90938

909380

1

SUPERVISOR'S USE ONLY

NZQA

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

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

Level 1 Physics, 2018

90938 Demonstrate understanding of aspects of wave behaviour

2.00 p.m. Friday 23 November 2018
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 extra space 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.

TOTAL

ASSESSOR'S USE ONLY

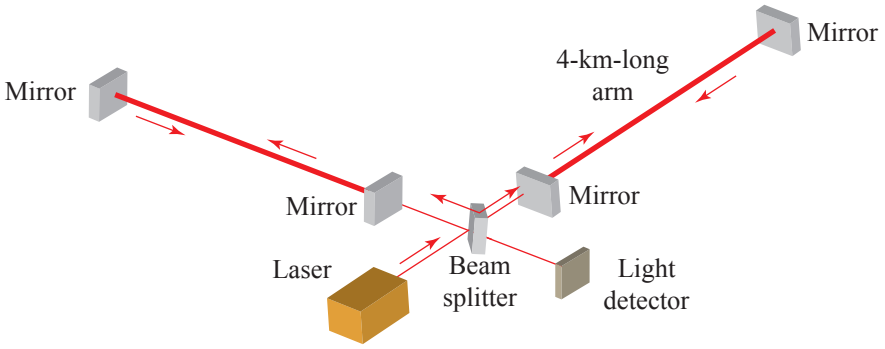
QUESTION ONE: LIGO

ASSESSOR'S USE ONLY

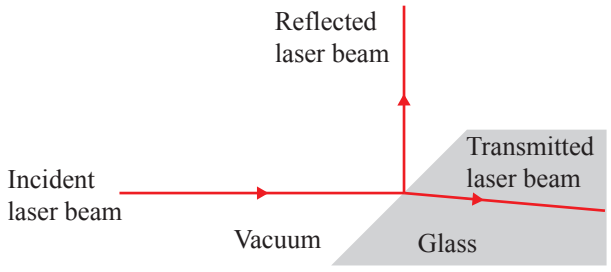
(a) (i) Describe the property that all transverse waves have in common.

(ii) Draw labelled arrows on the diagram below to show the wavelength and amplitude of the wave.

The Laser Interferometer Gravitational-Wave Observatory (LIGO) is a large-scale physics experiment and observatory created to detect cosmic gravitational waves. The first detection of gravitational waves was reported in 2016. Below is a diagram of how the LIGO observatory is set up.



(b) LIGO tunnels are kept at an ultra-high vacuum, which contains almost no particles. The beam splitter, which is made of glass, reflects half the light and transmits half the light, as shown below.



ASSESSOR'S USE ONLY

Compare the speed of the transmitted laser beam with the speed of the reflected laser beam and describe what causes the difference in speed between the two beams.

(c) The frequency of the laser light used in the LIGO observatory is 3.7×10^{14} Hz.

The speed of light in a vacuum is 3.00×10^{8} m s^{-1}.

Calculate the wavelength of the laser light.

(d) After passing through the beam splitter, the light is reflected back and forth between the mirrors at each end of the arm. The light travels along the arm 280 times **in each direction** before the beams are recombined. Each arm is 4 km long.

The speed of light in a vacuum is 3.00×10^{8} m s^{-1}.

Calculate the amount of time the light will spend travelling back and forth between the mirrors at each end of the arm.

State your answer in milliseconds.

