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Level 1 Physics 2022

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.

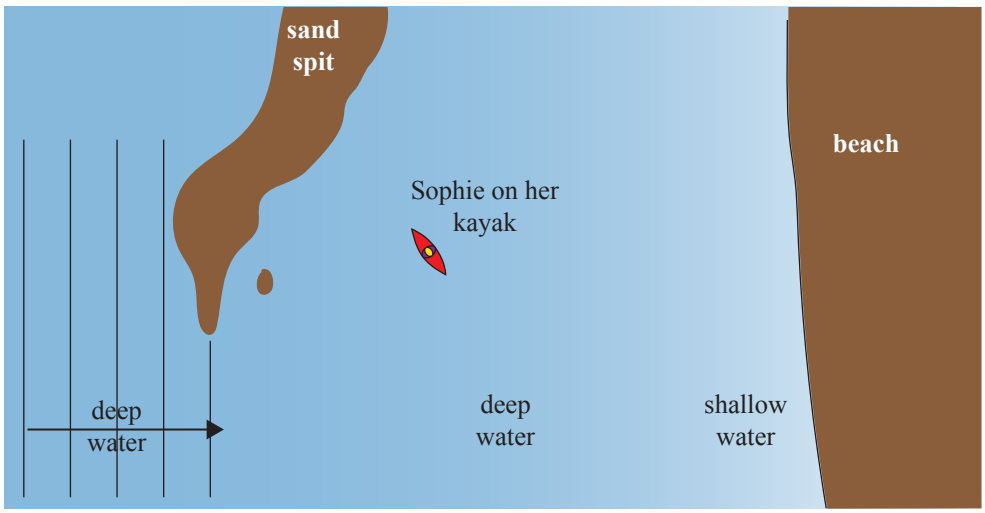
Check that this booklet has pages 2–12 in the correct order and that none of these pages is blank.

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

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

QUESTION ONE: OUT IN THE BAY

Sophie is in the bay on her kayak. At the position shown in the diagram below, she takes a moment to observe the ocean waves rolling past the sand spit and towards shallow water.



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

(a) State the name of the physics phenomenon when waves travel around a barrier.

(b) (i) In the diagram above, draw the waves as they travel around the sand spit in the **deep water**.

(ii) Explain what happens to the wavelength of the waves as they travel around the sand spit in deep water.

(c) The water at the beach is shallower than further out in the bay. As the ocean waves run into the shallow water, their wavelength decreases.

Explain why the waves have a smaller wavelength in shallow water.

(d) Sophie estimates the wavelength in deep water to be 12 m. Using her stopwatch, she measures the period of the waves to be 5.2 s. Sophie knows that the speed of waves in the shallow water is one third the speed of the waves in deep water.

Calculate the wavelength in shallow water and compare it to the wavelength in deep water.

Start by showing the wave speed in deep water is 2.31 m s^{-1}.

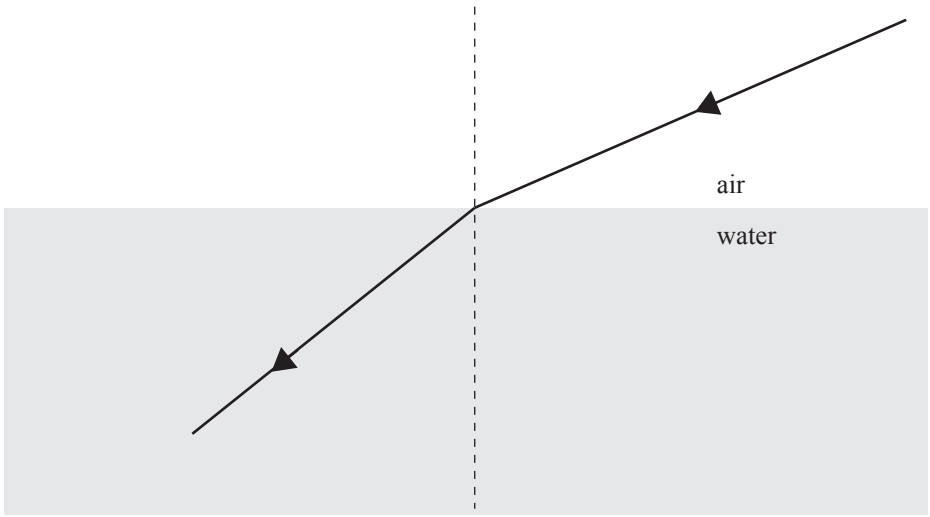
QUESTION TWO: A LITRE OF LIGHT

"Litre of light" is a design for inexpensive indoor lights that do not require a supply of electricity. It consists of a transparent plastic bottle full of water. The bottle is fitted into a hole in the roof of a dwelling. This way, daylight from the outside is directed indoors.

