongo rāua i tētahi oro o te 764 Hz, he toharite tēnei o ngā auautanga e rua. He rerekē te kaha o te oro, i te auautanga o te 4.00 Hz.

MĀ TE KAIMĀKA ANAKE

(c) Tuhia te ingoa o tēnei tītohunga, me te whakamārama he pēhea te rongo a Maria i tētahi rerekētanga o te kahaoro.

(d) Tātaihia te roa o te paipa a Sophie.

ASSESSOR'S USE ONLY

Maria blows air across one of her pipes and it produces a third harmonic with a frequency of 762 Hz. At the same time, her friend Sophie blows air across a similar pipe and also produces a third harmonic. They both hear a sound of 764 Hz, which is the average of the two frequencies. The sound varies in loudness, at a frequency of 4.00 Hz.

(c) State the name of this phenomenon, and explain how it causes Maria to hear a variation in loudness.

(d) Calculate the length of Sophie's pipe.

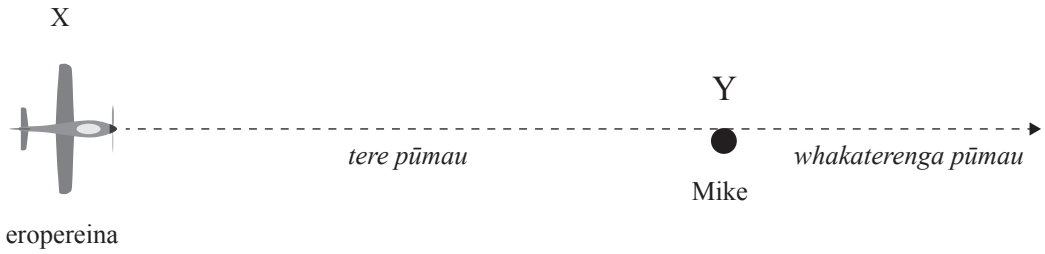
TŪMAHI TUARUA: HE EROPEREINA E WHAKAHAERE PŪMAMAOTIA ANA

MĀ TE KAIMĀKA ANAKE

Kei te whakahaere pūmamaotia e Mike tana eropereina. Ka rere mai te eropereina ki a ia i te tere pūmau, ā, ka ahu atu i a ia me te whakaterenga pūmau e ai ki te hoahoa i raro.

Kei te whakaputa te eropereina i te auautanga pūmau o te 185 Hz.

Ko te whakapae he 343 m s^{-1} te tere o te oro i roto i te hau.



(a) Whakaahuahia me te whakamārama i te auautanga o te oro ka rongo a Mike ina tae te eropereina ki te pūwāhi X.

(b) Whakaahuahia te auautanga o te oro ka rongo a Mike ina tae te eropereina ki te pūwāhi Y.

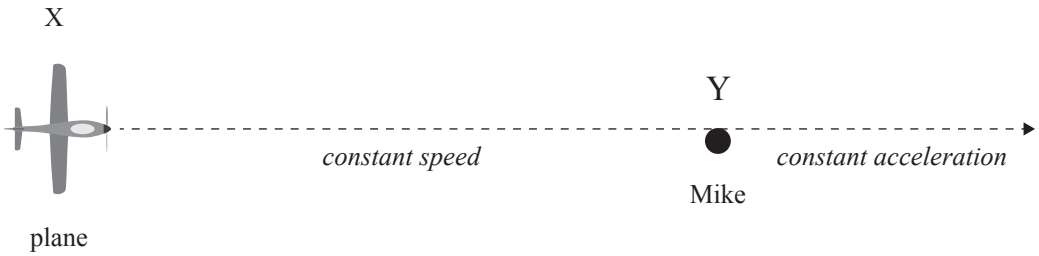
QUESTION TWO: A RADIO CONTROLLED PLANE

ASSESSOR'S USE ONLY

Mike is flying his radio controlled plane. The plane flies towards him at constant speed, and then away from him with constant acceleration, as shown in the diagram below.

The plane is producing a constant frequency of 185 Hz.

Assume the speed of sound in air is 343 m s^{-1}.



(a) Describe and explain the frequency of the sound Mike hears when the plane is at position X.

(b) Describe the frequency of the sound Mike hears when the plane is at position Y.

(c) Whakaahuahia me te whakamārama i te auautanga o te oro e rongo ana a Mike i te wā ka whakatere haere te eropereina atu i a ia.

MĀ TE KAIMĀKA ANAKE

(d) Tātaihia te tere o te eropereina ina he 2.00 m te roangaru o ngā ngaru oro e whakanaohia ana i muri mai i te eropereina.

ASSESSOR'S USE ONLY

(c) Describe and explain the frequency of the sound Mike hears as the plane gradually accelerates away from him.

