

91170



Draw a cross through the box (X) if you have NOT written in this booklet

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Mana Tohu Mātauranga o Aotearoa

New Zealand Qualifications Authority

Level 2 Physics 2024

91170 Demonstrate understanding of waves

Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of waves.	Demonstrate in-depth understanding of waves.	Demonstrate comprehensive understanding of waves.

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 L2–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 room for any answer, use the extra space provided at the back of this booklet.

Check that this booklet has pages 2–12 in the correct order and that none of these pages is blank.

Do not write in the margins (✂✂✂). This area will be cut off when the booklet is marked.

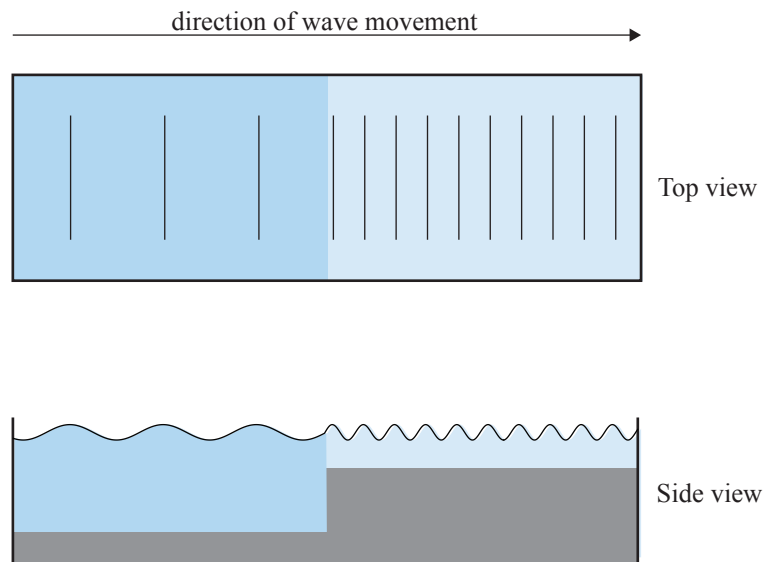
YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

QUESTION ONE: WAVES

A festival of light and sound has been organised in the local high school. The school entrance has a temporary water feature and guide ropes to direct visitors into the building.

The water feature looks like a long water tank with one shallow end and one deep end, and is shown below.

Joe notices a series of waves moving along the water surface shown in the diagram below. They move from left to right.



- (a) Name the physics phenomenon that causes the changes in the waves shown in the diagram above, as they move from left to right.

- (b) The waves are generated at the left-hand end, at a rate of 6 waves in 8.0 seconds. The initial wavelength of the waves is 4.0 cm, and this reduces to 2.0 cm at the right-hand end.

Calculate the final velocity of the waves just as they hit the wall on the right-hand end.

- (c) Describe and explain the phenomenon identified in part (a), as the wave moves from left to right. Include a description of any changes to wavelength, velocity, amplitude, and frequency of the waves.

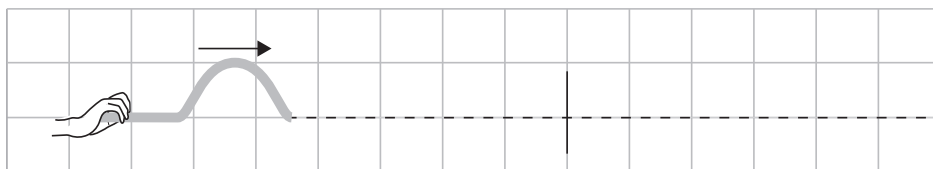
- (d) The guide ropes beyond the water feature consist of a less dense rope joined to a more dense rope. A student sends a pulse down the rope from the left along the less dense rope to the right. This is shown below in the diagram.



- (i) Complete the diagram below to show both the transmitted and reflected pulse after the pulse hits the boundary between the ropes.

You should include labels that identify:

- the transmitted pulse
- the reflected pulse.

