91170

911700

NZQA

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

QUALIFY FOR THE FUTURE WORLD
KIA NOHO TAKATŪ KI TŌ ĀMUA AO!

2

SUPERVISOR'S USE ONLY

Tick this box if you have NOT written in this booklet

Level 2 Physics 2022

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 2–12 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: BEHAVIOUR OF LIGHT

Helen is investigating wave behaviour in the school physics laboratory.

She starts by shining a ray of light from air into a glass block so that the angle of light inside the glass is 32°, as shown in the diagram.

Refractive index of glass = 1.52

Refractive index of air = 1.00

Speed of light in air = 3.00×10^8 m s^{-1}

Adapted from: https://en.wikipedia.org/wiki/Refraction#/media/File:Refraction_photo.png

(a) Calculate the angle of incidence.

(b) The light changes direction as it enters the block.

(i) State what happens to the speed of the light as it enters the glass.

(ii) Calculate the speed of light within the glass block.

(c) Helen now uses a semi-circular block and alters the angle that the light hits the straight side, and she observes the following phenomenon:

Adapted from: https://www.youtube.com/watch?v=d7U3k2XtzVU

(i) Identify the physics phenomenon occurring at the straight boundary.

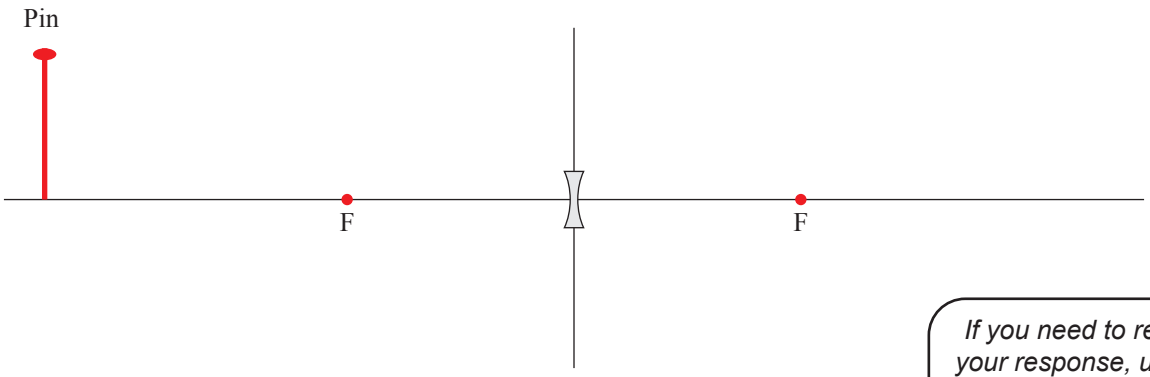
(ii) Describe the two conditions required for this phenomenon to occur.

(d) Helen then investigates a **concave** lens.

She places a pin at a distance of 7 cm in front of the lens, and finds that she **cannot** form an image on the screen.

The lens has a focal length of 3 cm.

Complete the following ray diagram AND use calculations to describe and explain why she cannot see the image on the screen.



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

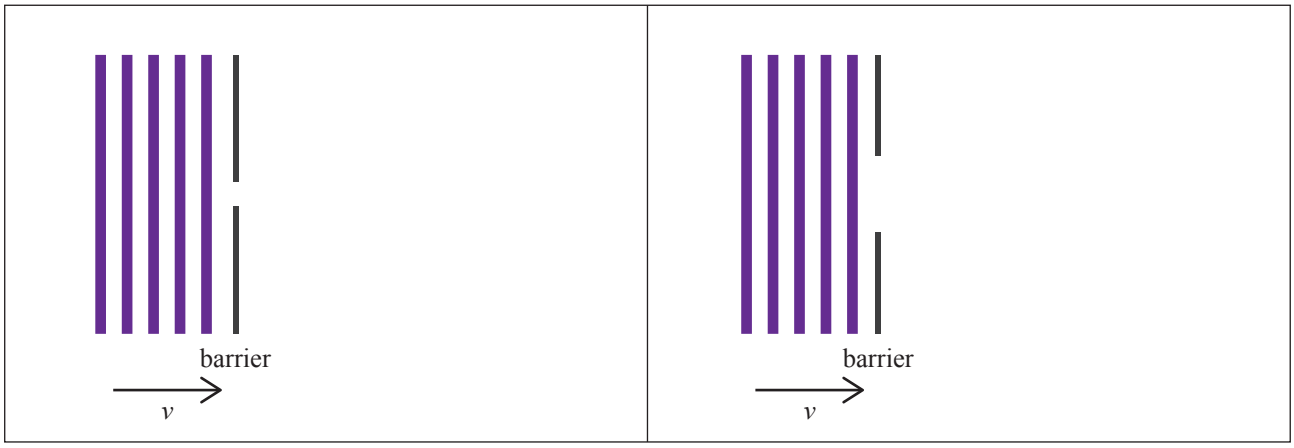
QUESTION TWO: LIGHT WAVES AND BARRIERS

Helen decides to investigate wave movement and barriers. She starts by shining a purple light, with a frequency of 7.5×10^{14} Hz, on the wall.

