See back cover for an English translation of this cover

2

91170M

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SUPERVISOR'S USE ONLY

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

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

Tohua tēnei pouaka mēnā KĀORE koe i tuhi kōrero ki tēnei pukapuka

Mātai Ahupūngao, Kaupae 2, 2022

91170M Te whakaatu māramatanga ki te ngaru

Ngā whiwhinga: E whā

Paetae	Kaiaka	Kairangi
Te whakaatu māramatanga ki te ngaru.	Te whakaatu i te hōhonu o te māramatanga ki te ngaru.	Te whakaatu i te tōtōpū o te māramatanga ki te ngaru.

Tirohia mēnā e rite ana te Tau Ākonga ā-Motu (NSN) kei runga i tō puka whakauru ki te tau kei runga i tēnei whārangi.

Me whakamātau koe i ngā tūmahi KATOA kei roto i tēnei pukapuka.

Tirohia kia kitea ai kei a koe te Pukapuka Rauemi L2–PHYSMR.

I ō tuhinga, whakaatuhia kia mārama ngā whiriwhiringa tohutau, ngā kupu, ngā hoahoa hoki/rānei, ki ngā wāhi me pērā.

Me hoatu te wae tika o te Pūnaha o te Ao (SI) ki ngā whakautu tohutau.

Mēnā ka hiahia whārangi atu anō koe mō ō tuhinga, whakamahia ngā whārangi wātea kei muri o tēnei pukapuka.

Tirohia kia kitea ai e tika ana te raupapatanga o ngā whārangi 2–23 kei roto i tēnei pukapuka, ka mutu, kāore tētahi o aua whārangi i te takoto kau.

Kaua e tuhi ki tētahi wāhi e kitea ai te kauruku whakahāngai (⁘). Ka poroa pea taua wāhanga ka mākahia ana te pukapuka.

HOATU TĒNEI PUKAPUKA KI TE KAIWHAKAHAERE Ā TE MUTUNGA O TE WHAKAMĀTAUTAU.

TE TŪMAHI TUATAHI: TE ĀHUA O TE AHO

E mātaihia ana e Helen te āhua o te ngaru i te taiwhanga ahupūngao o te kura.

Ka tīmata ia mā te whiti i tētahi hihi aho mai i te hau takiwā ki roto i tētahi paraka kōata kia 32° ai te koki o te aho i roto i te kōata, e whakaaturia nei ki te hoahoa.

Te taupū hakoko o te kōata = 1.52

Te taupū hakoko o te hau takiwā = 1.00

Te tere o te aho i te hau takiwā = 3.00×10^8 m s^{-1}

He mea panoni i: https://en.wikipedia.org/wiki/Refraction#/media/File:Refraction_photo.png

(a) Tātaihia te koki whakapā.

(b) Ka panoni te ahunga o te aho ka tomokia ana te paraka.

(i) Tuhia mai te āhua ka pā ki te tere o te aho ka tomokia ana te kōata.

(ii) Tātaihia te tere o te aho i roto i te paraka kōata.

(c) Ināianei ka whakamahi a Helen i tētahi poraka porohita weherua, ka whakarerekēhia ai te koki o te aho e pā atu ana ki te paenga torotika, ā, ka kite ia i te tītohunga e whai ake nei:

He mea panoni i: https://www.youtube.com/watch?v=d7U3k2XtzVU

(i) Tautohua te tītohunga mātai ahupūngao e kitea ana i te paenga torotika.

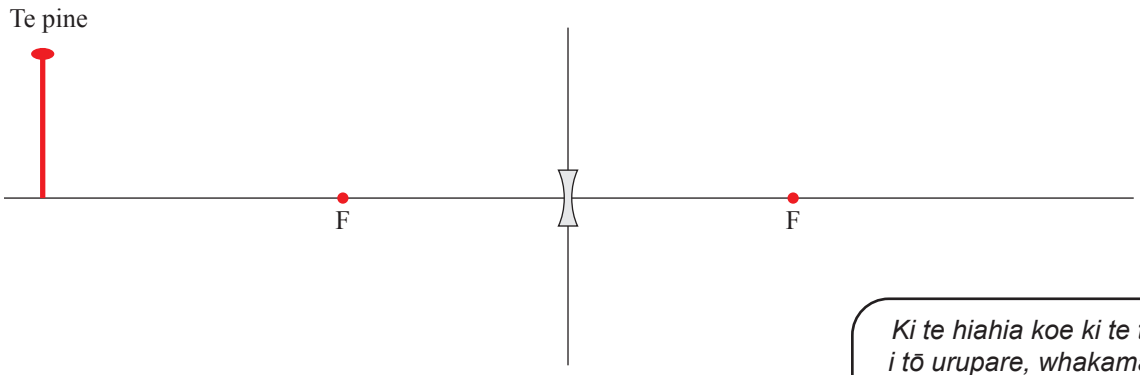
(ii) Whakaahuatia ngā āhuatanga e rua me kite e puta ai tēnei tītohunga.

