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NZQA

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2

SUPERVISOR'S USE ONLY

Level 2 Physics, 2016

91170 Demonstrate understanding of waves

9.30 a.m. Tuesday 15 November 2016
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 space for any answer, use the page(s) provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–11 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

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QUESTION ONE: LIGHT

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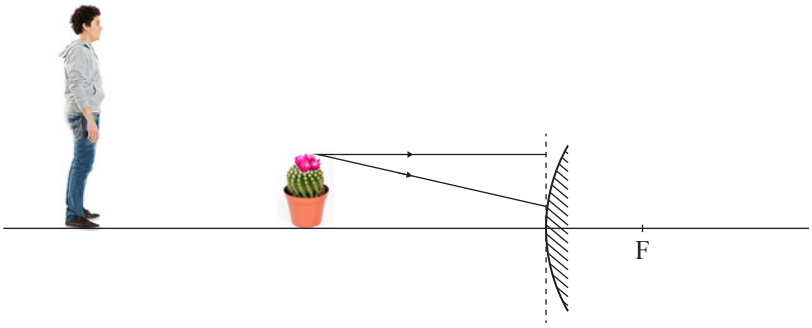
Tim was looking into a convex mirror ball in his garden.

Standing behind a small plant, he noticed that when he looked at the reflection of the plant in the convex mirror, it appeared smaller than it really was.

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



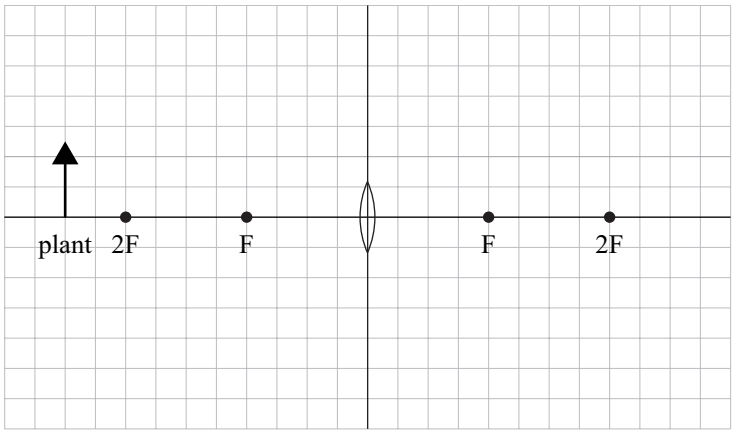
(a) Complete the simplified ray diagram above (not to scale) to show where the image of the small plant would appear.

Tim used a convex lens to create an image of the small plant. The convex lens has a focal length of 40.0 cm.

(b) Draw TWO appropriate rays on the diagram below to show where the image of the plant would be formed.

Draw the image in the correct position.

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



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(c) The images produced by the convex mirror and the convex lens are quite different. The convex mirror produces a virtual image, and the convex lens produces a real image.

- Explain the difference between a real and a virtual image.
- Explain how Tim could detect the difference between the two images.

(d) Tim places a small 10.0 cm tall plant a distance of 60.0 cm from the convex lens (with a focal length of 40.0 cm).

Calculate:

- the distance between the image and the lens
- the height of the image.

QUESTION TWO: WATER

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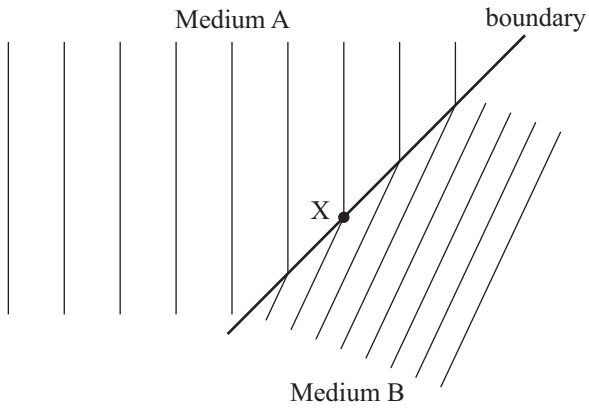
Tim looked at the pond in the garden and noticed a pattern in the water caused by the wind. The diagram below shows a simplified pattern of the water waves being refracted as the depth of the water in the pond changes. Refraction occurs at the boundary between the two depths of the pond. The **incident waves** are on the **left** of the boundary.



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

(a) Draw an arrow to mark on the diagram the direction of the incident wave as it reaches point X.

Draw an arrow to mark on the diagram the direction of the refracted wave after it leaves point X.

(b) (i) Which property of a wave does not change when it is refracted?

(ii) The wavelength of the wave gets smaller as it enters medium B.