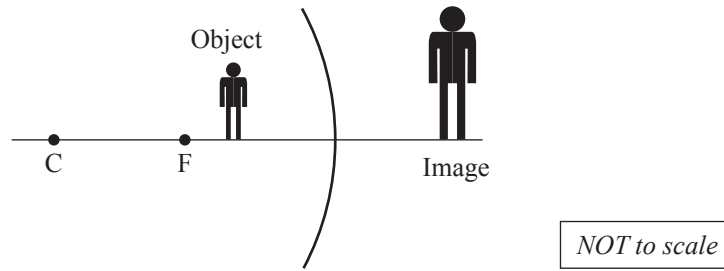


If you need to redraw your response, use the diagram on page 9.

- (ii) Compare the velocity of the reflected pulse with that of the transmitted pulse.

QUESTION TWO: MIRRORS AND LENSES

A room has been set up with mirrors and lenses to create different images. Anaru looks closely into a large curved mirror. His image is shown in the diagram below.



The image is enlarged and upright.

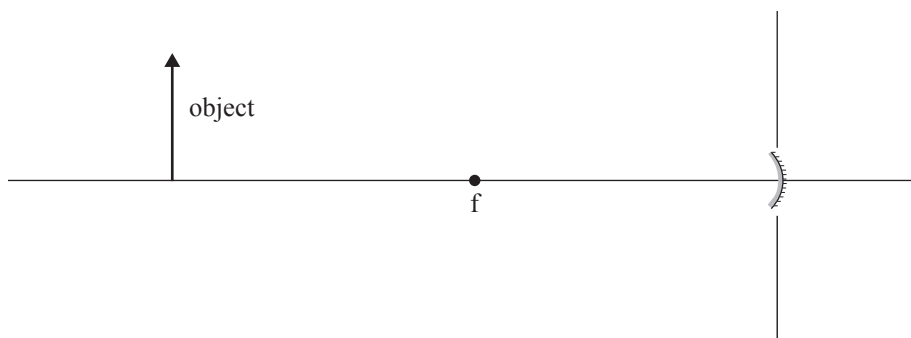
- (a) State the third property of the image.

- (b) Anaru is 1.5 m tall and is standing 0.90 m in front of the mirror, which has a focal length of 2.0 m.

Calculate the height of the image.

- (c) Joe stands 4.0 m in front of the concave mirror with focal length 2.0 m.

- (i) Complete the ray diagram below to locate the image.



If you need to redraw your response, use the diagram on page 9.

- (ii) State the three properties of the image formed.

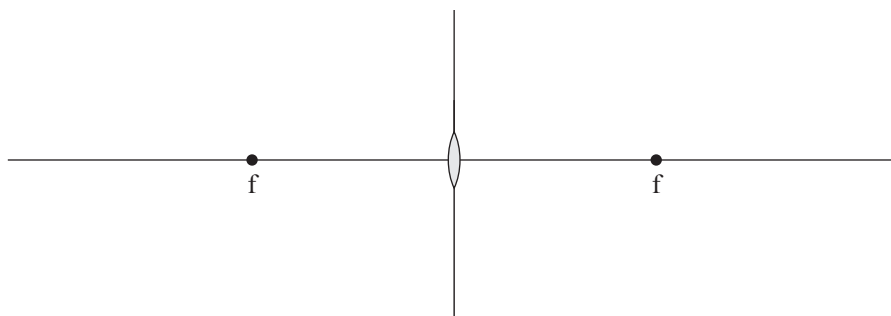
- (d) A candle is set up in front of a convex lens. The image produced is projected onto the screen, and is inverted and diminished, as seen below.



Source: <https://blogmedia.testbook.com/blog/wp-content/uploads/2022/04/class-7-science-chapter-15-e6be40d8.pdf>

- (i) State the property of the image that allows it to be projected on to a screen.

- (ii) Complete a ray diagram on the axis below to show how the inverted and diminished image could be formed.



*If you need
to redraw your
response, use
the diagram on
page 9.*

- (iii) The boys move the candle to produce a larger image, still able to be formed on a screen.

