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Level 1 Physics 2020

90938 Demonstrate understanding of aspects of wave behaviour

9.30 a.m. Thursday 3 December 2020
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.

Useful information for calculation questions is available on the Resource Sheet.

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

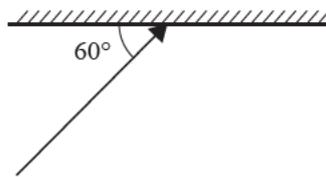
ASSESSOR'S USE ONLY

QUESTION ONE: REFLECTIONS

- (a) A light ray has a wavelength of 705.9 nm (7.059×10^{-7} m) as it travels through air with a speed of 3.00×10^8 m s⁻¹.

Calculate the frequency of the light ray.

- (b) The light ray is reflected at a polished glass surface.
- (i) In the diagram below, draw the normal where the ray hits the polished glass surface, and draw the reflected ray.



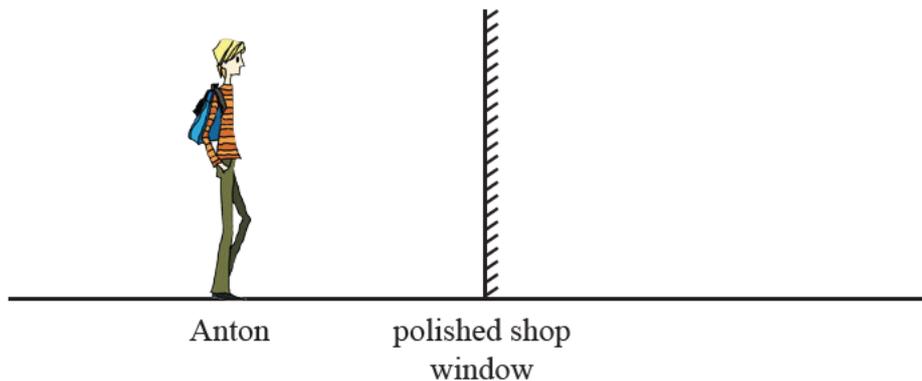
If you need to redraw your ray diagram, use the diagram on page 8.

- (ii) State the angle of incidence: _____

Anton walks up to a shop with highly polished windows.

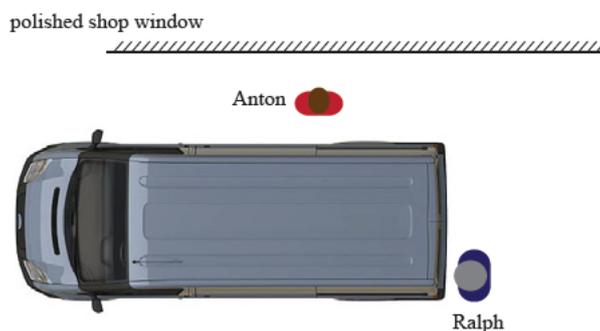
- (c) Anton can see his reflection in one of the windows.

In the diagram below, draw TWO light rays to show where the mirror image of Anton's knee would appear in the window.



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

- (d) Anton is between a van that has no rear side windows and the shop window. Anton's friend Ralph is positioned behind the van, as shown in the diagram below.



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

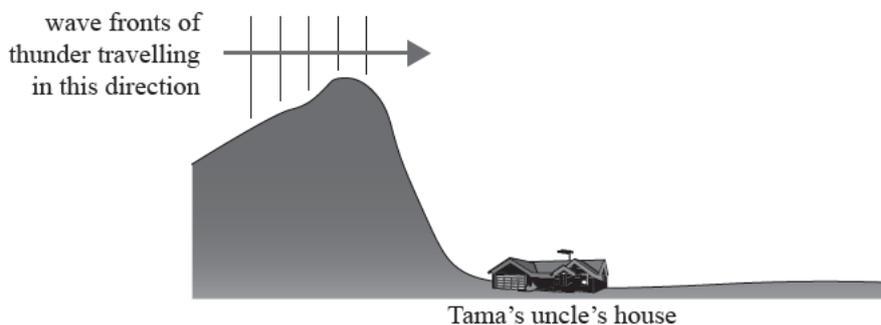
- (i) Discuss whether Ralph can see Anton's reflection in the shop window.

In your answer:

- Draw light rays to locate the image of Anton in the window onto the diagram above, labelling the point on the window that reflects light rays off Anton towards Ralph with an 'X'.

- (ii) Explain whether the light rays hitting the window left and right of the 'X' will reach Ralph.

- (c) The lightning strikes behind the hilltops. Tama and his uncle can hear the sound of the rolling thunder.



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

- (i) In the diagram above, draw wave fronts to show how the sound waves of the rolling thunder continue to travel.
- (ii) State the physics term that describes the way the sound waves travel across the hilltop.