(d) Kātahi a Helen ka tūhura i tētahi mōhiti **kōpapa**.

Ka whakatūngia e ia tētahi pine kia 7 cm i mua i te mōhiti, ka kitea **kāore e taea** e ia tētahi mātātuhi te whakaatu ki te mata.

E 3 cm te whāroa arotahi o te mōhiti.

Whakaotia te hoahoa hihi e whai ake nei, Ā, whakamahia ō tātaitanga hei whakaahua, hei whakamārama anō hoki i te take kāore ia i te kite i te mātātuhi i te mata.



Ki te hiahia koe ki te tā anō i tō urupare, whakamahia te hoahoa kei te whārangi 16.

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.

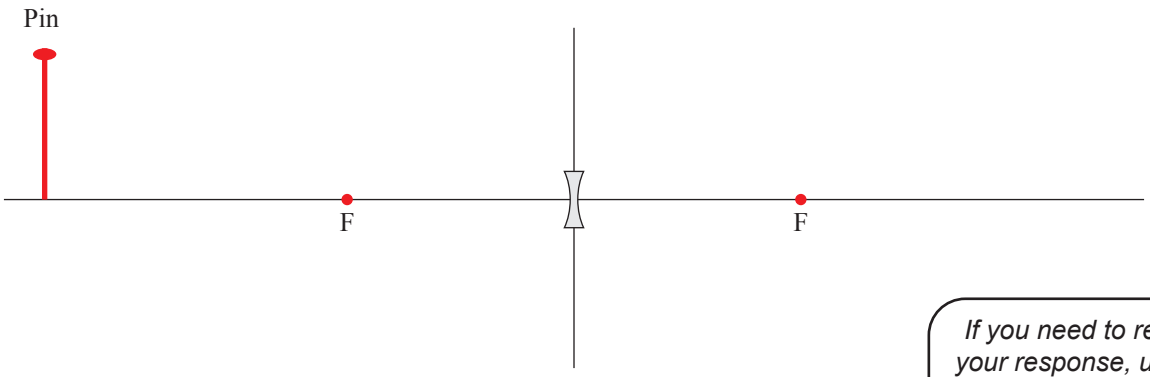
(ii) Describe the two conditions required for this phenomenon to occur.

(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 17.

