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SUPERVISOR'S USE ONLY

Level 2 Physics, 2017

91170 Demonstrate understanding of waves

2.00 p.m. Friday 10 November 2017
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: CONCAVE AND CONVEX MIRRORS

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

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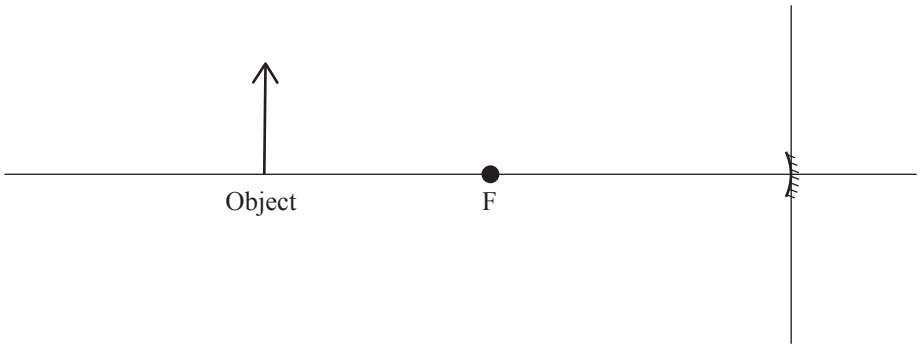
Sarah placed a candle in front of a concave mirror.

(a) Draw two rays from the candle (object) to locate the position of the image.
Draw and label the image.

Diagram is NOT to scale



(b) The candle, which has a height of 20.0 cm, is placed 140.0 cm in front of the concave mirror.
The mirror has a fixed focal length of 80.0 cm.

Calculate the height of the image formed.

(c) Sarah then puts the same 20.0-cm-tall candle at the same 140.0 cm distance in front of a convex mirror, which also has a focal length of 80.0 cm.
The images formed by the concave and convex mirrors are different.

Describe two differences in the images formed, and explain why these differences occur.
No calculations are necessary.

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(d) The same 20.0-cm-tall candle is again placed in front of the first concave mirror of focal length 80.0 cm. The candle is moved until the image is upright and is three times the size of the object.

(i) Describe the nature of the image.

(ii) Calculate the distance the candle (object) is away from the mirror.

QUESTION TWO: REFRACTION AND LENSES

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Sarah found two pairs of old reading glasses in her grandmother's drawer. One pair was quite heavy, made up of glass lenses and the other pair was quite light, made up of plastic lenses. Sarah has learned from her physics class that glass and plastic have different refractive indexes.

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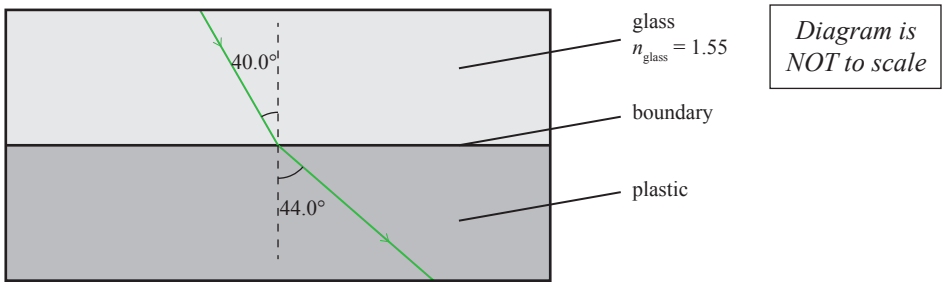
To investigate further, she places a transparent glass and a transparent plastic rectangular block together and shines a green laser beam, as shown below.



(a) Show that the refractive index for plastic is 1.43.

(b) If the angle of incidence in glass becomes greater than the critical angle, then the light is totally internally reflected and no refraction takes place.

Calculate the critical angle for the glass-plastic boundary to 3 significant figures.

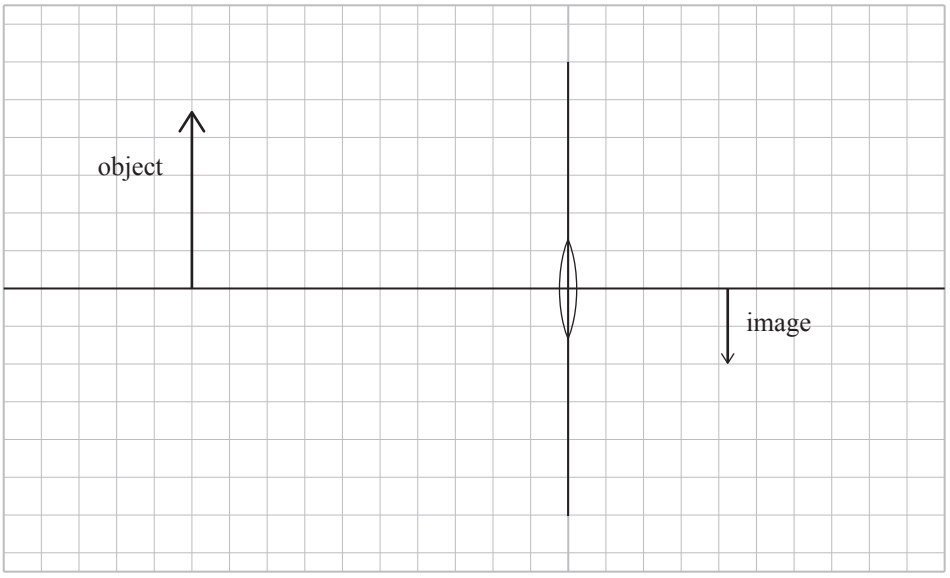
The diagram below shows a simplified version of the glass lens used in reading glasses.