- (d) Tama uses the following method to estimate how far away the thunderstorm is.

When Tama sees the lightning strike, he counts the seconds until he hears the thunder, and divides the result by 3. The answer gives the distance of the thunderstorm from Tama in units of **km**.

Explain in detail the physics behind Tama's reasoning.

You should support your answer with a calculation that links the speed of sound in air (330 m s^{-1}) to the distance between the source of the sound and Tama.

QUESTION THREE: ON THE BEACH

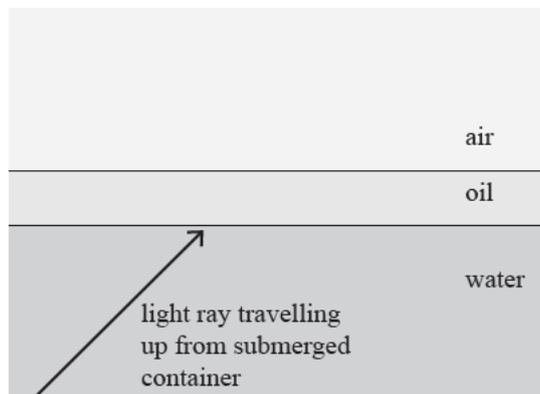
- (a) A fisherman is on his boat and the waves are causing his boat to move up and down. As it moves up and down, the boat completes 3 oscillations every 11 seconds.

Calculate the period of its motion.

- (b) The fisherman notices a small container in the ocean that is leaking engine oil

The oil from the container has formed a thin film floating on the water surface. The oil has a higher optical density than water.

The diagram below shows a light ray coming off the submerged container, travelling up through the water and into the oil.

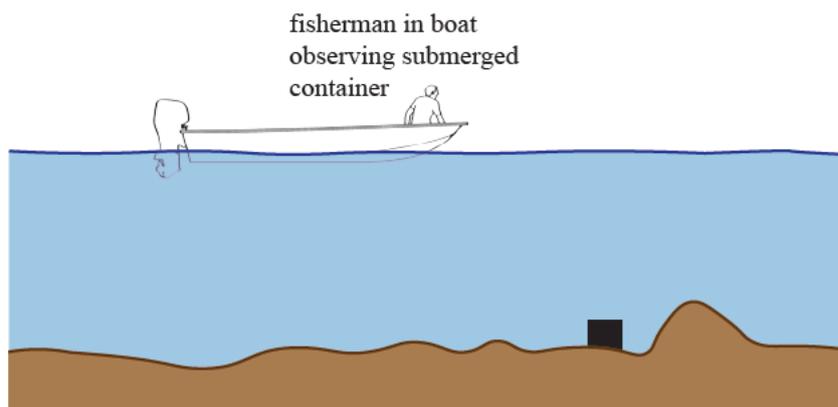


Source: www.shutterstock.com/fr/image-illustration/oil-barrel-sinking-deep-into-ocean-1302471235

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

- (i) In the diagram above, draw how the light ray would travel through the oil film and into the air.
- (ii) State how the frequency, the speed, and the wavelength of the light ray change when the ray goes **from the water into the oil**.

- (c) A fisherman on the boat inspects the submerged container from above the water.

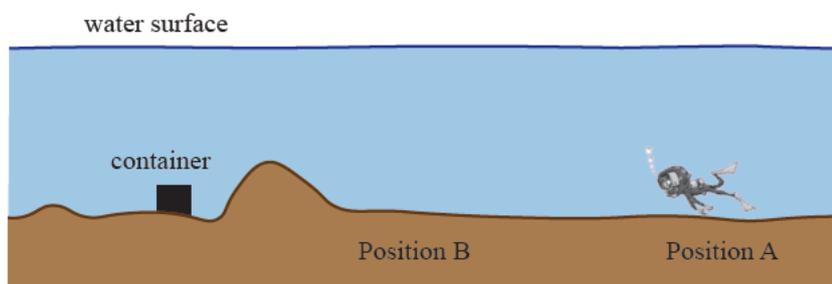


*If you need
to redraw your
response, use the
diagram on page 10.*

The fisherman sees an image of the container in the water.

- (i) Draw TWO rays from the container to show where the location of the image would be.
- (ii) Describe the properties of the the container's image.

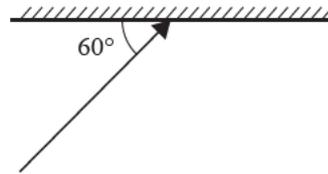
- (d) A diver approaches the container from behind a formation of rocks. The rocks block her line of sight to the container at all times. Initially, at position A in the diagram below, she can see an image of the container in the water surface above.