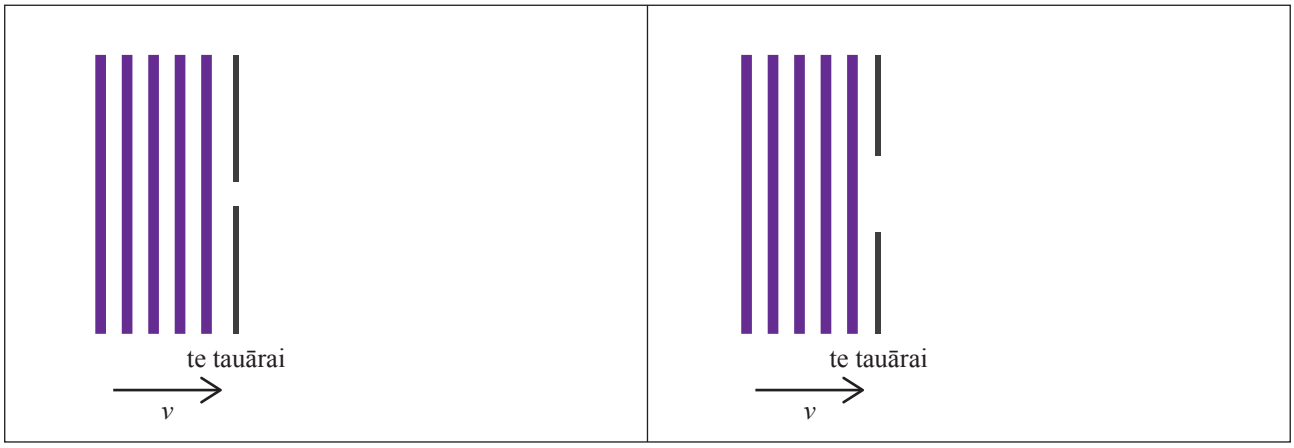
TE TŪMAHI TUARUA: NGĀ NGARU ME NGĀ TAUĀRAI AHO

Ka whakatau a Helen ki te tūhura i ngā nekehanga ngaru me ngā nekehanga tauārai. Ka tīmata ia mā te whiti i tētahi aho pāpura, kia 7.5×10^{14} Hz te auau ki te pātū.

(a) Tātaihia te roa o te ngaru o te aho pāpura.

(b) Ka kitea e ia tētahi whaihanga tuihono o ngā nekehanga ngaru mā tētahi āputa i te tauārai. Ka whakaritea e ia ngā whaihanga e rua kei raro iho nei.

Whakaotia ngā hoahoa e kitea ai te pānga o te āputa ki ngā ngaru.



Ki te hiahia koe ki te tā anō i tō urupare, whakamahia te hoahoa kei te whārangi 16.

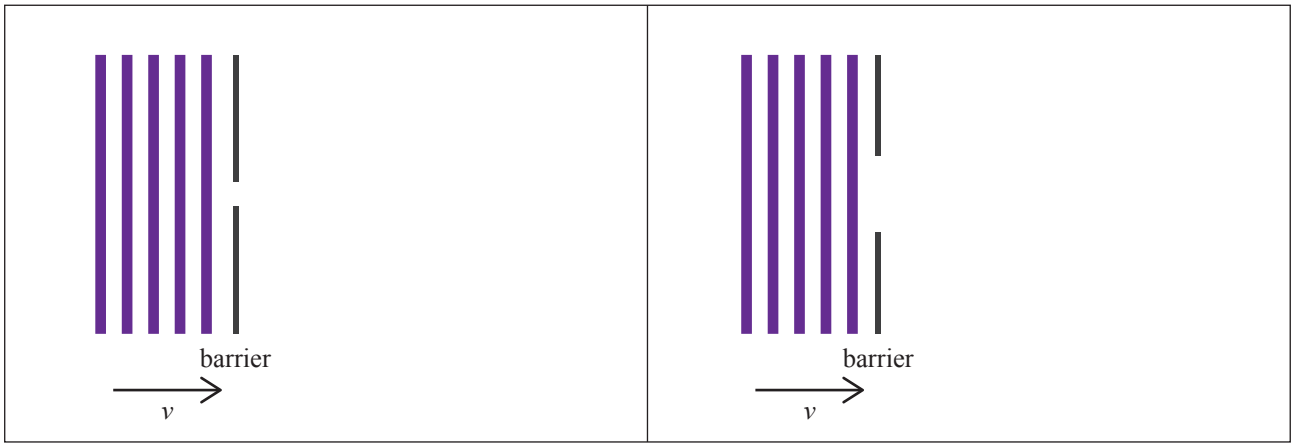
QUESTION TWO: LIGHT WAVES AND BARRIERS

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.

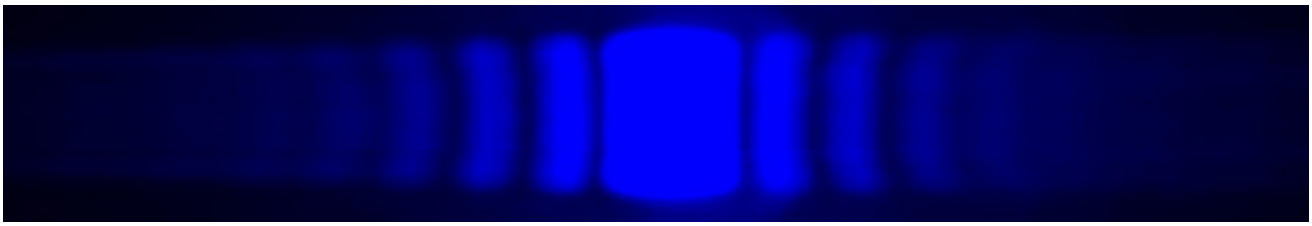
(b) She finds an online simulator of wave movement through a gap in a barrier. She sets up the two simulations below.