Explain how the image size can be made larger and still formed on a screen.

QUESTION THREE: LIGHT

The final room is filled with a light display using fibre optics.



Source: <https://physics.stackexchange.com/questions/699725/working-of-the-optical-fibre>

Source: https://www.linkedin.com/pulse/dark-fiber-market-share-industry-analysis-size-growth-tdoac?trk=public_post

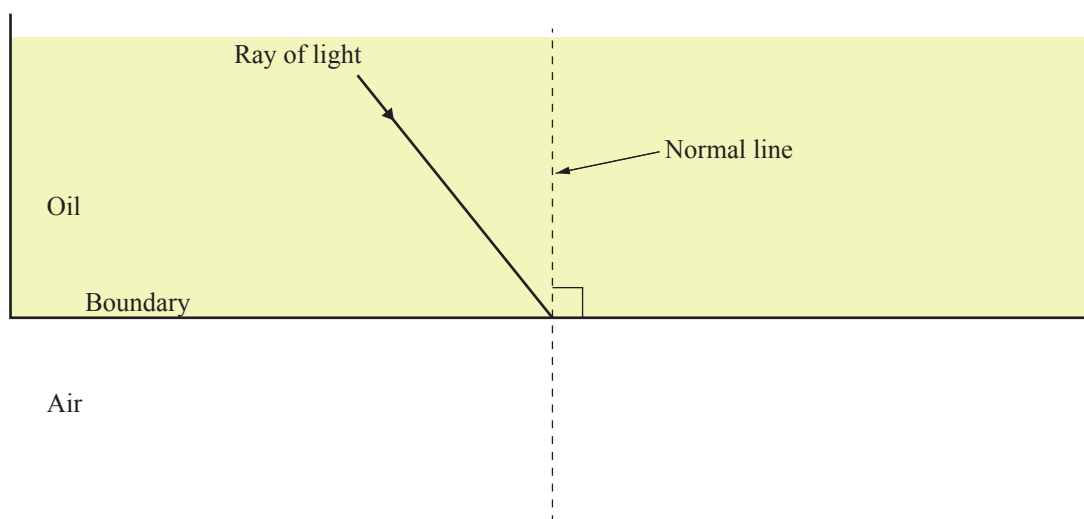
A fibre optic cable is made from a glass core contained within a cladding (covering).

- (a) State what the symbols n_1 and n_2 represent in the diagram above.

- (b) (i) Name the phenomenon that allows light rays to be transmitted along the fibre optic cable.

- (ii) State the conditions required for this phenomenon to occur within this fibre optic cable.

- (c) A table has been set up with a single beam of light shining through a tank that is filled with oil, as shown below. The light is moving from the oil into the air.



- (i) Add a labelled arrow to the diagram above to show the refracted ray as light passes from oil to air.
- (ii) The angle of incidence on the oil air boundary is 30° .

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

The refractive index of air is 1.00.

The velocity of light in air: $v_2 = 3.00 \times 10^8 \text{ m s}^{-1}$
and in oil: $v_1 = 2.56 \times 10^8 \text{ m s}^{-1}$

Calculate the angle of refraction in air.

Question Three continues on the following page.

- (d) As the people leave, they pass a signal generator set up with two loudspeakers lined up, as shown. The speakers are both sounding the same single frequency at the same volume.



<https://spark.iop.org/collections/youngs-slits>



The people walk past the speakers as shown in the diagram above.

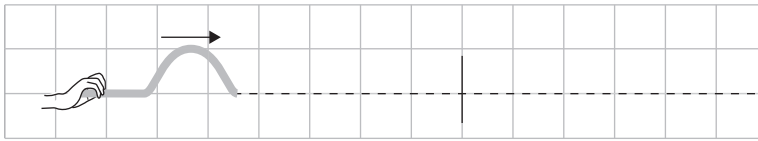
Describe and explain any changes to the sound experienced by the people as they walk past the speakers.

You may use a diagram to help explain your answer.