ASSESSOR'S USE ONLY

(c) (i) Draw a ray diagram to find the positions of both focal points.

Label a focal point on the diagram below.

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



(ii) State the focal length for the above lens (1 square = 0.5 cm).

(d) The above diagram shows an inverted, diminished image.

By modifying the properties of the lens and/or its position, it is possible to create an image that is enlarged and upright.

Explain THREE different changes that could allow this to happen.

QUESTION THREE: WAVES

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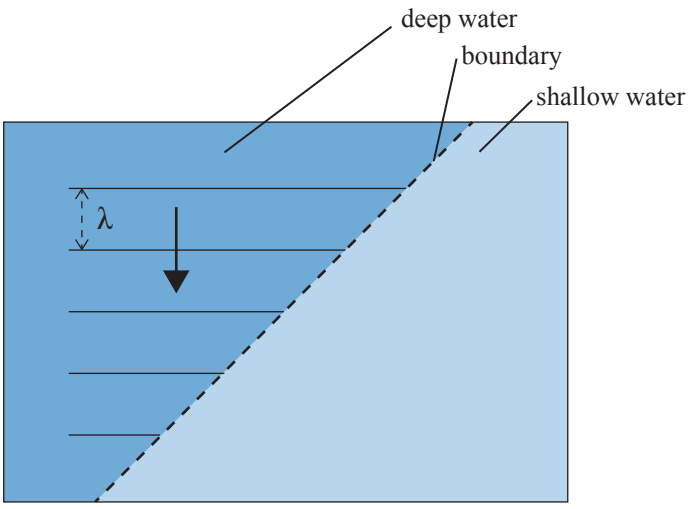
During her summer break, Sarah goes to her holiday home by the beach. Due to rocks at the beach, the depth of the water changes sharply.

At the beach Sarah counts 3 waves reaching the boundary in 15.0 seconds. The wavelength of the waves in deep water is 18 m.

(a) Calculate the speed of the waves in the deep water area.

(b) The waves move from deep water into shallow water.

(i) On the diagram below draw the refracted waves in shallow water.



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

(ii) If the wave speed in shallow water is 3.0 m s^{-1}, calculate the wavelength of the refracted waves in shallow water.

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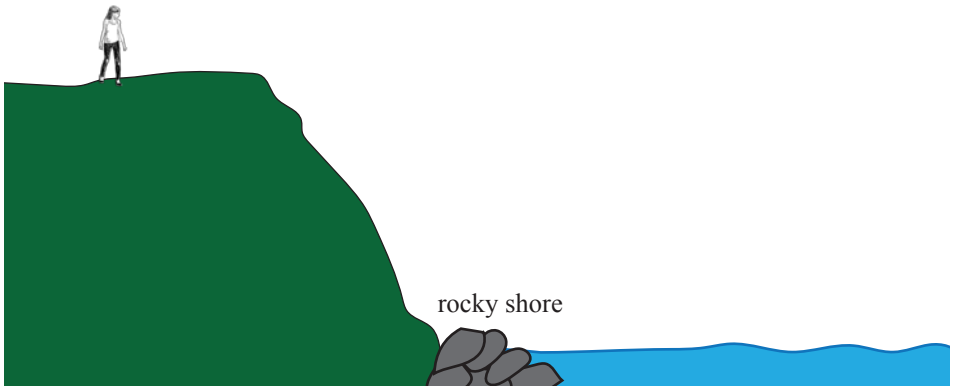
(c) One day Sarah is walking along a cliff beside the beach. She cannot see the water waves reaching the rocky shore, but she can hear them hitting the rocky shore.



Explain why Sarah cannot see the water waves reaching the rocky shore, but can hear them hitting the rocky shore.

Question Three continues on the following page.

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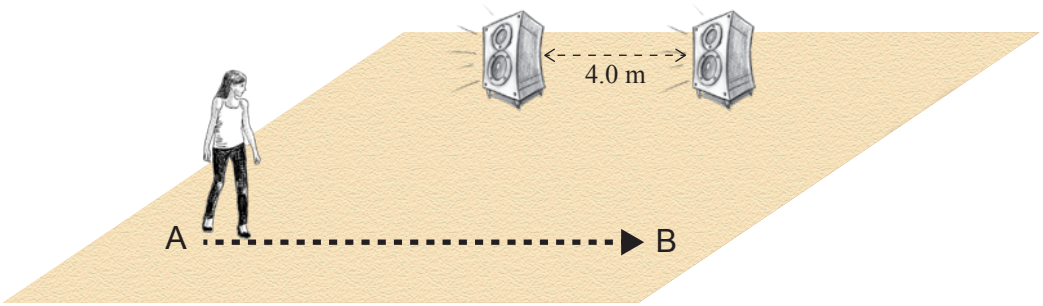
(d) Further down the beach a band was preparing to play music. They had set up two speakers which were 4.0 m apart. As part of their sound test, they were playing a sound of constant frequency (pitch) through the speakers. Sarah walks along a straight line from A to B, as shown below. Sarah notices that the sound she hears varies from very quiet to very loud many times as she walks from A to B.



