

SUPERVISOR'S USE ONLY

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90938



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

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Mana Tohu Mātauranga o Aotearoa
New Zealand Qualifications Authority

Level 1 Physics 2023

90938 Demonstrate understanding of aspects of wave behaviour

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 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.

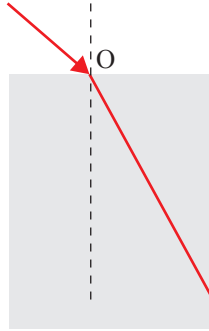
Do not write in any cross-hatched area (☒). This area will be cut off when the booklet is marked.

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

QUESTION ONE: LIGHT

Julian plays with two glass blocks of equal dimensions, but different optical densities. He uses a red laser pointer to investigate how the materials bend light.

- (a) In the diagram below, label the angle of incidence (θ_i) and the angle of refraction (θ_r) at point O.



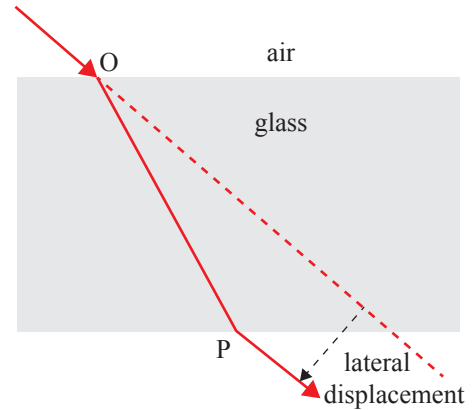
If you need to redraw your response, use the diagram on page 8.

- (b) Julian observes that the ray exiting the block into air at P is in the same direction as the ray entering the block at O, but shifted away from it. This shift is called ‘lateral displacement’.

Discuss why the laser light is laterally displaced after exiting the glass block at point P.

In your answer you should:

- define refraction
- explain what is happening to the laser light at the boundaries O and P, in terms of speed of light.



- (c) Julian plans to swap the first block for the second one. The second block has a larger optical density.

Explain what changes in the lateral displacement he should expect.

- (d) When Julian plays around with the block with higher optical density, as shown in the diagram, he observes that all the light rays refract **into** the block, but not all light rays refract **out of** the block. Julian finds that this depends on their angle of incidence on the inner surface of the block.



Discuss this phenomenon.

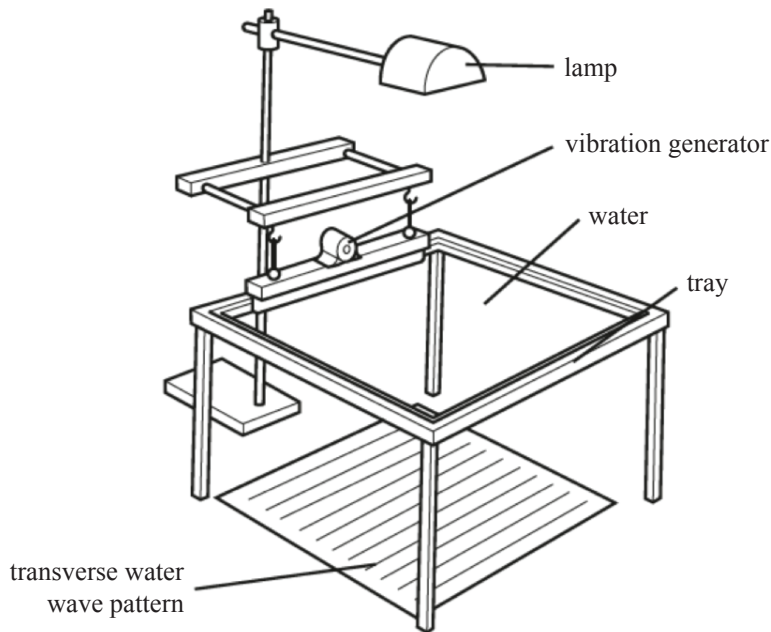
In your answer you should:

- name the physics phenomenon
- complete the ray diagram showing the light reflecting in the block
- explain the two necessary conditions for this phenomenon to occur.

