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NZQA

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

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SUPERVISOR'S USE ONLY

Level 3 Physics, 2013

91523 Demonstrate understanding of wave systems

2.00 pm Monday 25 November 2013
Credits: Four

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 any answer, use the extra space provided at the back of this booklet.

Check that this booklet has pages 2–8 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.

TOTAL

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You are advised to spend 60 minutes answering the questions in this booklet.

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QUESTION ONE: THE POLICE WHISTLE

Some police forces have used whistles that have two chambers of different lengths.

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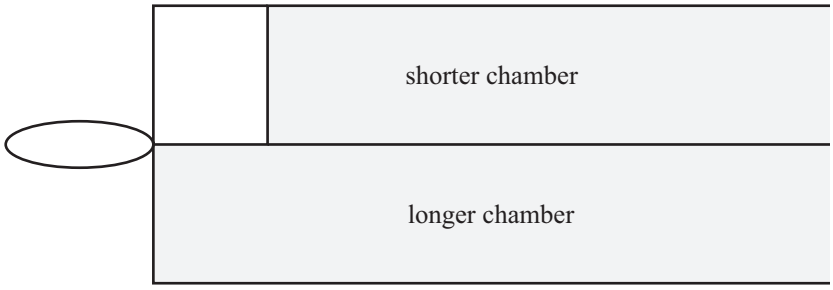
http://ecx.images-amazon.com/images/I/314ODDsS1qL._SL500_SS500_.jpg

A model of the whistle chamber is shown in the diagram below.



(a) On the above diagram, draw the fundamental standing wave in the shorter chamber, AND label any displacement nodes and antinodes.

The fundamental frequencies for the two chambers are 2136 Hz and 1904 Hz. The speed of sound in air is 343 m s^{-1}.

(b) Calculate the length of the longer chamber.

(c) Explain how a standing wave is produced in a pipe that is closed at one end.

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(d) When the whistle is blown, the sound made is quite different to a pure sound of either 2136 Hz or 1904 Hz.

Calculate the value of TWO other frequencies produced, AND explain why these other frequencies are produced, and what effect they have on the sound.

QUESTION TWO: THE DOPPLER EFFECT

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An ambulance with its siren on drives towards a stationary police officer.

(a) State the differences (if any) in the velocity, and in the wavelength, of the sound waves that are observed by the police officer compared to the ambulance driver.

Velocity: _____

Wavelength: _____

(b) The ambulance drives towards the police officer at constant speed.

Explain why the frequency heard by the police officer does not change as the ambulance approaches.

(c) The ambulance passes close by the police officer, and continues on past without changing speed. The frequency heard by the police officer changes from 960 Hz to 870 Hz. The speed of sound in air is 343 m s^{-1}.

Determine the speed of the ambulance.

(d) The driver of the ambulance then accelerates directly away from the police officer before coming to a sudden stop.

Explain how the frequency of the sound heard by the police officer changes during this time.

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QUESTION THREE: INTERFERENCE

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Jenny is looking through a window at an orange street light outside. Many vertical scratches on the window act as a diffraction grating.

(a) Describe what Jenny would see when she looks at the orange street light.

(b) Orange light with a wavelength of 589×10^{-9} m diffracts through the window, and Jenny measures the first order maximum at an angle of 1.04°.

Calculate the separation of the scratches on the window.

(c) Explain why monochromatic light shone through a diffraction grating produces a different pattern of fringes than it does when shone through a double slit of the same spacing.

(d) Jenny now observes a white light through the same window.

Explain what effect the scratches have on Jenny's view of the white light.

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Extra paper if required.
Write the question number(s) if applicable.

QUESTION NUMBER

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