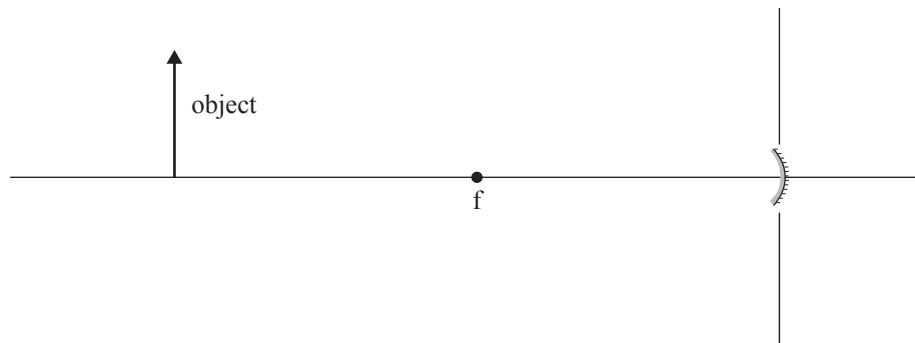
If you need to redraw your diagrams, use the space on page 10.

SPARE DIAGRAMS

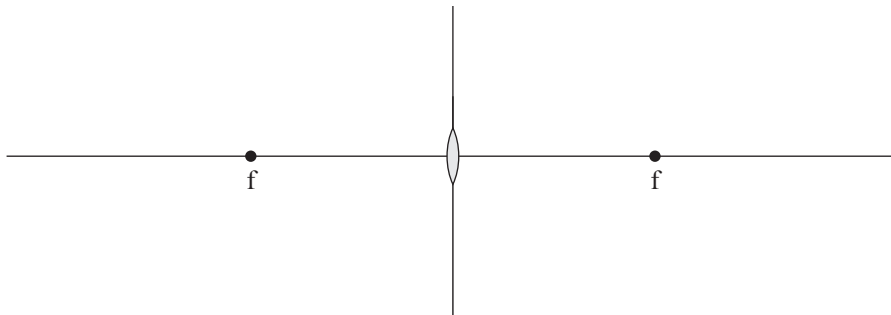
If you need to redraw your response to Question One (d)(i), use the diagram below. Make sure it is clear which answer you want marked.



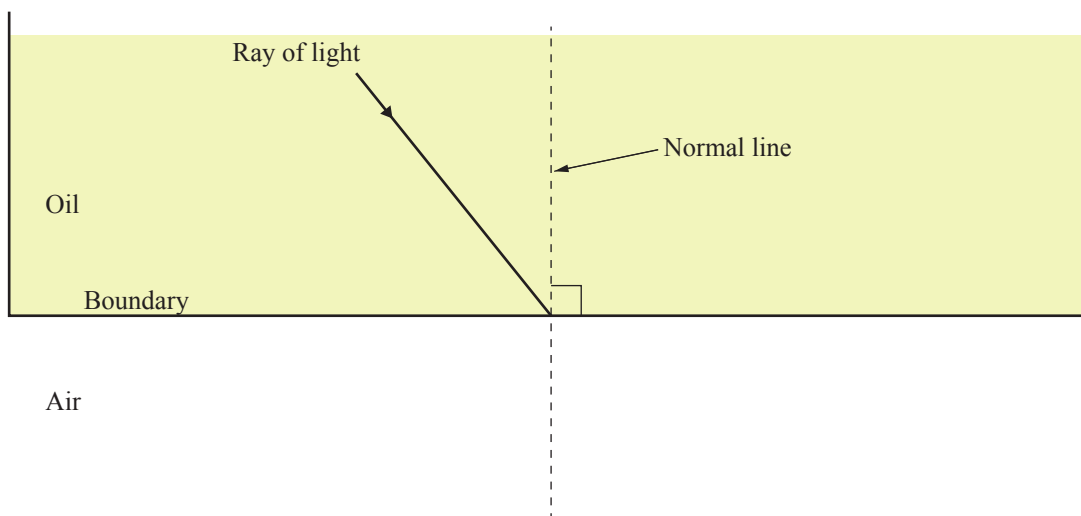
If you need to redraw your response to Question Two (c), use the space below. Make sure it is clear which answer you want marked.



