1

SUPERVISOR'S USE ONLY

90938

909380

NZQA

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

Level 1 Physics, 2014

90938 Demonstrate understanding of aspects of wave behaviour

2.00 pm Tuesday 25 November 2014
Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of aspects of wave behaviour.	Demonstrate in-depth understanding of aspects of wave behaviour.	Demonstrate comprehensive understanding of aspects of wave behaviour.

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 Sheet L1–PHYSR.

In your answers use clear numerical working, words and/or diagrams as required.

Numerical answers should be given with an appropriate SI unit.

If you need more space for any answer, use the page(s) provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–12 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.

Achievement

TOTAL 09

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QUESTION ONE: GEOLOGICAL SURVEY

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A speaker produces a sound wave.

(a) (i) Describe what a wave is.

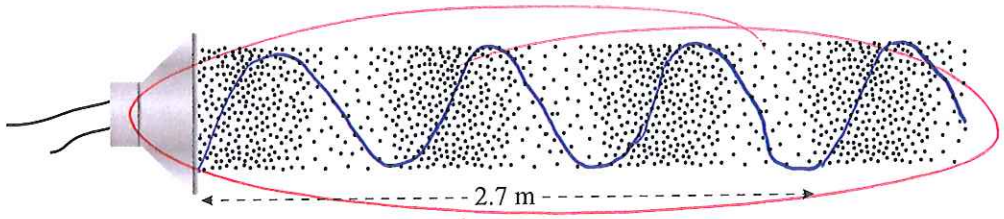
a wave is the movement of energy from one place to another there are two types of waves, transverse and Longitudinal waves

(ii) Using a physics idea, describe the function of a wave.

a wave is used to carry energy from one place to another e.g. sound from a stereo to your ear

A

(b) When a speaker produces a particular frequency of sound, the air particles in front of the speaker produce a pattern as shown in the diagram below.



(i) On the diagram above, draw arrow(s) to show the direction of movement of an air particle associated with the sound produced by the speaker.

(ii) From the information given in the diagram, calculate the wavelength of the sound wave in air produced by the speaker.

$\frac{2.7}{5}$ = 0.54 m

A

Wavelength = _____

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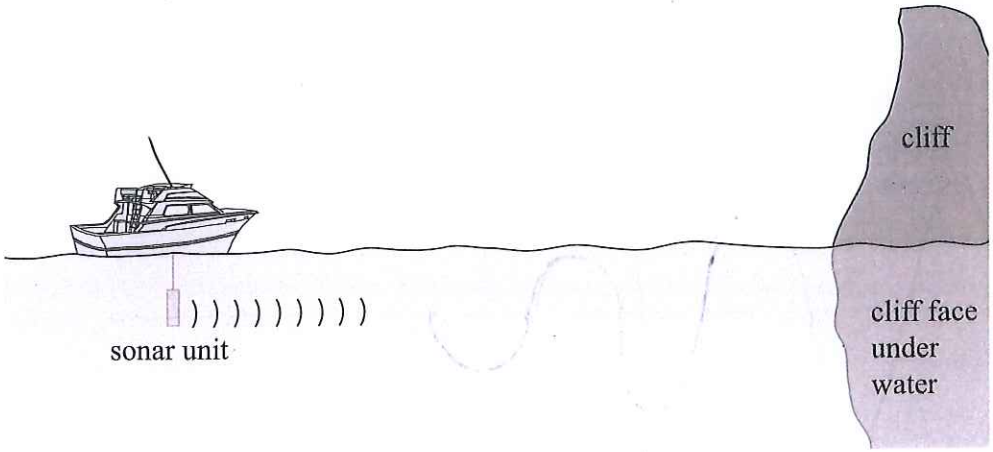
A scientist sets up a sonar unit to survey the water near a cliff. Part of the cliff face is submerged in water, as shown in the diagram. The transmitter in the sonar unit sends a pulse towards the submerged cliff face. The receiver in the sonar unit picks up the reflected pulse from the submerged cliff face 0.54 s later. The frequency of the sonar pulse is 10 kHz and its wavelength is 0.153 m.