(d) Calculate the speed of the plane when the sound waves being produced behind it have a wavelength of 2.00 m.

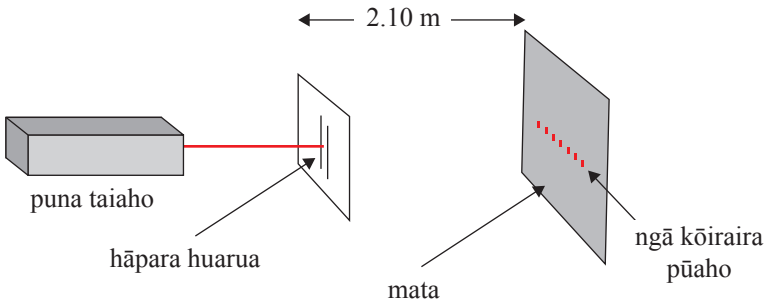
TŪMAHI TUATORU: NGĀ TIRIATA ROROHA

MĀ TE KAIMĀKA ANAKE

Kei te mahi a Moana i tētahi whakamātautau i roto i te taiwhanga pūtaiao. Ka whakawhiti atu ia i tētahi hihi taiaho ki tētahi hāpara huarua, ā, ka mātaki ia i tētahi tauira whakararuraru i runga i te mata. E whakaatu ana te hoahoa i raro nei i te whakamātautau. Ka inea e Moana te tawhiti i waenga i ngā kōiraira pūaho pātata (mōrahi), ā, ka kite ia he 0.0100 m te wehe tētahi i tētahi.

He 1.28×10^{-4} m te wehe o ngā hāpara.

He 2.10 m te mata mai i ngā hāpara.



(a) Me whakaatu ko te roangaru o te hihi taiaho he 6.10×10^{-7} m.

Ka whakakapihia e Moana te hāpara huarua ki tētahi tiriata roroha ki taua wāhi ōrite. E 500 ngā rārangi o te tiriata roroha i ia mm.

(b) Tātaihia te koki i waenga i te rārangi pūrahi pūwaenga me te rārangi pūrahi tuatahi.

(c) Whakamāramahia mai ka ahatia te tawhiti i waenga i ngā kōiraira pūaho kei te mata mēnā ka huria te puna taiaho ki tētahi mea poto ake te roangaru.

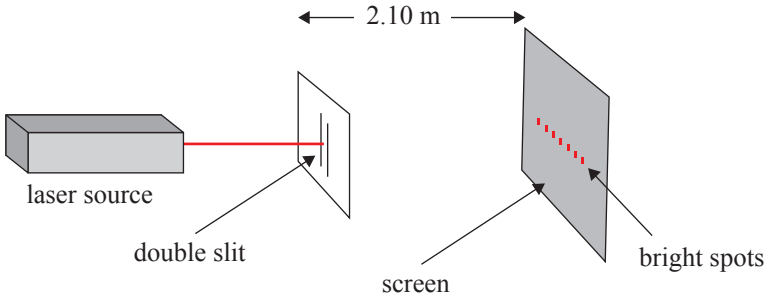
QUESTION THREE: DIFFRACTION GRATINGS

ASSESSOR'S USE ONLY

Moana is doing an experiment in the laboratory. She shines a laser beam at a double slit and observes an interference pattern on a screen. The diagram below shows the experiment. Moana measures the distance between adjacent bright spots (maxima) and finds they are 0.0100 m apart.

The slits are 1.28×10^{-4} m apart.

The screen is 2.10 m from the slits.



(a) Show that the wavelength of the laser light is 6.10×10^{-7} m.

Moana replaces the double slit with a diffraction grating in the same position. The diffraction grating has 500 lines per mm.

(b) Calculate the angle between the central antinodal line and the first antinodal line.

(c) Explain what would happen to the distance between the bright spots on the screen if the laser source is changed to one with a shorter wavelength.

(d) Kātahi ka whakawhitia e Moana he tūrama mā mā tētahi tiriata roroha. E whakaaturia ana i raro te tauira e kite ana ia.

MĀ TE KAIMĀKA ANAKE

Whakamāramahia te tauira e kite ana a Moana.

Me whakauru ki tō whakamāramatanga:

- te take he aha i mā ai te pokapū o te tauira
- te take he tūāwhiorangi whaikano kei ia taha
- te take he wāhi pōuri kei waenga i ngā wāhi mā me ngā wāhi whaikano.

ASSESSOR'S USE ONLY

(d) Moana then shines white light through a diffraction grating. The pattern she sees is shown below.

Explain the pattern Moana observes.

Your explanation should include:

- why the centre of the pattern is white
- why there is a coloured spectrum on each side
- why there are dark regions between the white and coloured regions.

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, 2016

91523 Demonstrate understanding of wave systems

2.00 p.m. Tuesday 15 November 2016
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–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.