

SUPERVISOR'S USE ONLY

2

91170



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 2 Physics 2023

### 91170 Demonstrate understanding of waves

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 room for any answer, use the extra space provided at the back of this booklet.

Check that this booklet has pages 2–16 in the correct order and that none of these pages is blank.

Do not write in any cross-hatched area (DO NOT WRITE). 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: THE COSTUME SHOP**

Marco and Harvey head to the mall to buy props for the school show. Their first stop is the costume shop.

The students start looking at hats in a concave mirror of focal length 25 cm. The mirror image is initially real.

(a) Define the term real as it is used in this context.

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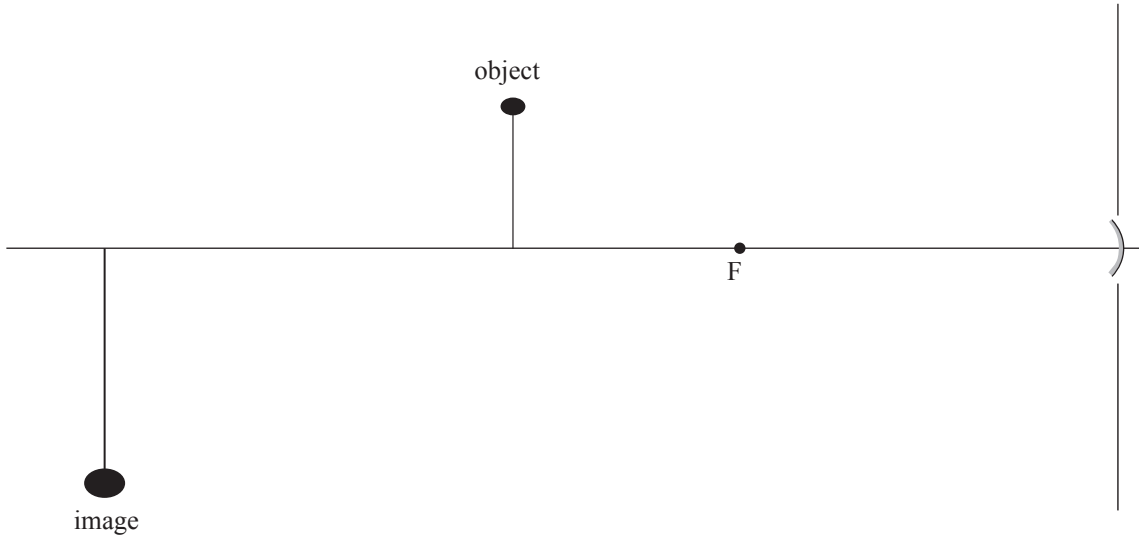
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Marco stands 40 cm in front of the mirror and the image is formed in the location shown below.

(b) Complete the diagram below to show how this image forms.



(c) Calculate the magnification of the image formed.

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

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## QUESTION TWO: THE WISHING POND

The students walk past a wishing pond for a local charity. People throw coins into the water, and these are collected at the end of the day. As the students sit on the side of the pond, they notice the coins appear closer to the surface of the water than they actually are.

- (a) Name the physics phenomenon that causes the coins to appear closer to the surface than they actually are.



<https://www.istockphoto.com/photo/many-coins-thrown-into-a-water-fountain-gm1278125918-377163413>

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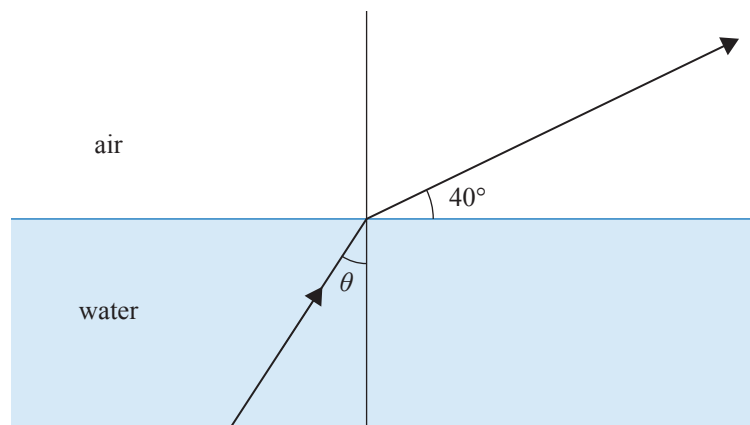


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- (b) The following diagram shows the light ray as it leaves the water. The refractive index of water is 1.33 and air is 1.00.