Explain what this tells you about the speed of the wave in medium B.

(c) If the wavelength of the wave in medium A is 0.300 m, and the speed of the wave in medium A is 3.30 m s^{-1}, calculate the wave speed in medium B if the wavelength of the waves in medium B is 0.200 m.

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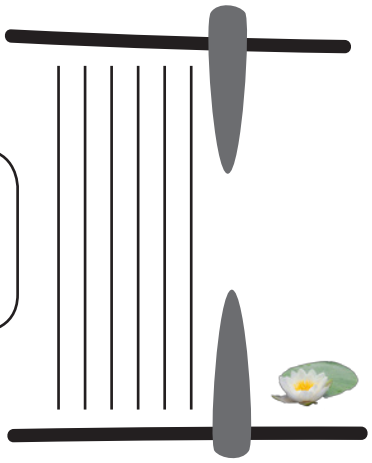
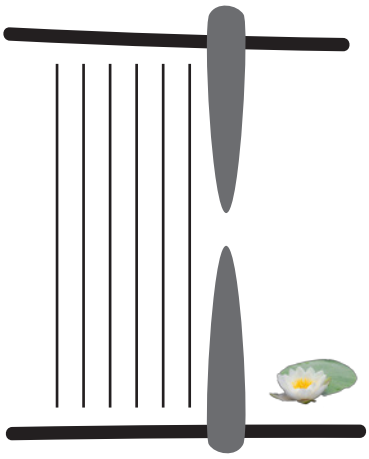
(d) The pond is large enough that other wave effects can be seen by Tim. At one end of the pond, there are two large rocks that can be made to partially block the waves as they move from left to right. A water lily is floating beyond the rocks. By changing the position of the rocks, Tim can cause the water waves to move the floating water lily.

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



Rock position A



Rock position B

(i) Name the process by which waves could reach the floating water lily.

(ii) Complete both diagrams to show the pattern created by the waves as they pass through the gap between the two rocks in both rock position A and rock position B.

(iii) Use your answer to part (ii) to decide whether the waves reached the floating water lily using rock position A or rock position B.

Give a comprehensive explanation as to why this rock position affected the waves more than the other rock position.

QUESTION THREE: WASHING THE CAR

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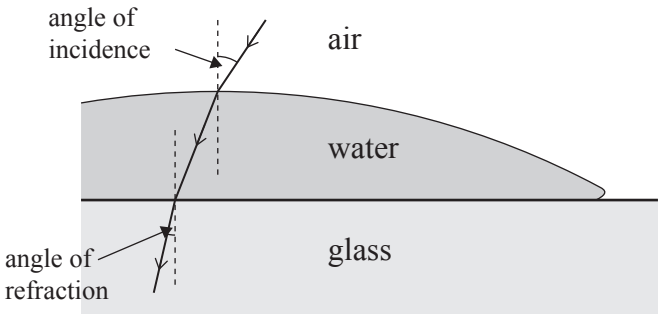
Ana is washing her car and notices that she can see drops of water on the windscreen, even though both the glass and the water drops are transparent.

(a) Why is Ana able to distinguish between the glass and the water?

Ana tries to sketch a drawing of a large bead of water on the windscreen to help her understand what is happening.



Use the information below to answer part (b).

Refractive index of air = 1.00

Refractive index of water = 1.33

Refractive index of glass = 1.52

Angle of incidence at air-water interface = 32°.

(b) If the air-water interface and the water-glass interface are roughly parallel, calculate the angle of refraction in the glass (as labelled).

Ana experiments with a red laser, a perspex bottle, and a stream of water, to create total internal reflection.

http://www.aapt.org/programs/contests/winnersfull.cfm?id=2687&theyear=2011

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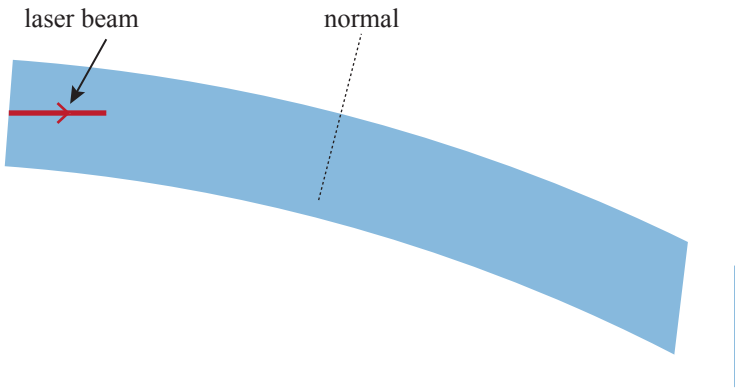
(c) State two conditions necessary for total internal reflection to occur.