Time in milliseconds _____

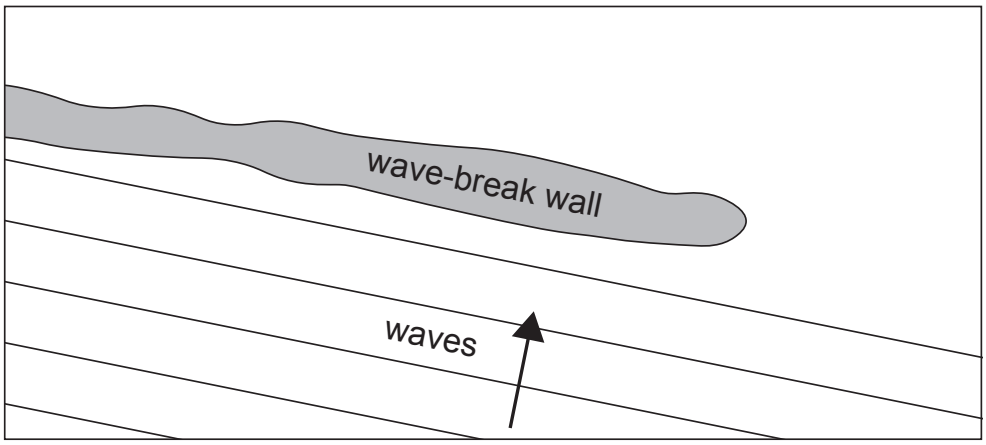
QUESTION TWO: SANDSCAPE RESORT

ASSESSOR'S USE ONLY

Sam and Doug are on their honeymoon in the Caribbean at the Sandscape Resort. Sam noticed that a man-made wave-break wall had been built to help protect guests while they swim. A picture of the wave-break wall is shown below.

http://www.sunscaperesorts.com/our-resorts-spas

(a) Complete the diagram below to show how the waves pass through the opening at the end of the wave-break wall. The water depth does not change.



If you need to redraw your response, use the diagram on page 10.

(b) (i) State the name of this phenomenon.

(ii) Describe how this phenomenon affects the frequency, velocity, and wavelength of the wave.

ASSESSOR'S USE ONLY

(c) Doug was fishing on the edge of the barrier wall and was counting the waves as they were coming in. He counted exactly 8.00 waves per minute.

(i) State the definition of the physics term **frequency** of a wave.

(ii) Doug determined that the wave speed was 10.0 m s^{-1}.

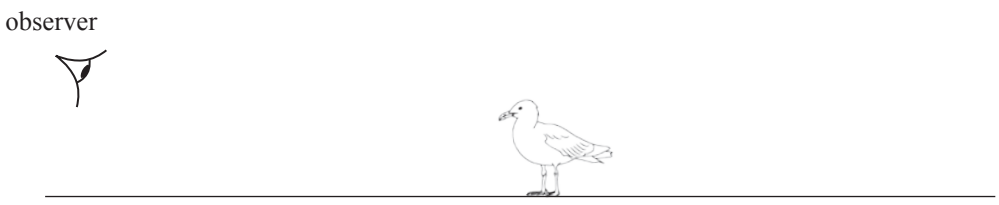
Calculate the wavelength of the wave.

Round your answer to the correct number of significant figures.

(d) When Sam was walking along the beach, some birds were standing in a small amount of water. The surface of the water acted like a mirror. The reflections of the birds can be seen in the water, as shown.

Complete the ray diagram below to show how a single light ray travels from the bird to the observer to form the reflection of the bird.

Indicate the location of the image with an "x".

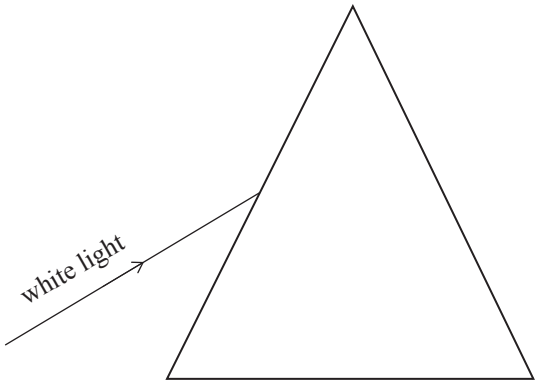


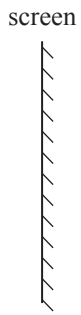
If you need to redraw your response, use the diagram on page 10.