(a) Calculate the wavelength of the purple light.

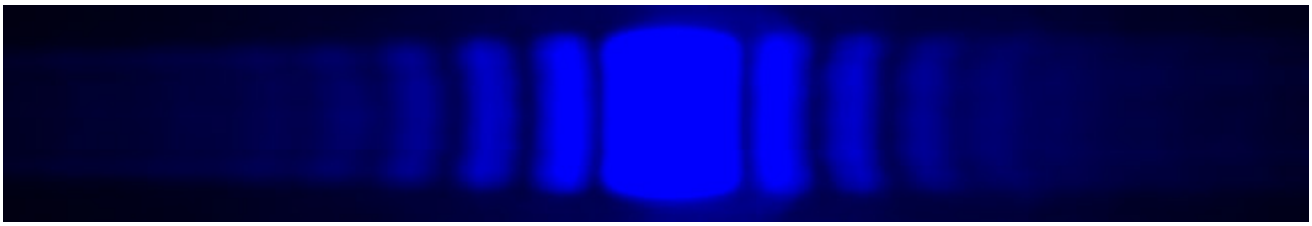
(b) She finds an online simulator of wave movement through a gap in a barrier. She sets up the two simulations below.

Complete the diagrams to show the effect of the gap on the waves.

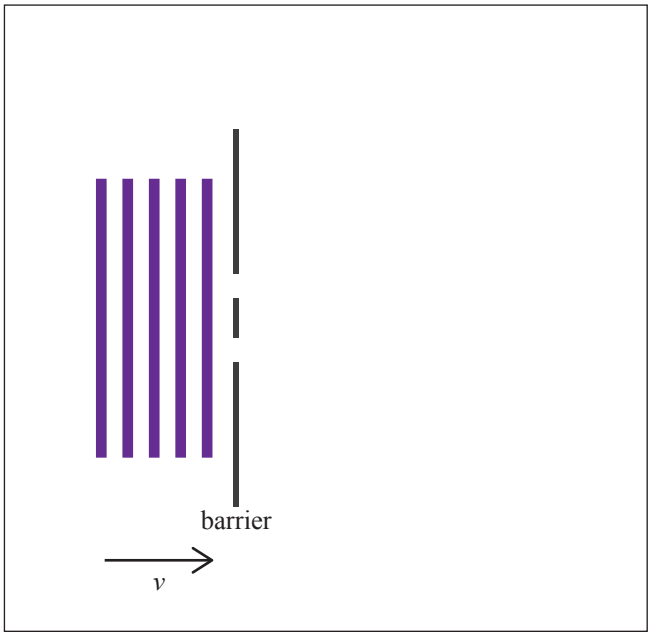


If you need to redraw your response, use the diagram on page 9.

She then shines the same light through a double slit and observes the following pattern formed on a screen.



(c) Complete a labelled wave diagram to show how this phenomenon occurs.



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

(d) Use physics principles to describe and explain how the pattern in part (c) is formed.

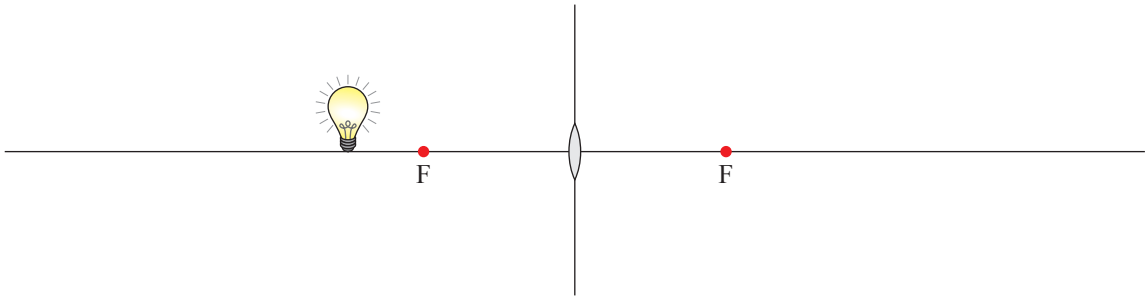
Start by naming the phenomenon that is taking place, and then discussing the conditions required for the pattern to form.