(c) Calculate the distance between the sonar transmitter and the cliff face under water.

$v = \frac{d}{t}$ $d = 0.153$ $t = 0.54$ $v = f\lambda$

$v = \frac{0.153}{0.54} = 0.283$ (3dp) $f = 10000\,Hz$ $\lambda = 0.153$

$v = 10000 \times 0.153 = 1530\,ms^{-1}$

$d = vt$ $t = 0.54$ $v = 1530\,ms^{-1}$

$d = 0.54 \times 1530 = 826.2\,m$

M

Distance = 826.2 metres

When an object is thrown into water, it creates waves on the surface of the water. The amplitude of the waves decreases as they travel outwards. The sketch below shows the amplitude against distance for the first wave.

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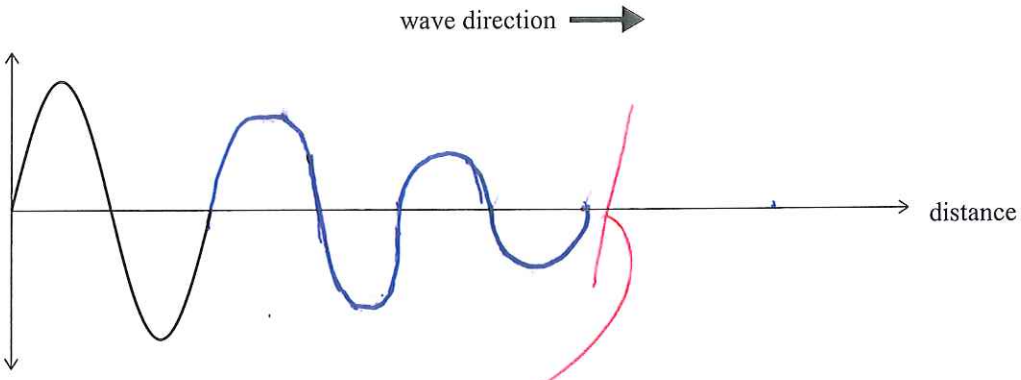
(d) (i) Complete the diagram by drawing the next two complete cycles of the wave as it travels outwards.



(ii) Using physics ideas, explain why the amplitude of the wave decreases as it travels outwards.

because more energy is needed to push the waves out further also time could affect how the distance covered because d=vt so if v and t are low d is going to be low

a

A3

QUESTION TWO: BEHAVIOUR OF SOUND WAVE

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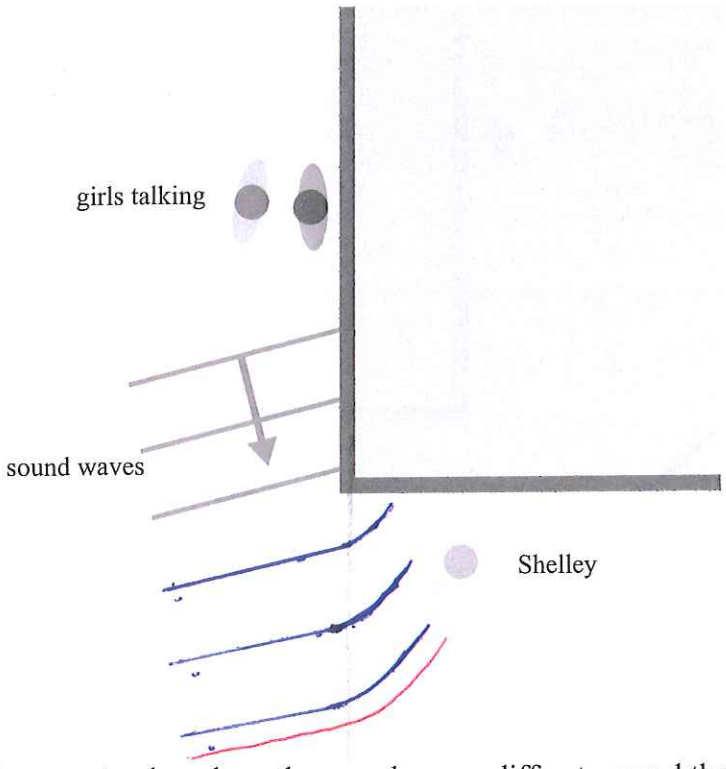
The diagram below shows two friends talking to each other next to a gymnasium wall. Shelley is standing near the corner of the gymnasium building. She can hear her friends around the corner, even though she cannot see them.