QUESTION THREE: PROPERTIES OF LIGHT

ASSESSOR'S USE ONLY

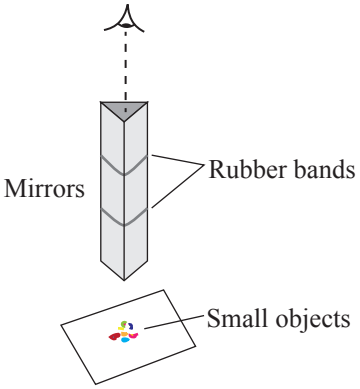
(a) Complete the diagram below to show the dispersion of white light through the prism.
Label where the colour red, and where the colour violet will appear on the screen.



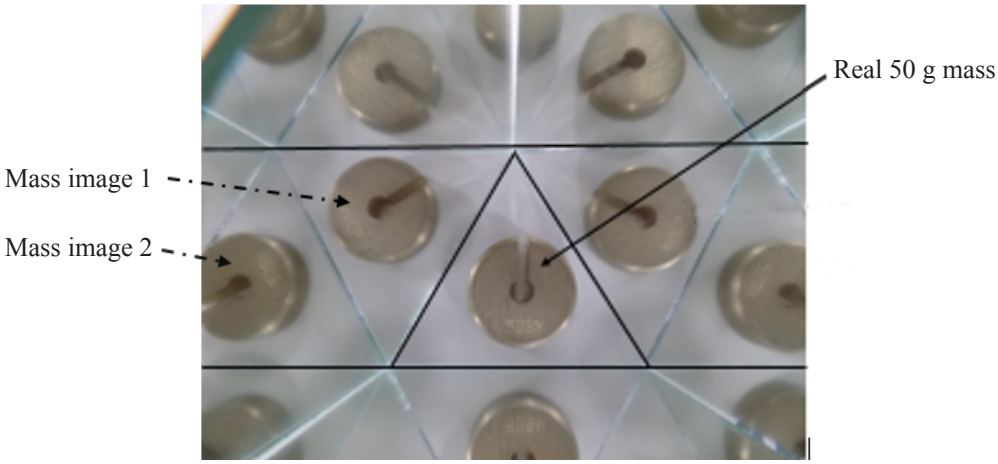


If you need to redraw your response, use the diagram on page 10.

A kaleidoscope is a popular children's toy. It consists of a long reflective triangular tube inside a circular tube with small objects at the end, as shown below.



When you look down into the kaleidoscope, you can see different patterns. One such pattern is shown below.

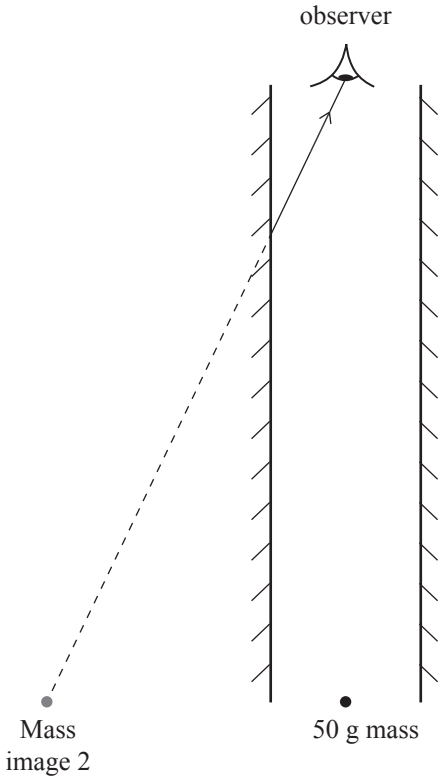


The 50 g mass in the centre of the picture above is real. All the other 50 g masses are images of the real 50 g mass.

ASSESSOR'S USE ONLY

(b) (i) State the law of reflection of light.