Source: https://www.thenorthernecho.co.uk/opinion/leader/10792097.lightbulb-moment/

(a) The diagram below shows a light ray entering water from air.

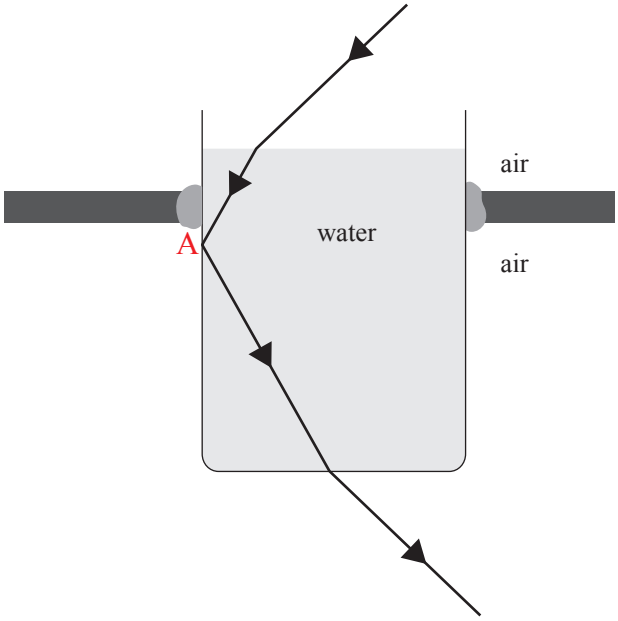
In the diagram, label the angle of incidence, θ_i, and the angle of refraction, θ_r.



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

(b) Explain how the optical density of water compared to the optical density of air affects the path of light, as shown in the diagram above.

(c) The bottle of water directs daylight indoors by a combination of refraction and reflection. The diagram below shows how one ray travels through the bottle of water.



Explain how the ray can be reflected on the inside surface of the bottle at point A, even though the bottle is made from transparent (non-reflective) material.

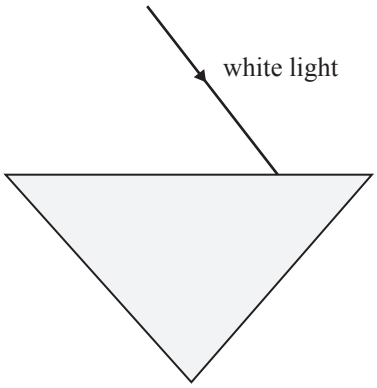
Question Two continues on the following page.

(d) The ‘deck prism’ is a similar design that was historically used to light the inside of seafaring ships without a supply of electricity. It consists of a glass prism fitted flush with the deck floor, its triangular side pointing down, as shown in the diagram below. This would direct light from outside into the ship.

Source: www.tonygrove.com/articles/new-deck-for-kentish-maid-p2.php

Explain why deck prisms were often found to split the white light from the outside into the colours of the rainbow.

As part of your answer, complete the diagram below to show what happens to the incident white light as it travels through the deck prism.



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

QUESTION THREE: DOLPHIN WATCHING.

Rehutai and a friend want to observe Māui dolphins from their small boat. They cannot see that there is a dolphin in the water. However, the dolphin knows that they are there.

Māui dolphins use high-pitched clicking sounds to echolocate. In doing so, a dolphin makes a sound and 'listens' to the sound wave bouncing off objects in the water.

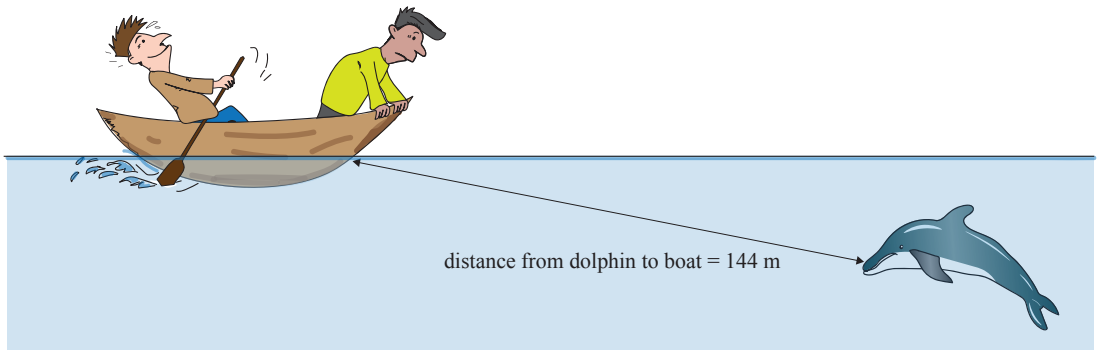
(a) What type of wave is a sound wave?