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

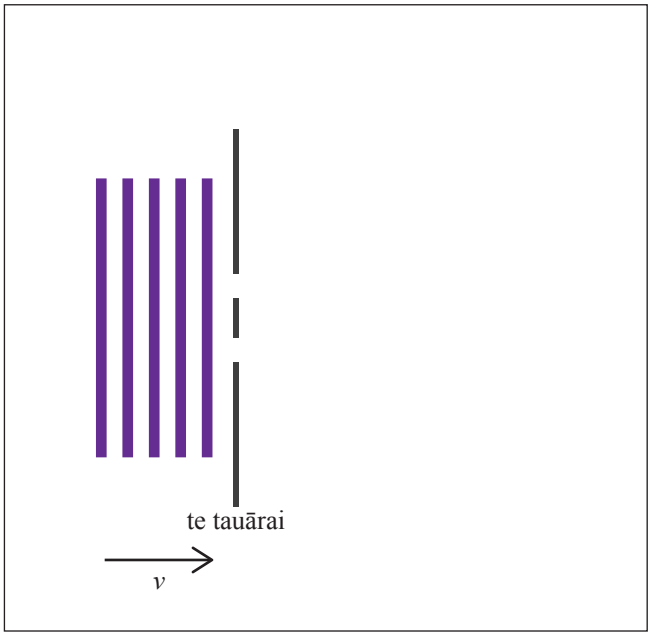


If you need to redraw your response, use the diagram on page 17.

Kātahi ia ka tore i taua aho tonu ki waenganui i ngā āputa e rua, ka kitea ai te tauira e whai ake nei i te mata.



(c) Whakaotia he hoahoa tapanga ngaru hei whakaatu i te putanga mai o tēnei tītohunga.

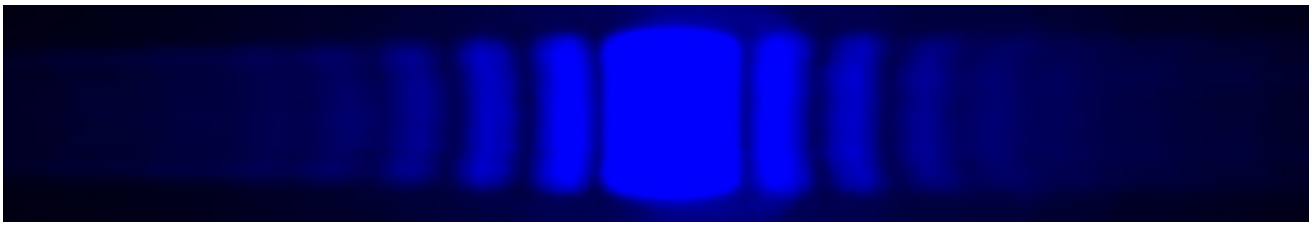


Ki te hiahia koe ki te tā anō i tō urupare, whakamahia te hoahoa kei te whārangi 16.

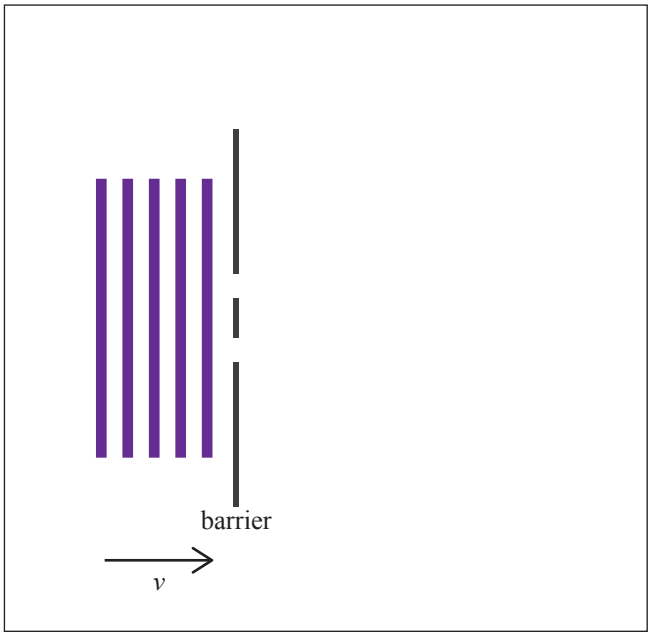
(d) Whakamahia ngā mātāpono mātai ahupūngao hei whakaahua, hei whakamārama anō hoki i te hanganga mai o te tauira kei te wāhanga (c).