QUESTION THREE: LIGHT RAYS AND PULSES IN A ROPE

Helen continues to investigate light and optics. She chooses to look at the images formed by **convex** lenses, and then compares these with mirrors.

She starts by placing a lamp in front of the lens and looking at the image formed on a screen.

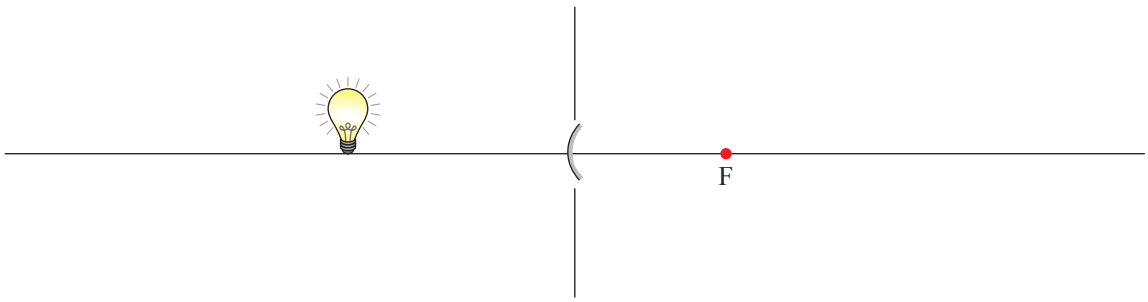
(a) Complete the following ray diagram for the lamp placed at 3 cm from a convex lens of focal length 2 cm.



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

(b) Helen then tries the same lamp in front of a convex mirror of the same focal length (2 cm) and the same distance away (3 cm).

(i) Complete the ray diagram.

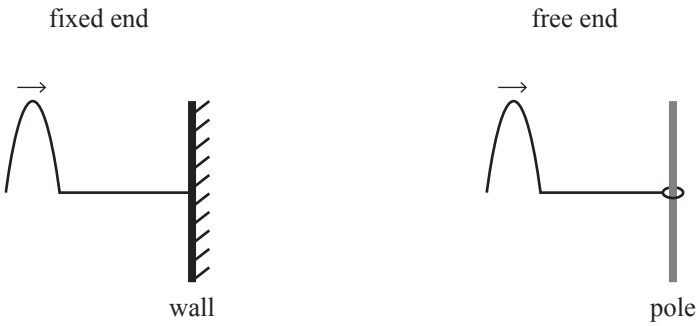


If you need to redraw your response, use the diagram on page 10.

(ii) Describe the image produced.

(c) To further investigate waves, Helen looks at the effect of sending a pulse down a rope, firstly with a fixed end, and then with a free end.

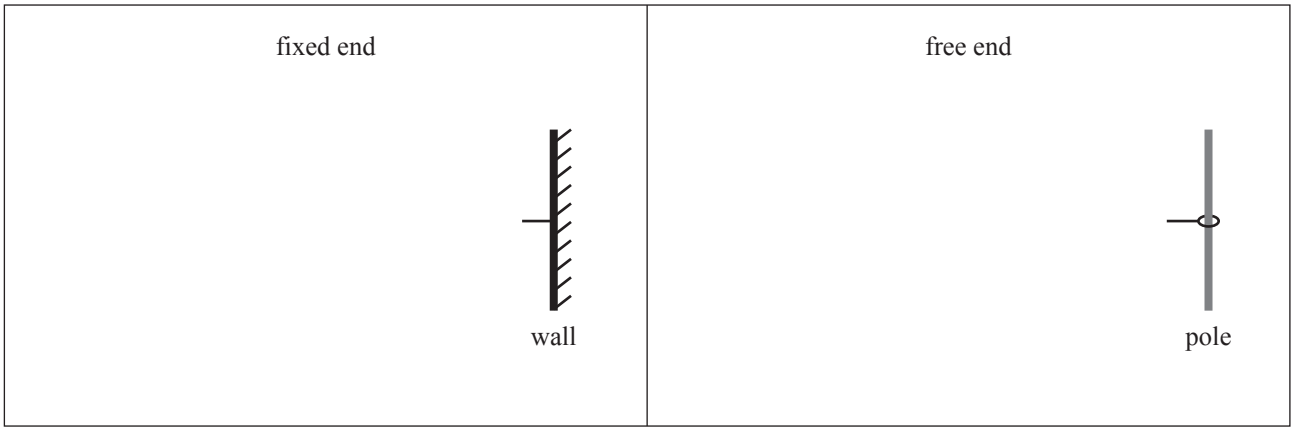
Before



Complete the diagrams below to show the reflected pulses from each system.