a

(a) Complete the diagrams to show how the sound waves diffract around the corner to reach Shelley's ear.

(b) Shelley notices that she is able to hear low frequency sounds from the girls' chat more loudly than high frequency sounds.

Explain why the low frequency sounds from the girls' chat are heard more loudly than the high frequency sounds.

because low frequency sounds mean that the waves are further apart than high frequency sounds which means that they are not travelling as fast and their wavelength is longer making it easier for her to read

a

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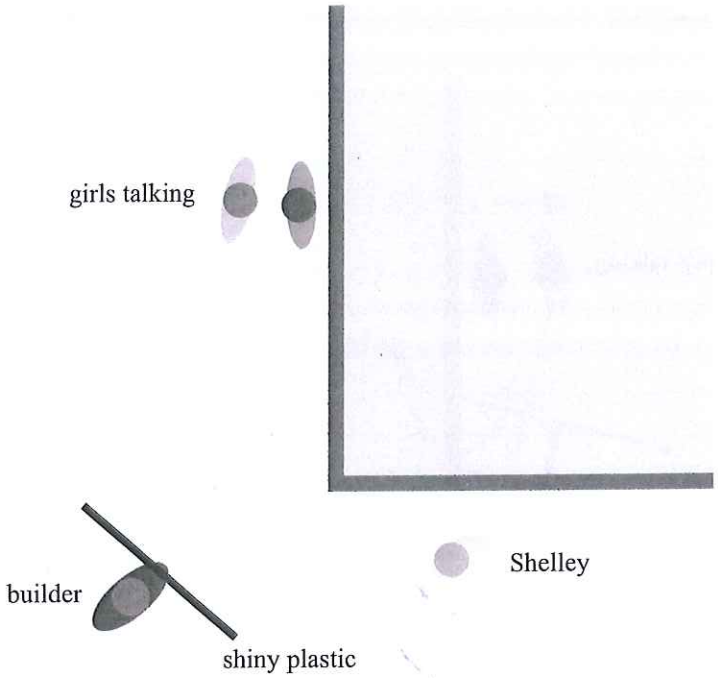
(c) When a builder carrying a large **shiny plastic board** passes by the corner of the gymnasium building, as shown in the diagram, the sound waves are reflected off the board towards Shelley.



Explain how the sound heard by Shelley in the above situation is different from the sound heard due to diffraction in the previous situation.

the shiny plastic will make the sound clearer because the sound has not slowed down in refraction

a

(d) Explain how the phenomena diffraction and reflection, affect the amplitude and direction of the sound waves.