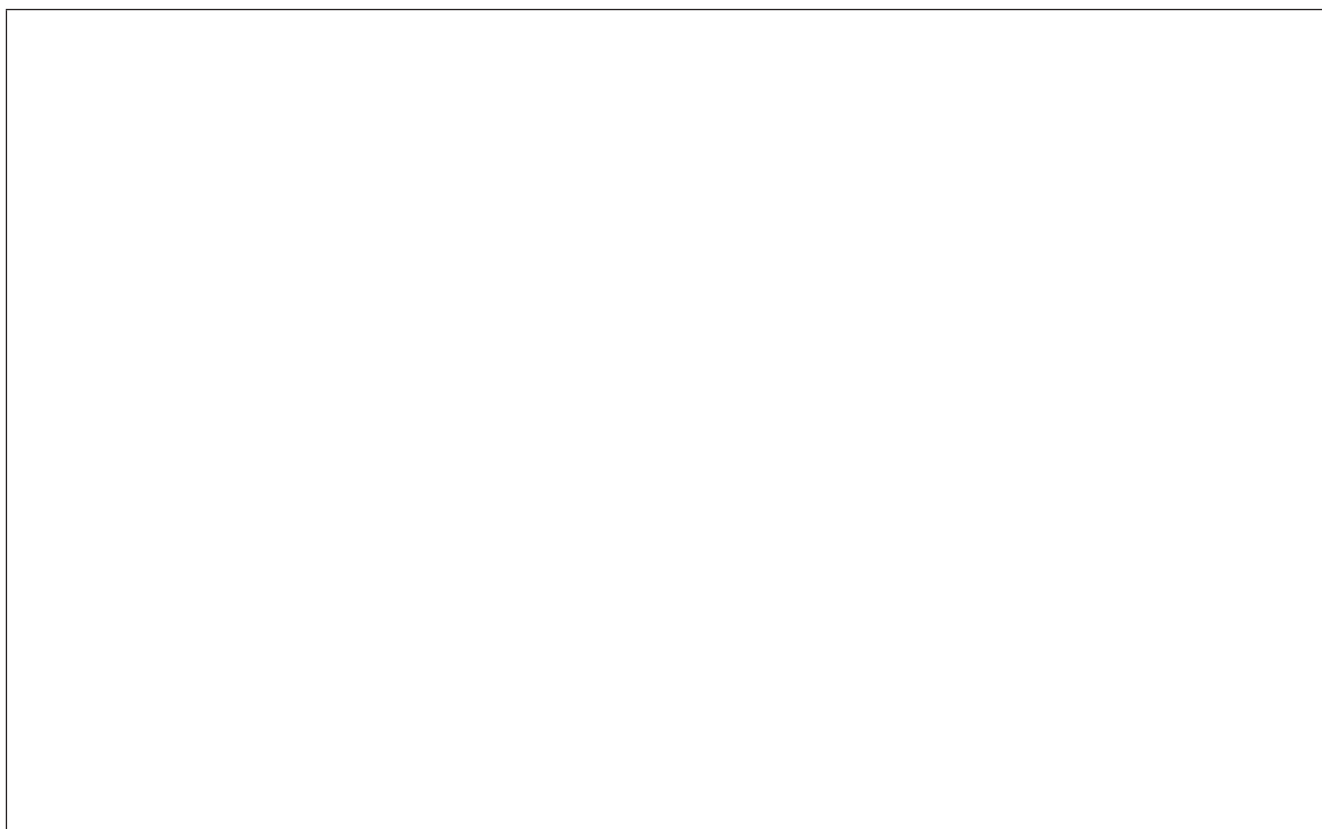
If you need to redraw your response to Question Two (d)(ii), use the space below. Make sure it is clear which answer you want marked.



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



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



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

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

QUESTION
NUMBER

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