After

(i) (ii)

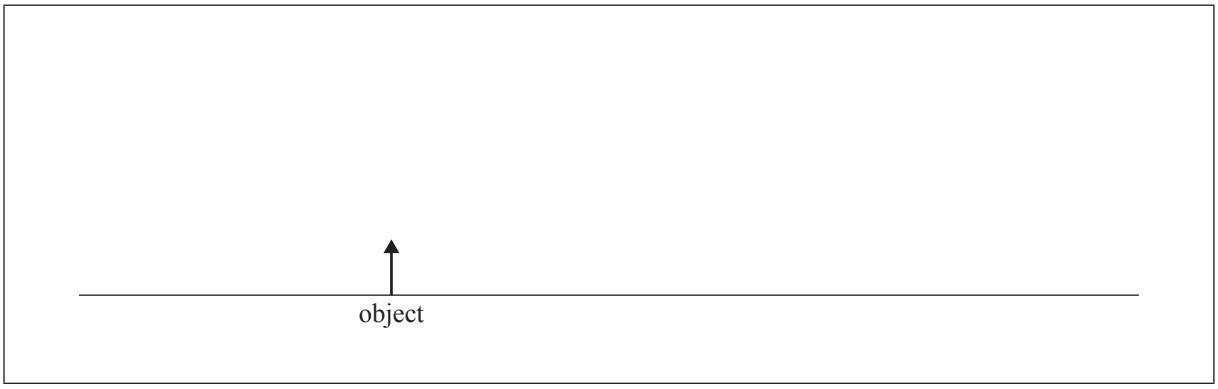


If you need to redraw your response, use the diagram on page 10.

Question Three continues on the next page.

(d) Helen wanted to see if she could create a virtual image with a concave mirror.

(i) Use a ray diagram to show how this is possible.



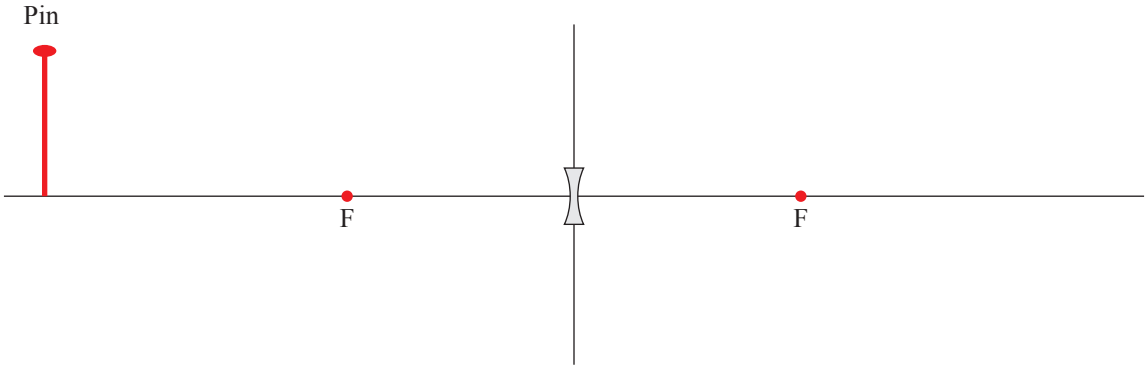
If you need to redraw your response, use the diagram on page 11.

(ii) Describe the position of the object in relation to the mirror.