(i) the amplitude of the waves

reflection will have amplitude remain the same
diffraction will have a lower amplitude because the wave is slowing as it diffracts

(ii) the direction of the waves

diffraction

~~diffraction~~ the direction of the waves will stay the same

reflection the direction will change as it hits the reflective object

M

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A4

QUESTION THREE: ELECTROMAGNETIC WAVES

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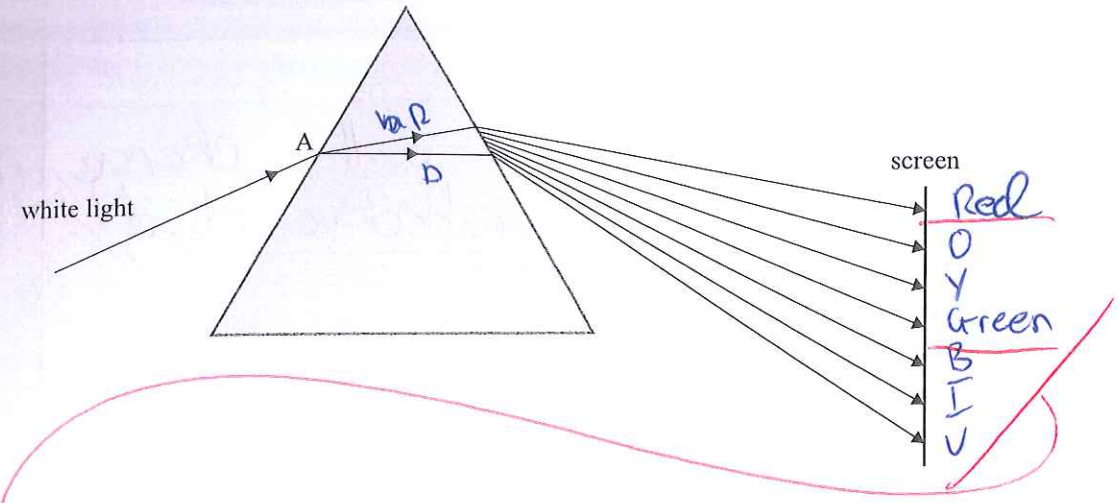
The diagram below shows a ray of white light entering a prism at point A.



(a) State the TWO phenomena that take place as the incident ray **enters** the prism at point A.

the white light refracts (bends inwards) a
and splits into 2 colours Red and Blue

(b) (i) On the diagram above, label the position of the red and green rays on the screen.

(ii) Explain why the light splits up in this way.

because when all coloured light is combined
it makes white light and only
a prism can seperate the colours.
White light enters the prism refracts
into 2 colours red and blue
into the prism then refracts again a
into a less dense medium as a
spectrum of the rainbow

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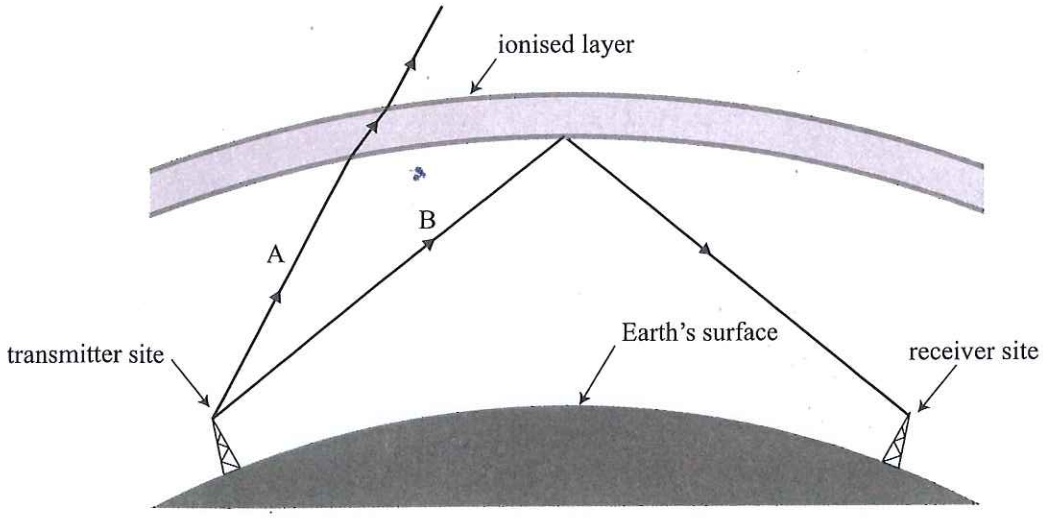
Radio waves travel in straight lines. Long-distance radio communication between distant locations on the Earth's surface is possible due to the existence of the ionised layer of the Earth's atmosphere. Two radio waves, A and B, are broadcast from the surface of the Earth. When the radio waves reach the ionised layer of the Earth's atmosphere, ray A travels into space and ray B bounces back towards the Earth's surface, as shown in the diagram.