(b) Compare the direction of travel of the sound wave in water, and the direction the water particles vibrate when the sound wave moves through them.

Question Three continues on the following page.

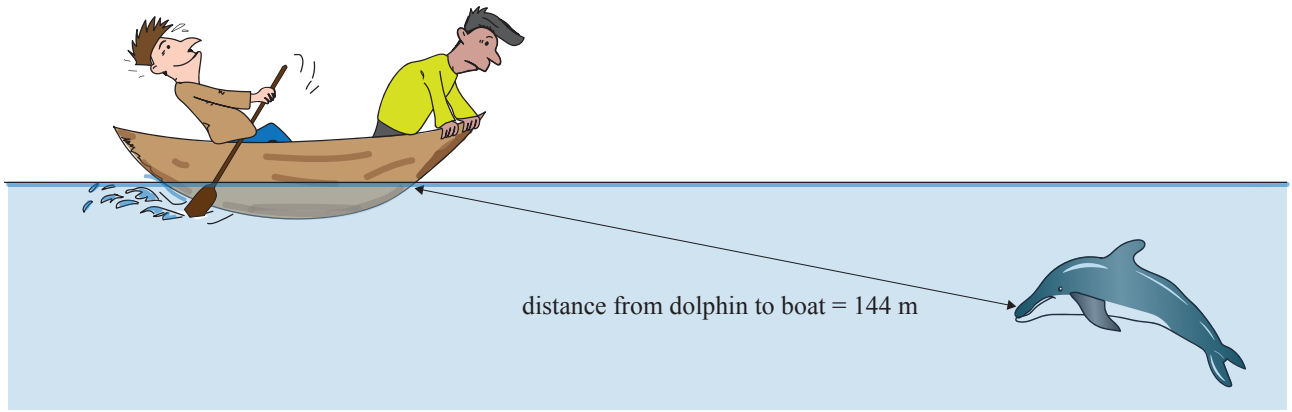
(c) The dolphin makes a 120 kHz (120×10^3 Hz) sound and listens for the echo from Rehutai's boat. In water, the wavelength of the sound is 0.012 m. It takes 0.20 s until the dolphin hears the reflected sound.

Calculate the distance the sound has travelled, and explain why this is not the distance shown in the diagram below.



(d) The dolphin can also see Rehutai on his boat.

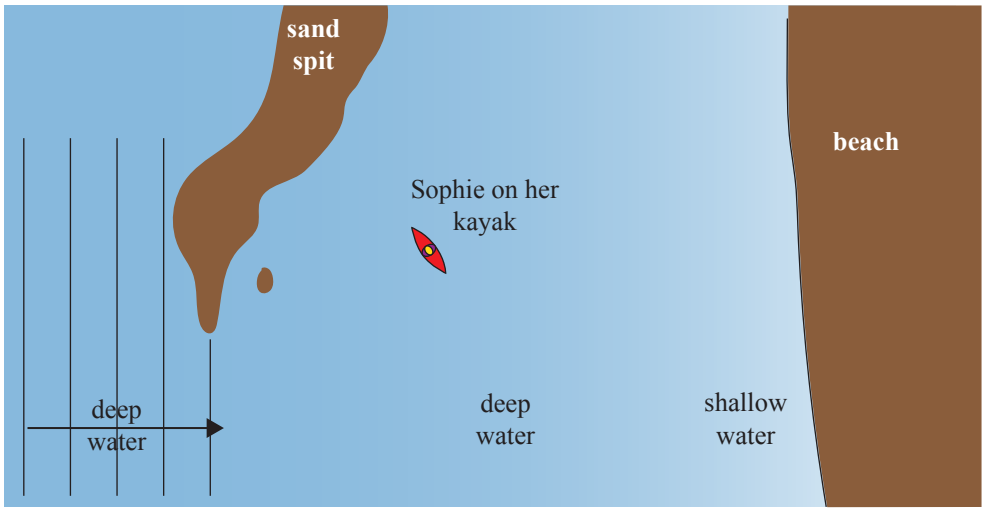
In the diagram below, draw two light rays to show where the dolphin would see an image of Rehutai on his boat.