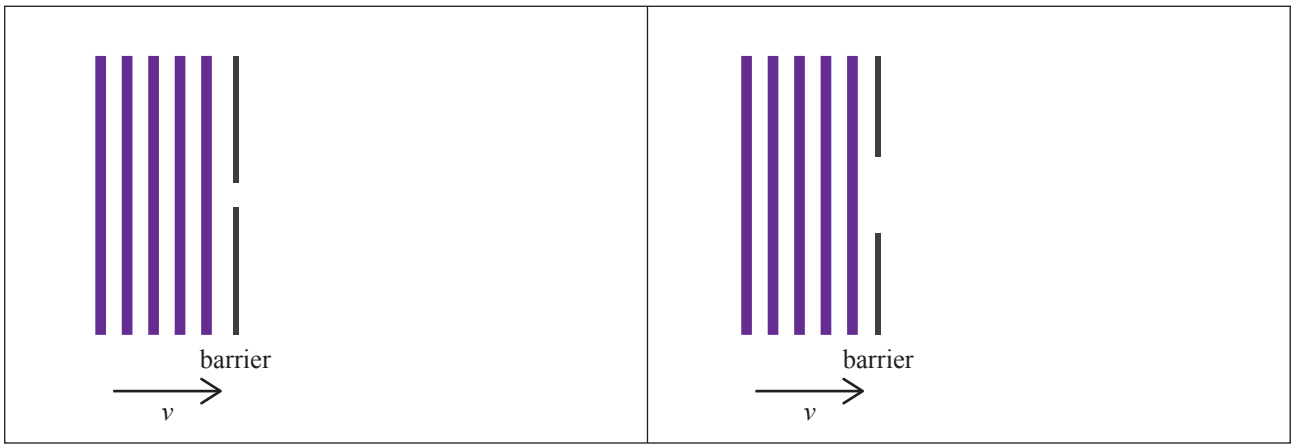
(iii) Compare the similarities and differences of the image (if any) with a virtual image formed by a convex mirror.

SPARE DIAGRAMS

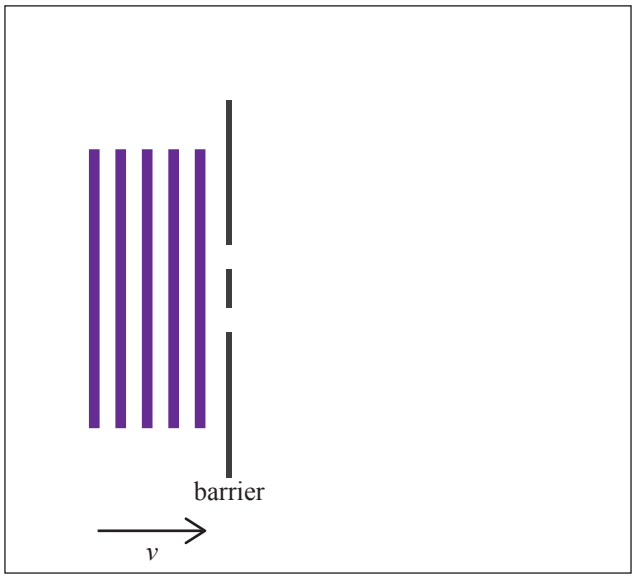
If you need to redraw your response to Question One (d), use the diagram below. Make sure it is clear which answer you want marked.



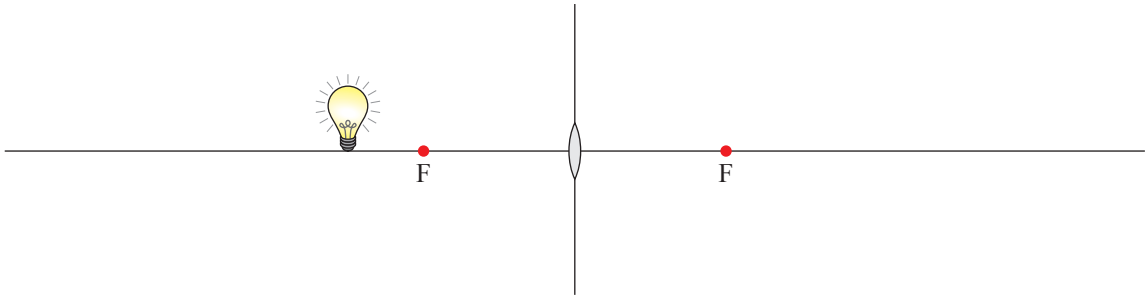
If you need to redraw your response to Question Two (b), use the diagram below. Make sure it is clear which answer you want marked.