(ii) Complete the ray diagram below to show the path of the light ray inside the kaleidoscope that creates the Mass image 2, as labelled in the picture.



If you need to redraw your response, use the diagram on page 11.

(c) The images inside a kaleidoscope are caused by mirrors, **not** by total internal reflection.

(i) State the TWO conditions that must be met for total internal reflection to occur.

(1)

(2)

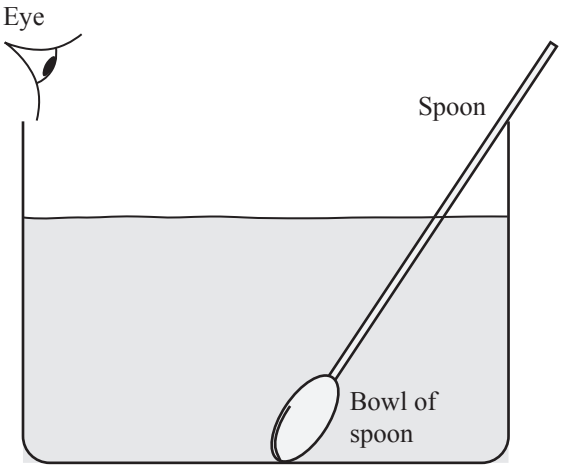
ASSESSOR'S USE ONLY

(ii) Explain how the reflections inside a kaleidoscope are different from total internal reflection.

(d) (i) When you put a spoon into water, it looks as though the spoon is being bent, as shown in the picture on the right.

On the diagram below, draw TWO rays to show how light travels from the bowl of the spoon to the eye, AND how these rays form the image.

Place an "x" on the diagram to indicate where the image of the bowl of the spoon appears.



If you need to redraw your response, use the diagram on page 11.

(ii) When you look down from a higher view point, you can see the spoon, as shown right.

Explain how we see two images of the bowl of the spoon in the picture.

Your answer should include:

- how light bends when it passes from the water into the air
- the path, or paths, that light follows from the spoon to the observer.

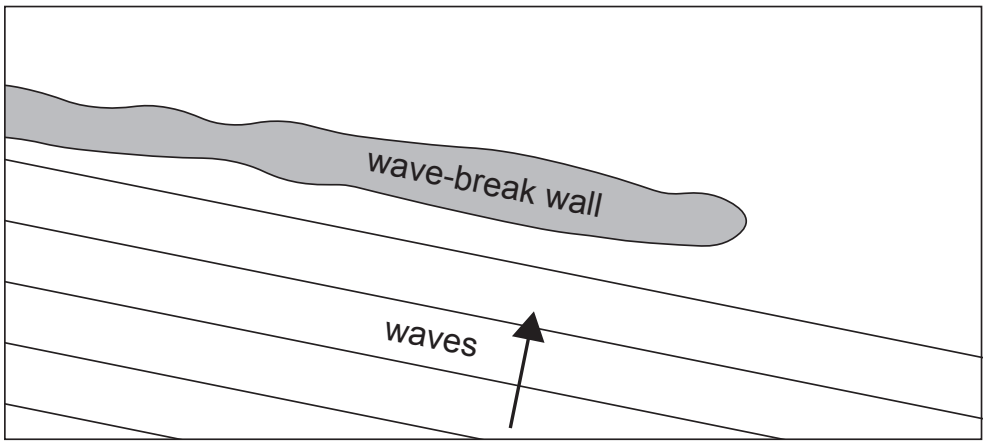
You may include a diagram as part of your answer.