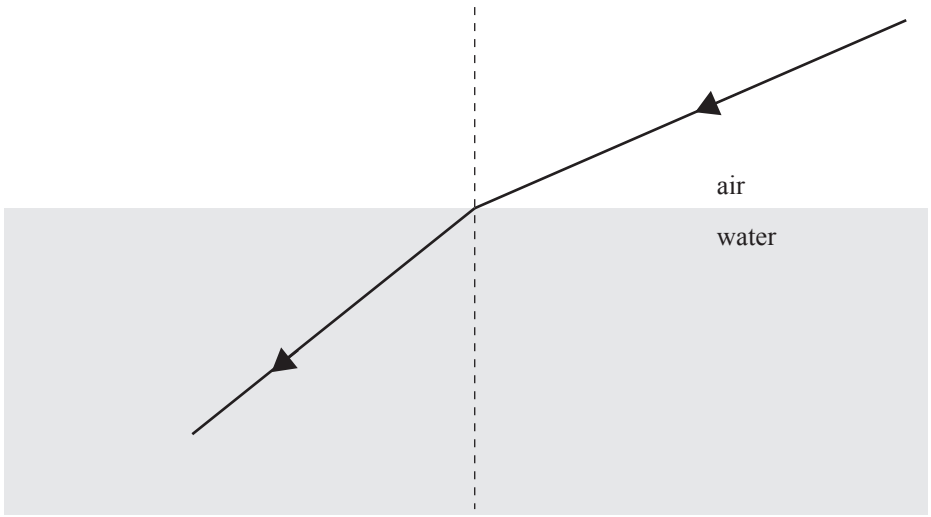
If you need to redraw your response, use the diagram on page 11.

SPARE DIAGRAMS

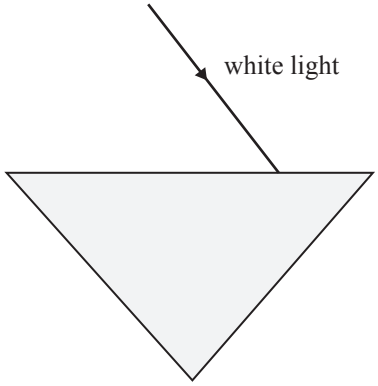
If you need to redraw your response to Question One (b)(i), use the diagram below. Make sure it is clear which answer you want marked.



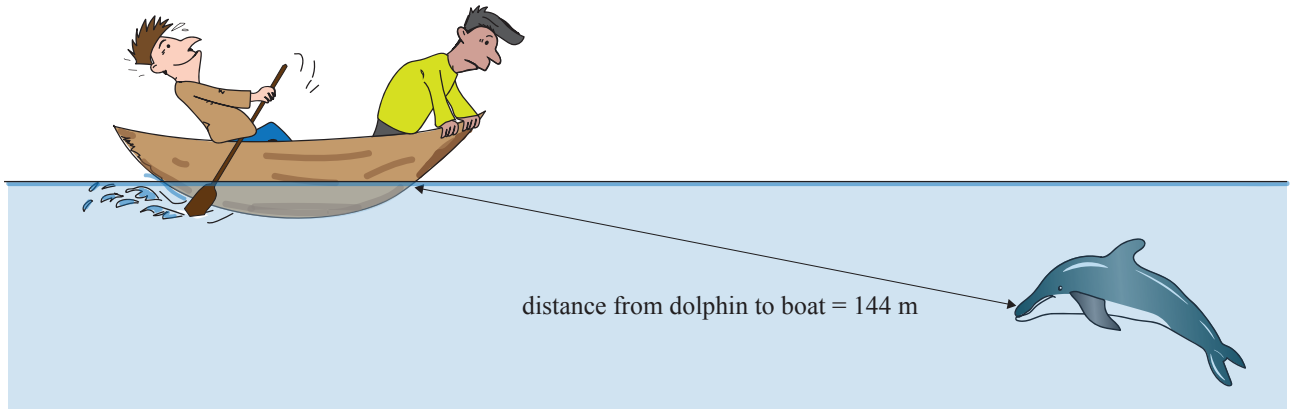
If you need to redraw your response to Question Two (a), use the diagram below. Make sure it is clear which answer you want marked.



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



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

QUESTION NUMBER