Tīmata mā te whakaingoa i te tītohunga e kitea ana, ka matapaki ai i ngā āhuatanga me kite e hanga ai te tauira.

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 17.

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

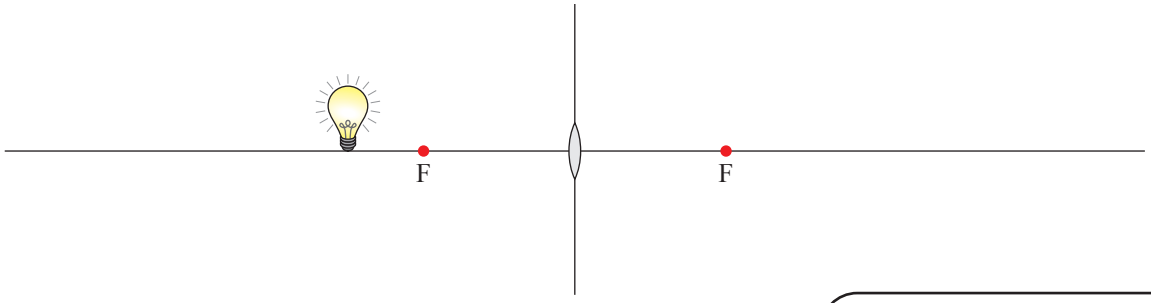
Start by naming the phenomenon that is taking place, and then discussing the conditions required for the pattern to form.

TE TŪMAHI TUATORU: NGĀ HIHI AHO ME NGĀ HIHIKO I TE TAURA

Ka tūhura tonu a Helen i te aho me ngā āhuatanga ōmata. Ka whakatau ia ki te titiro ki ngā mātātuhi ka hua mai i ngā mōhiti **koropuku**, ka whakatairitea ai ki ngā whakaata.

Ka tīmata ia mā te whakanoho i tētahi rama ki mua i te mōhiti me te titiro ki te mātātuhi e puta ana ki te mata.

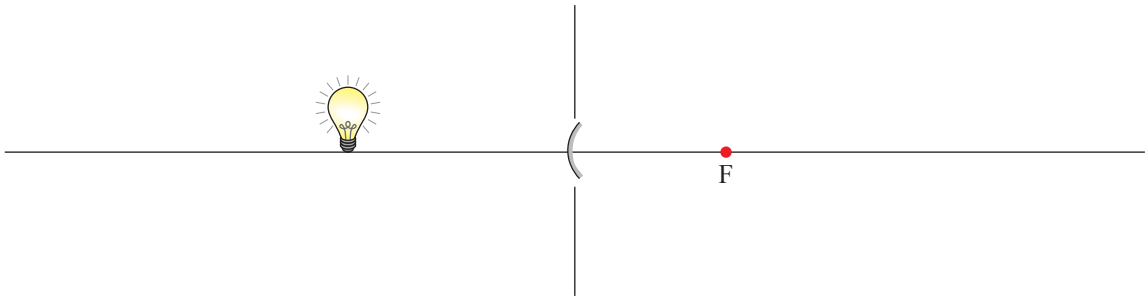
(a) Whakaotia te hoahoa hihi e whai ake nei mō te rama kua whakatūria kia 3 cm atu i te mōhiti koropuku e 2 cm tōna whāroa arotahi.



Ki te hiahia koe ki te tā anō i tō urupare, whakamahia te hoahoa kei te whārangi 18.

(b) Kātahi a Helen ka whakamātau i taua rama tonu ki mua i tētahi whakaata koropuku e ōrite ana te whāroa arotahi (e 2 cm), e ōrite ana hoki te tawhiti atu (e 3 cm).

(i) Whakaotia te hoahoa hihi.



Ki te hiahia koe ki te tā anō i tō urupare, whakamahia te hoahoa kei te whārangi 18.