Calculate the angle  $\theta$ , shown at the surface of the water.

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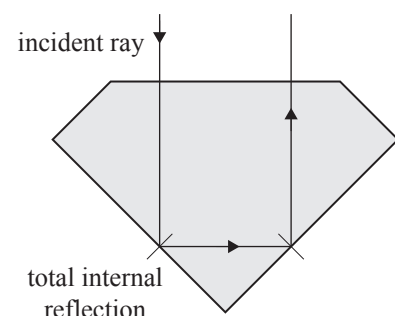
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- (c) The students notice a diamond in a jeweller's shop. They know total internal reflection is the main cause of the sparkle of the diamond.

Refractive index of diamond = 2.42

Critical angle of diamond =  $24.4^\circ$

Speed of light in air =  $3.00 \times 10^8 \text{ m s}^{-1}$





### QUESTION THREE: THE OPTICIAN

The students decide to try out some prescription glasses. They try out two types of glasses, both of the same shape and material but with different thicknesses.



Thick lens

[www.aliexpress.com/i/4001151117795.html](http://www.aliexpress.com/i/4001151117795.html)

Thin lens

[www.amazon.in/Artificial-Glass-Crystal-Watchmakers-Accessories/dp/B09ZTT7C19](http://www.amazon.in/Artificial-Glass-Crystal-Watchmakers-Accessories/dp/B09ZTT7C19)

- (a) How does the focal length of the thin lens compare to the focal length of the thick lens?

*No calculation required.*

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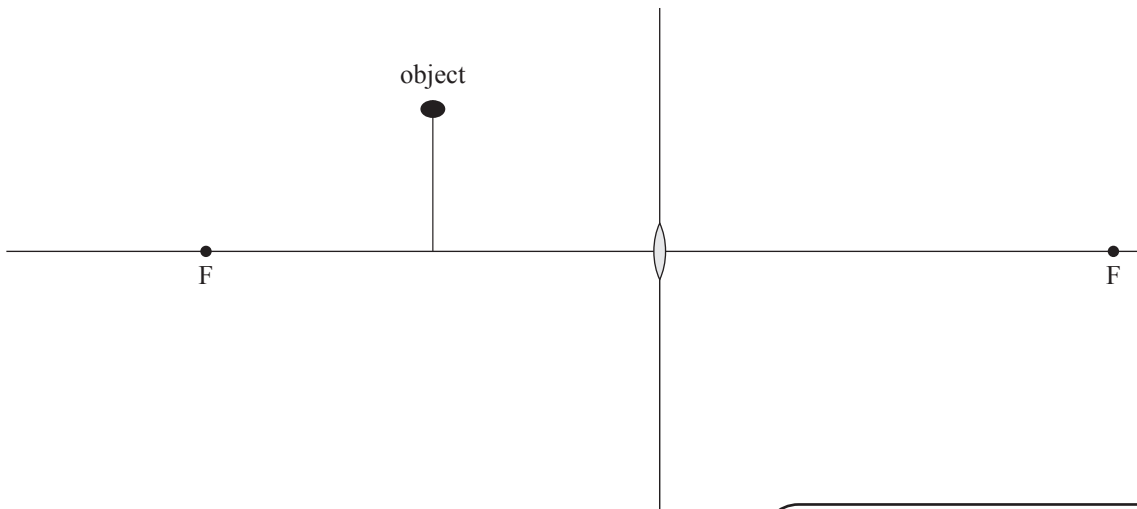
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- (b) A different set of glasses has convex lenses with focal length 30 cm.