(c) (i) Name the phenomenon that causes ray B to bounce back towards the Earth's surface.

reflection

(ii) In terms of the optical properties of the ionised layer, discuss why ray B bounces back towards the Earth's surface, while ray A is transmitted.

ray A is refracted because it hits the ionised layer at a ∠ greater than 45° below 90° whereas ray B hits the ionised layer at a ∠ less than 45° causing it to reflect

2

(d) The diagram below shows the true positions of the Sun from sunrise to midday. Light reaching the Earth from the Sun has to pass through the Earth's atmosphere. The atmosphere is **optically denser** than the space outside the atmosphere.

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Adapted from: http://jeweell.com/data_images/out/75/1134759-earth.jpg

(i) Complete the diagram showing the path of the ray from the mid-morning sun after it enters the atmosphere.

(ii) On the diagram, draw the **apparent position** of the mid-morning sun, as seen by the viewer on Earth.

(iii) The angle of incidence of the light hitting the atmosphere decreases from sunrise to midday.

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Explain how the **apparent position** of the Sun as seen from the Earth changes between sunrise and midday compared to its true position.

You may make sketches on the diagram to aid your answers.

the sun will be slightly ahead of the apparent position until it gets to midday when it will be exactly the same then the apparent position will be in front of the ~~seen~~ sun, until sunset when it will be the same (also starts at sunrise apparent position will be the same as real position then.

N1

N2

Achievement exemplar for 90938 2014		Total score	09
Q	**Grade score**	**Annotation**	
1	A3	(a) **Achievement.** For Achievement, the description of the wave needs to include the term disturbance or the idea that waves carry energy. For Merit ,there needs to be a clear idea that there is no transmission of matter (only energy) – which in this case there was not. (b) **Not Achieved.** For Achievement, the direction of movement of air particles needs to be both to the right and the left OR the wavelength needs to be the length of the waves shown (2.7) divided by the number of waves (3) = 0.90. (c) **Merit.** The distance between the cliff and the transmitter is incorrectly calculated as 826 m (as opposed to the Excellence answer which includes halving the time). (d) **Achievement.** There are two ideas correct here – either worth an Achievement. There is a clear decreasing of amplitude of the wave but the wavelength of the drawn wave is inconsistent AND there is a description that the wave loses energy but no mechanism causing the energy loss is described.	
2	A4	(a) **Achievement.** The diagram shows the wave diffracting but the wavelength of the wave before and after striking the obstacle is inconsistent. (b) **Achievement.** There is the correct idea that low frequency waves have a longer wavelength but there is no clear discussion that lower wavelength diffract more than shorter wavelength. (c) **Achievement.** There is a comparison between diffraction versus reflection, but there is no attempt to explain why the reflected sound is clearer based on different frequencies. (d) **Merit.** There is a discussion of the effects both of reflection and diffraction on the amplitude AND the effects both of reflection and diffraction on the direction of the wave but none of the four ideas is correctly explained.	
3	N2	(a) **Achievement.** Correctly states one of the phenomena (refraction). (b) **Achievement.** Correctly identifies position of red and green rays but does not explain dispersion well. (c) **Not Achieved.** For Achievement, needs to identify phenomena as Total Internal Reflection or describe one aspect of Total Internal Reflection. (d) **Not Achieved.** For Achievement, needs to complete the diagram or draw the apparent position or explain the change in apparent position.	