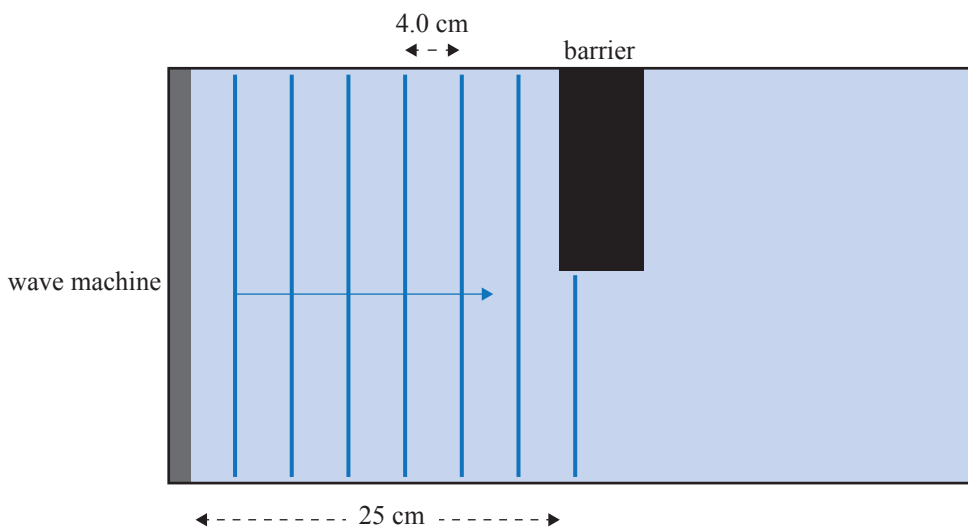
If you need to redraw your response, use the diagram on page 8.

QUESTION TWO: RIPPLE TANK

Mr Kingi sets up a ripple tank for his class. He wants to demonstrate how waves travel around obstacles.



- (a) In the diagram below, draw the wavefronts of the waves as they travel past the barrier.



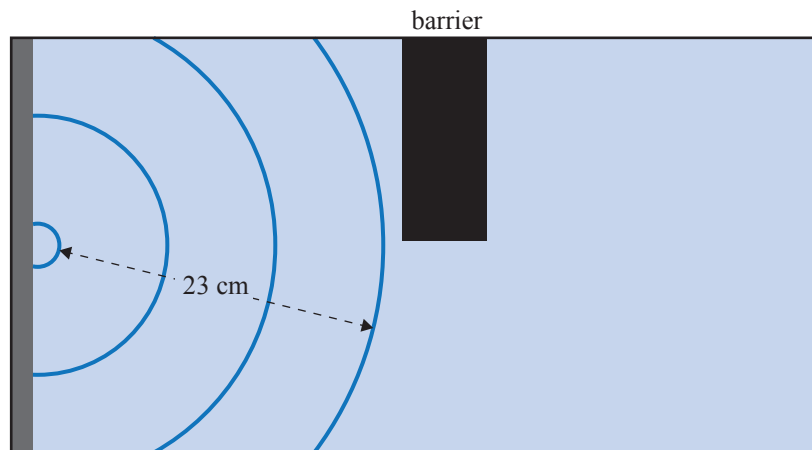
- (b) Mr Kingi sets the wave machine to a frequency of 2.6 Hz. This results in a wavelength of 4.0 cm.

Calculate the time it takes the first wavefront to reach the barrier.

- (c) Mr Kingi doubles the frequency of the wave machine.

Discuss how this affects the wavelengths AND the time taken for the waves to reach the barrier.

- (d) When Mr Kingi comes back from his lunch break, he notices the tap dripping. Water droplets fall into the tank at regular intervals and create waves, as shown in the diagram below. Mr Kingi knows that the wave speed in the tank, 10.4 cm s^{-1} , has not changed.



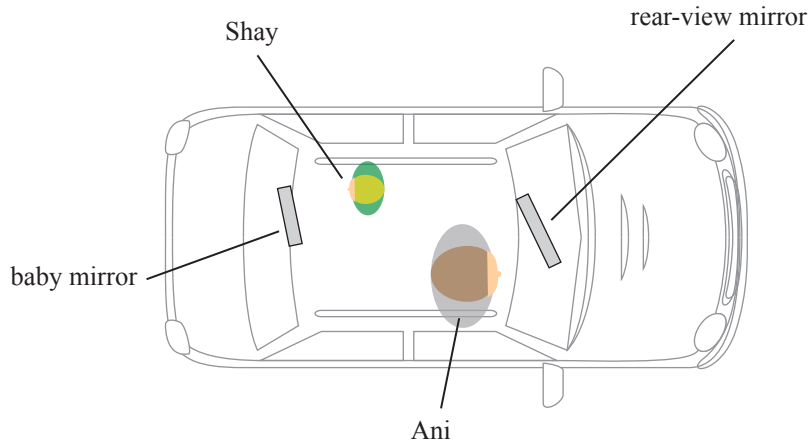
Calculate the number of drops that fall into the tank in one minute.

- (c) Ani uses a baby mirror and her rear view mirror to see Shay's face when the child seat is backwards-facing.

In the diagram below, draw light rays from Shay to Ani to show how Ani can see Shay's face.