Explain in detail why Sarah hears louder and quieter sounds many times, as she walks from A to B.

SPARE DIAGRAMS

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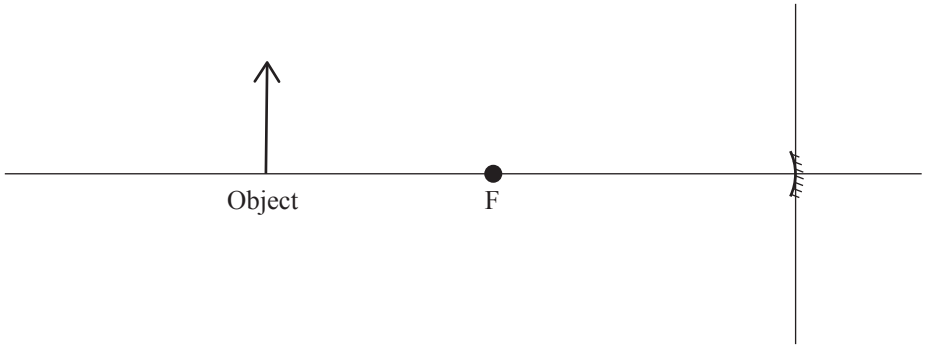
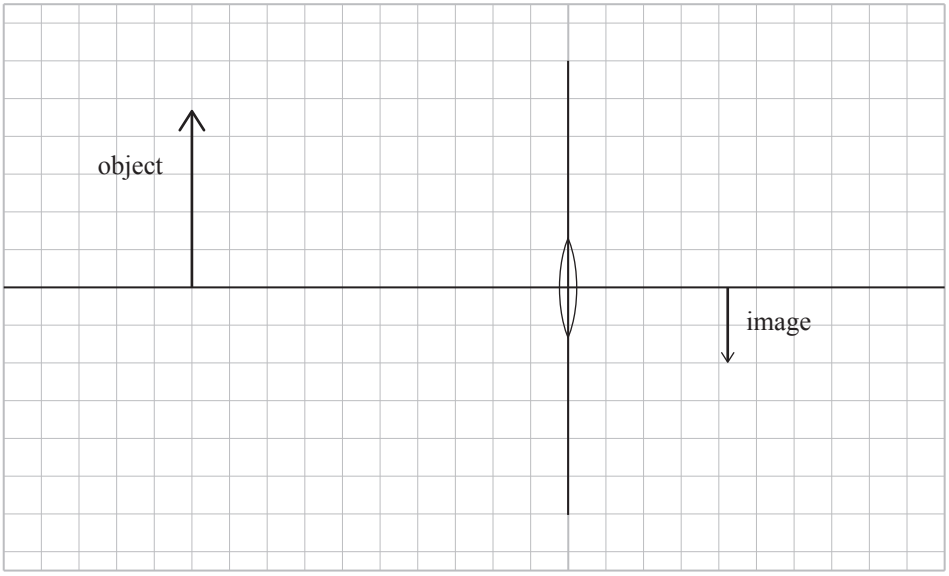
If you need to redraw your ray diagram for Question One (a), use the diagram below. Make sure it is clear which diagram you want marked.

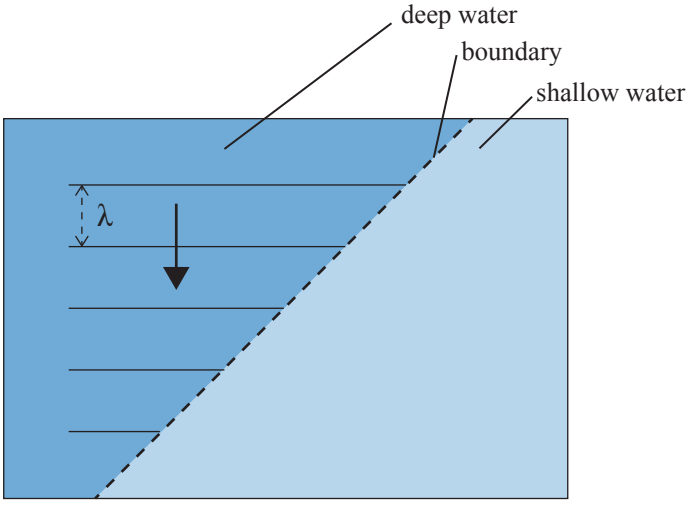
Diagram is NOT to scale



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



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



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

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