(d) (i) Complete the diagram below to show the path of the laser beam in the stream of water.
On your diagram, mark the angle of incidence. The normal has been drawn for you.



(ii) If the exact critical angle for red light is 48.70°, calculate the refractive index of water for red light, to 3 decimal places.

SPARE DIAGRAMS

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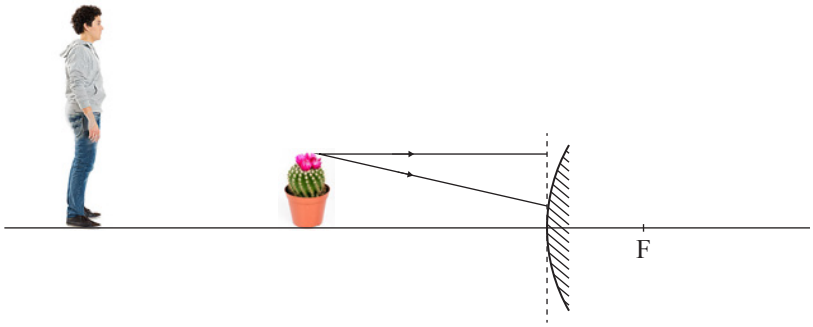
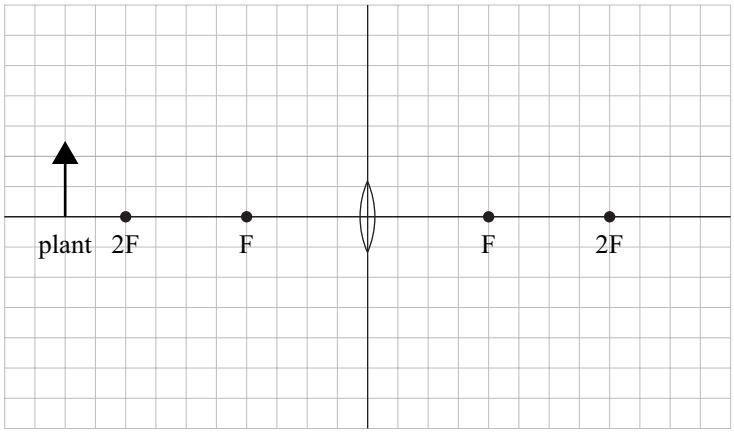
If you need to redraw your ray diagram for Question One (a), use the diagram below. Make sure it is clear which diagram you want marked.



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



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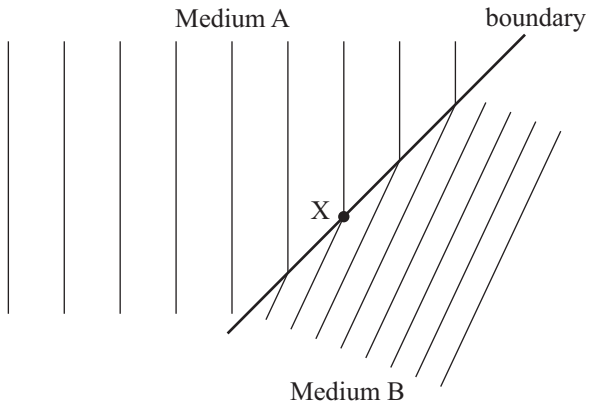
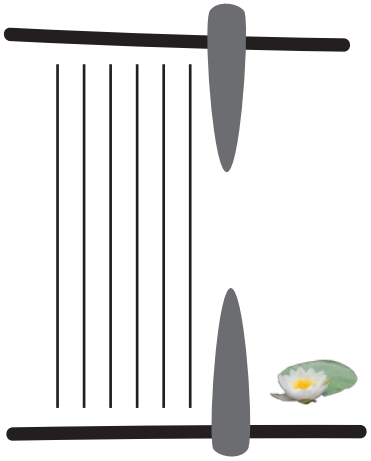
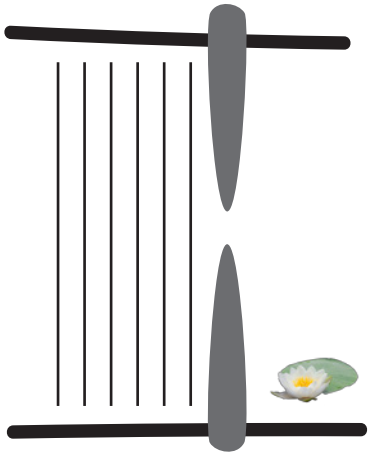
If you need to redraw your arrows for Question Two (a), use the diagram below. Make sure it is clear which diagram you want marked.



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



Rock position A



Rock position B

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

QUESTION NUMBER

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

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