Source: www.amazon.co.uk/Magnelex-Mirror-Crystal-Adjustable-Assembled/dp/B07R7D8NZG

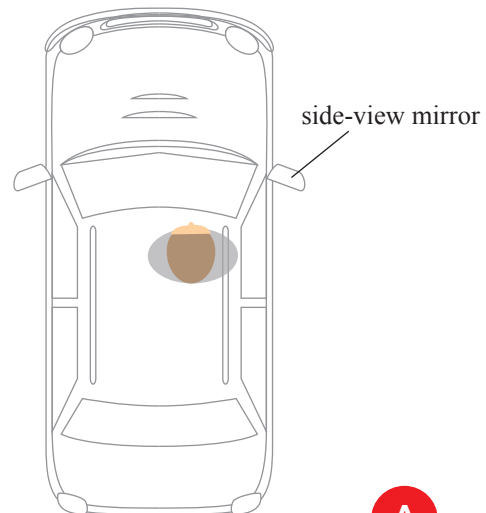


If you need to redraw your responses, use the diagrams on page 9.

- (d) Before reversing her car, Ani checks her side-view mirrors.

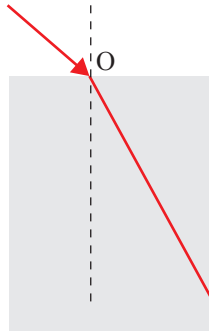
Discuss by referring to the diagram opposite, why Ani can see object A in her side-view mirror, but not object B.

As part of your answer, you should refer to the law of reflection, and draw light rays on the diagram.

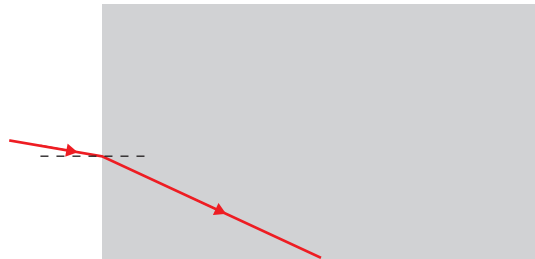


SPARE DIAGRAMS

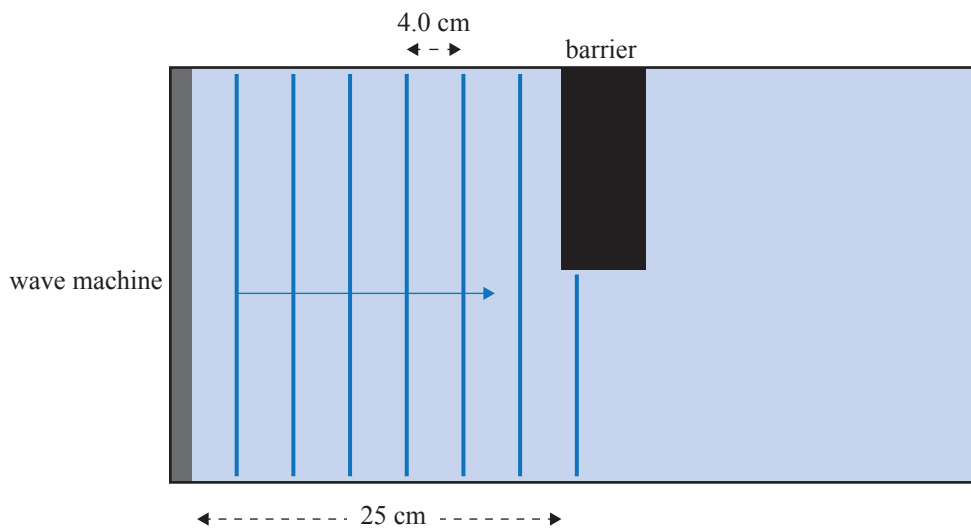
If you need to redraw your response to Question One (a), use the diagram below. Make sure it is clear which answer you want marked.



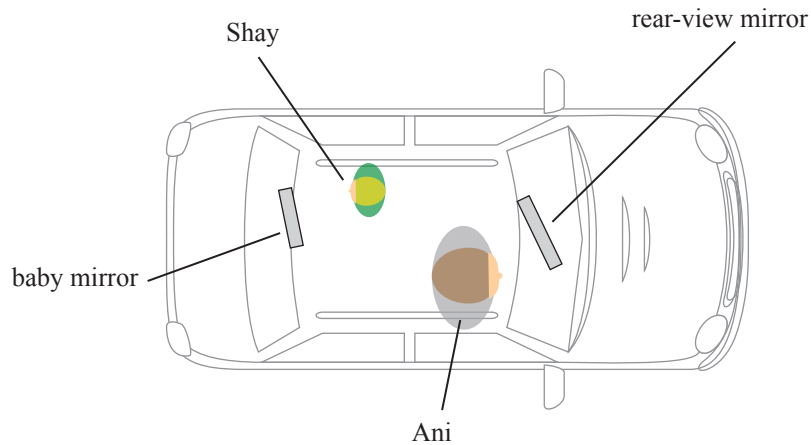
If you need to redraw your response to Question One (d), use the diagram below. Make sure it is clear which answer you want marked.



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 Three (c), use the diagram below. Make sure it is clear which answer you want marked.



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