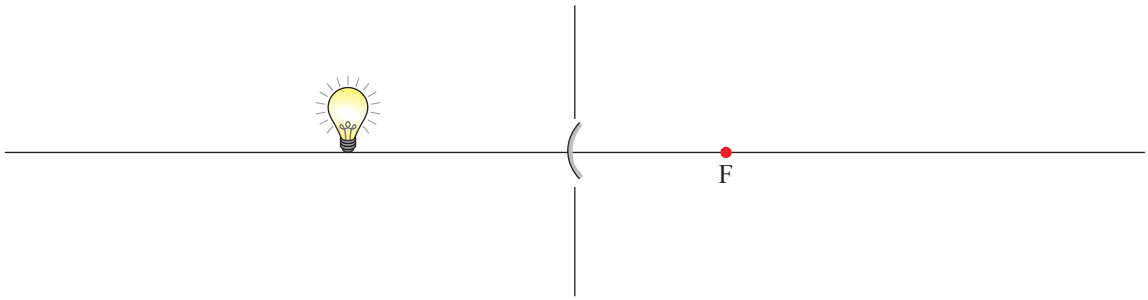
If you need to redraw your response to Question Two (c), use the diagram below. Make sure it is clear which answer you want marked.



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



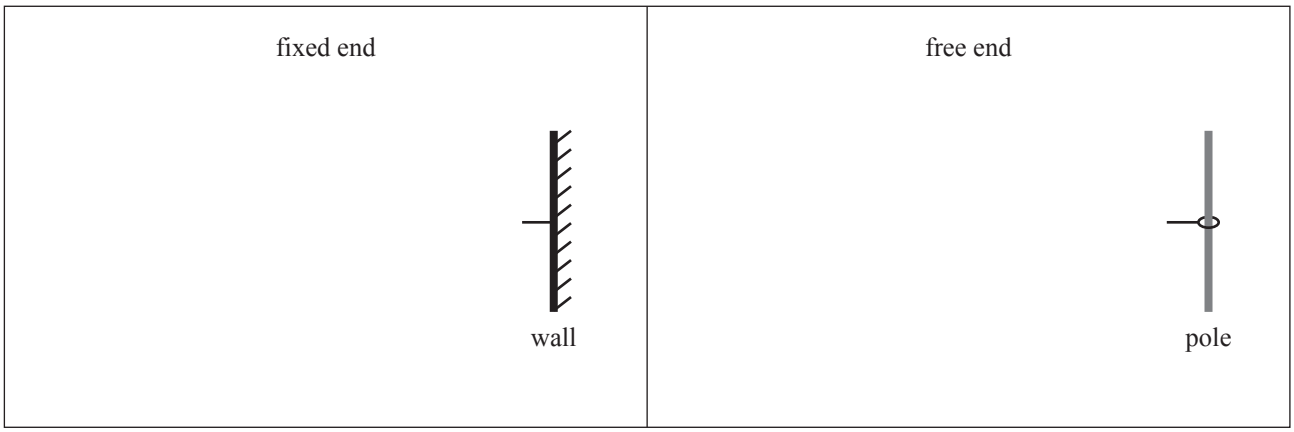
If you need to redraw your response to Question Three (b)(i), use the diagram below. Make sure it is clear which answer you want marked.



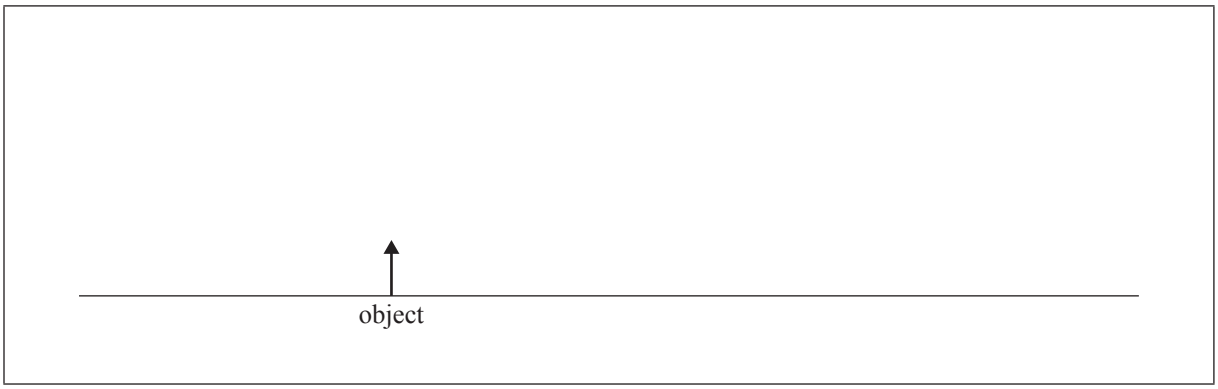
If you need to redraw your response to Question Three (c), use the diagram below. Make sure it is clear which answer you want marked.

After

(i) (ii)



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



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

QUESTION NUMBER

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

QUESTION NUMBER