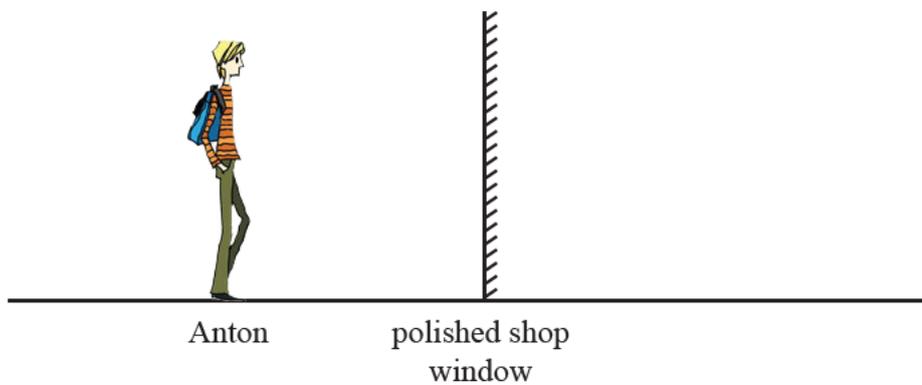
Explain in full why she can see an image of the container in the water surface at position A, but when at position B, she cannot see the container in the water surface.

SPARE DIAGRAMS

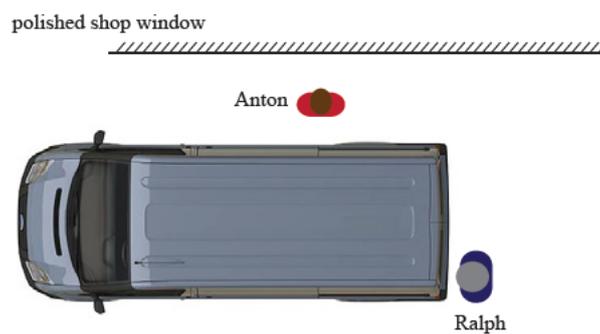
If you need to redraw your response to Question One (b), use the diagram below. Make sure it is clear which answer you want marked.



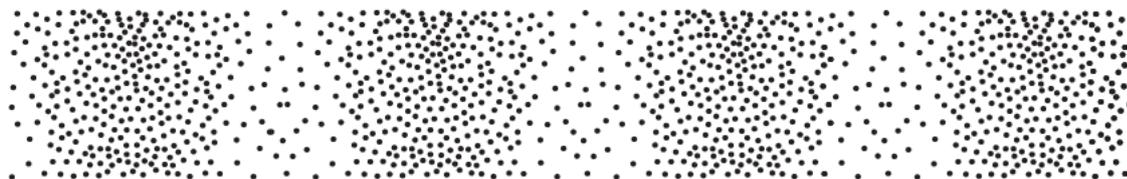
If you need to redraw your response to Question One (c), use the diagram below. Make sure it is clear which answer you want marked.



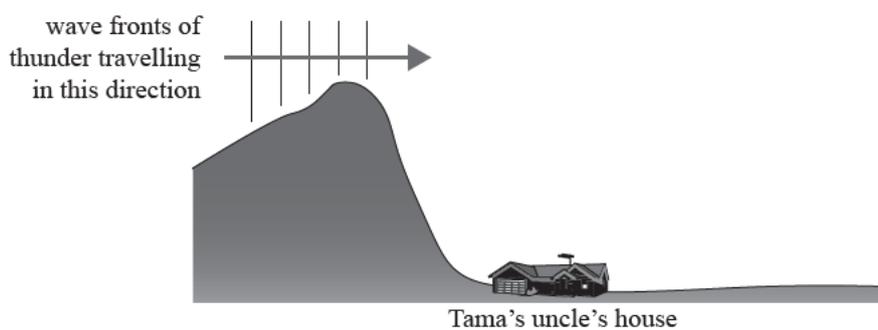
If you need to redraw your response to Question One (d), use the diagram below. Make sure it is clear which answer you want marked.



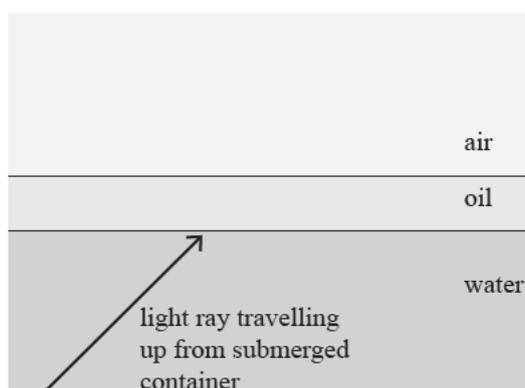
If you need to redraw your response to Question Two (a), use the diagram below. Make sure it is clear which answer you want marked.



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