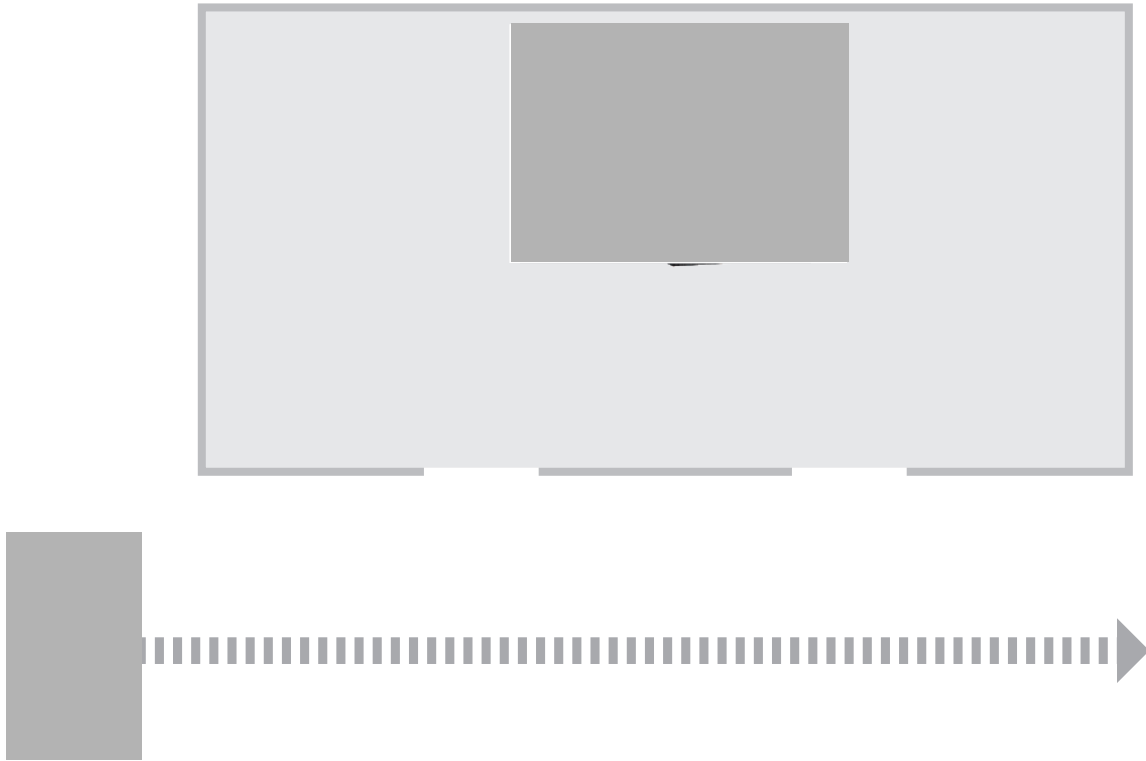
Complete the ray diagram below to show the position and appearance of the image produced.



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



- (d) Later they pass by the hall where a band is tuning their instruments and playing a single frequency. The hall has two open doors. The students notice the sound appears to vary in volume as they walk past the doors. Assume the tuning frequency is played at a constant volume.



Sources: <https://www.pngwing.com/en/free-png-njmcz>  
[www.kindpng.com/imgv/iiRhiJh\\_ykle-caillou-cartoon-asian-cartoon-characters-disney-hd/](http://www.kindpng.com/imgv/iiRhiJh_ykle-caillou-cartoon-asian-cartoon-characters-disney-hd/)

Through the use of appropriate diagrams and the use of physics concepts, identify, describe, and explain the physics phenomena that are taking place to cause the sound to vary in volume.

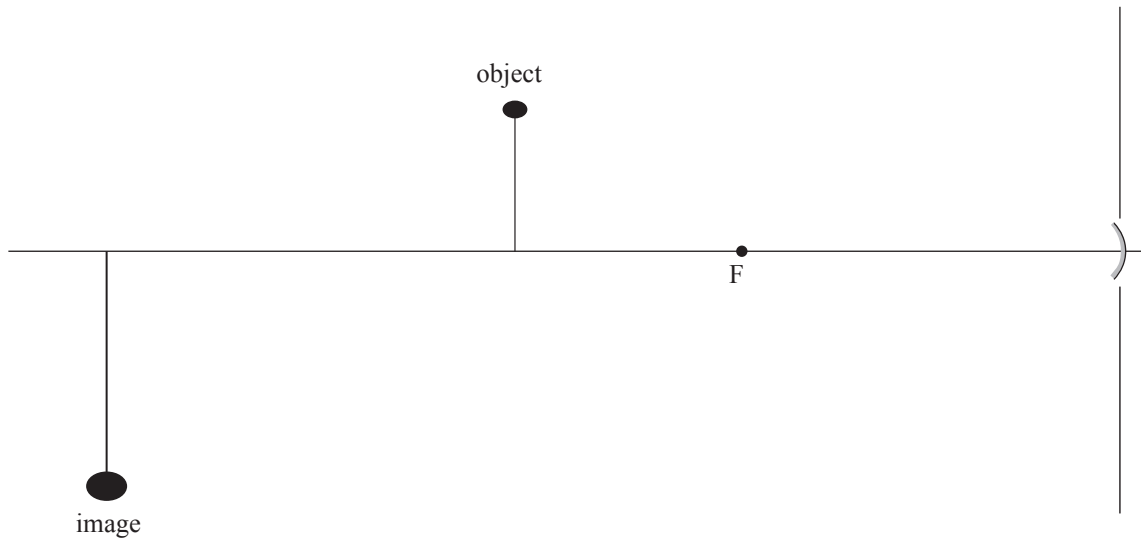
*If you need to redraw your diagrams, use the space on page 12.*