ASSESSOR'S USE ONLY

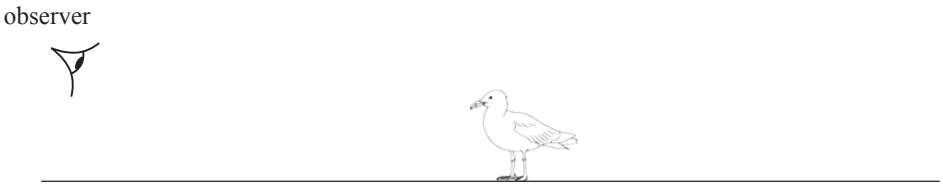
SPARE DIAGRAMS

ASSESSOR'S USE ONLY

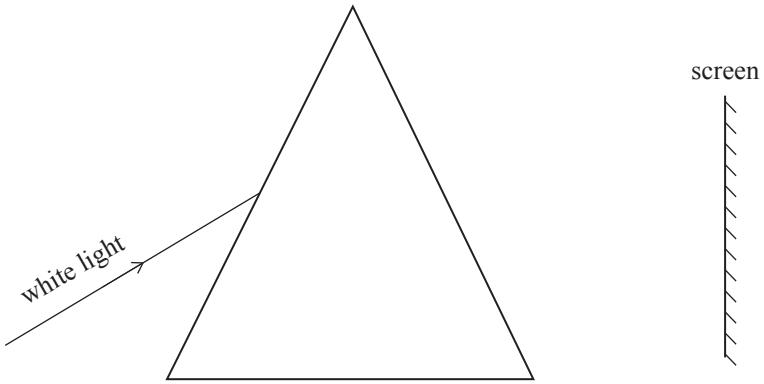
If you need to redraw your response to Question Two (a), use the diagram below. Make sure it is clear which answer you want marked.



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

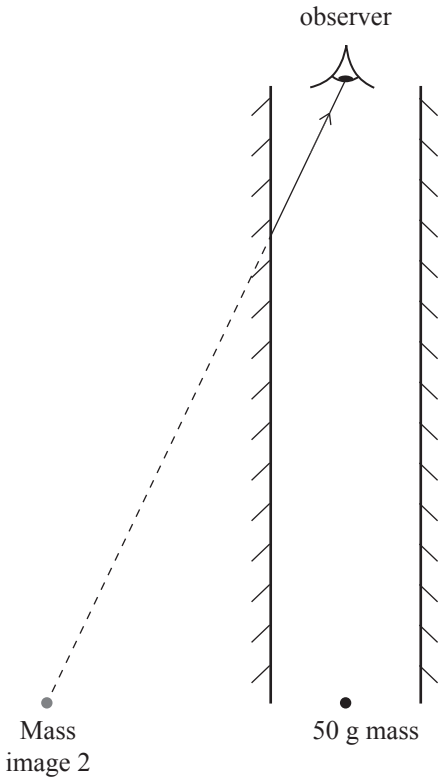


If you need to redraw your response to Question Three (a), use the diagram below. Make sure it is clear which answer you want marked.

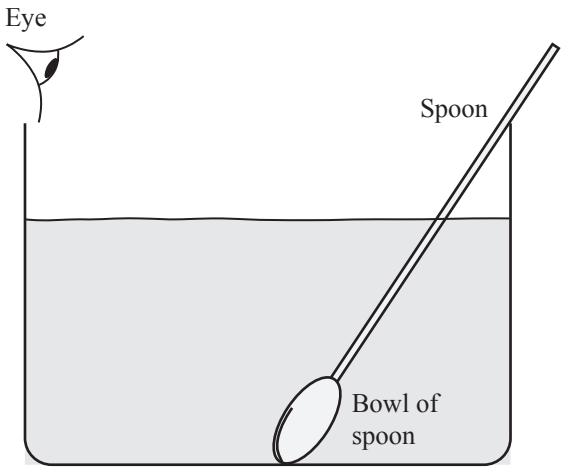


ASSESSOR'S USE ONLY

If you need to redraw your response to Question Three (b)(ii), use the diagram below. Make sure it is clear which answer you want marked.



If you need to redraw your ray diagram for Question Three (d)(i), use the diagram below. Make sure it is clear which answer you want marked.



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

QUESTION NUMBER

ASSESSOR'S USE ONLY

90938