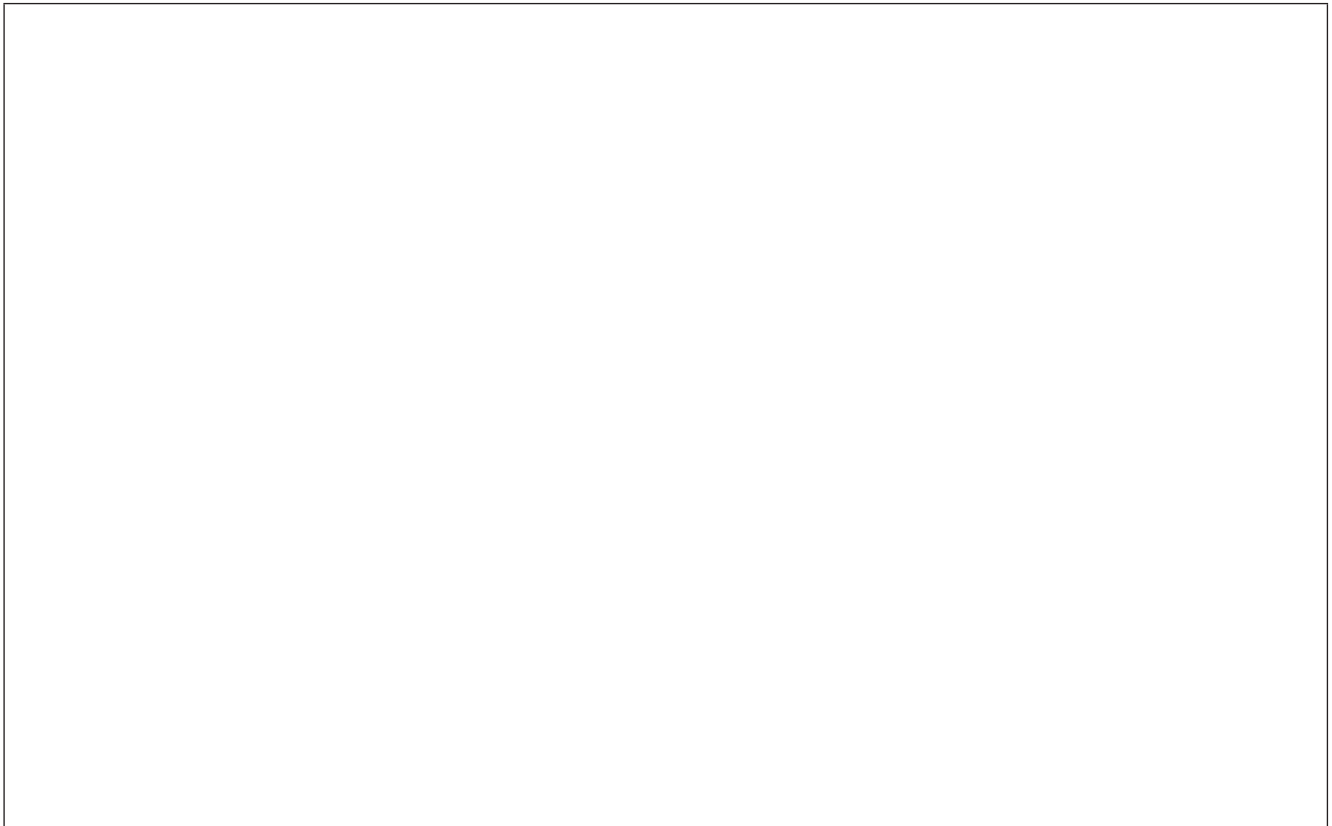


## SPARE DIAGRAMS

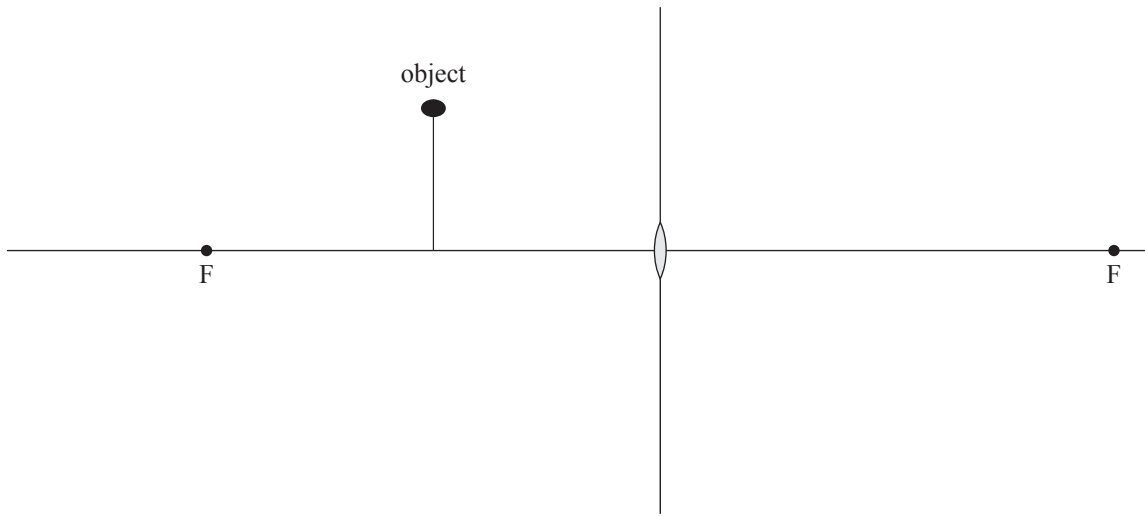
If you need to redraw your response to Question One (b), use the diagram below. Make sure it is clear which answer you want marked.



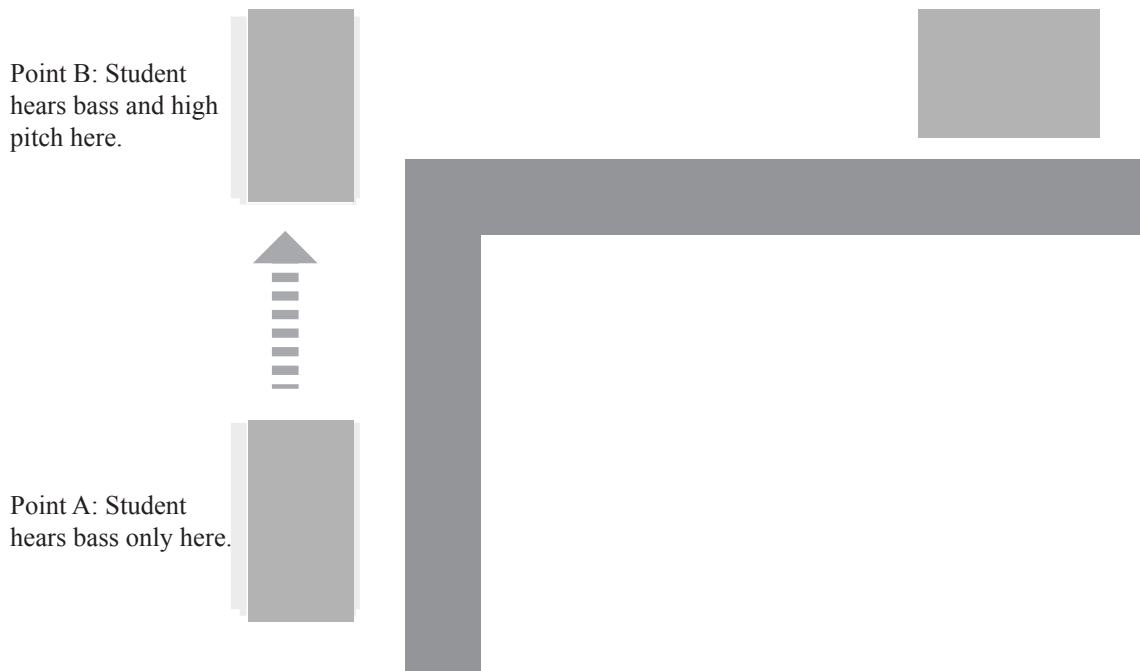
If you need to redraw your response to Question One (d), use the space below. Make sure it is clear which answer you want marked.



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



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



Point B: Student hears bass and high pitch here.

Point A: Student hears bass only here.