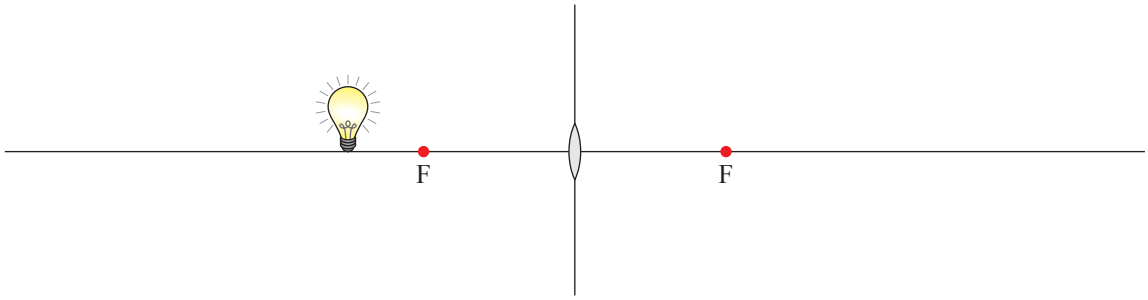
(ii) Whakaahuatia te hoahoa kua whakaputaina.

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.

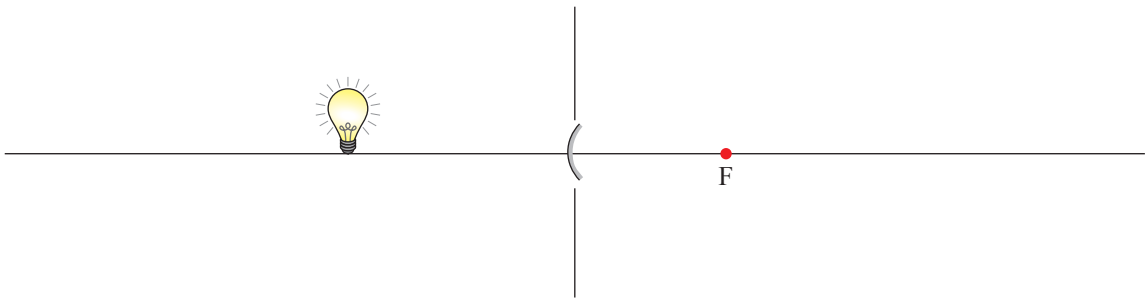
(a) Complete the following ray diagram for the lamp placed at 3 cm from a convex lens of focal length 2 cm.



If you need to redraw your response, use the diagram on page 19.

(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.



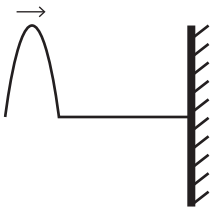
If you need to redraw your response, use the diagram on page 19.

(ii) Describe the image produced.

(c) E hōhonu ake ai te tūhuraina o ngā ngaru, ka tirohia e Helen te hua o te tuku i tētahi hihiko mā te taura, otiia, mā tētahi kua aukatia te pito i te tuatahi, kātahi ka mahia mā tētahi taura e wātea nei te pito.

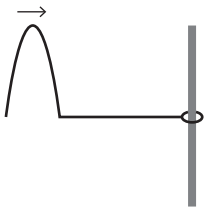
I mua atu

te pito kua aukatia



te pātū

te pito kua wātea



he pou

Whakaotia ngā hoahoa kei raro iho nei hei whakaatu i te takahuri haere o te hihko i ia pūnaha.

I muri iho

(i)

te pito kua aukatia

te pātū

(ii)

te pito kua wātea

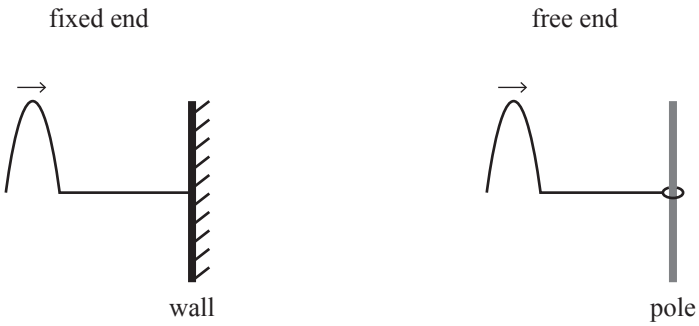
he pou

Ki te hiahia koe ki te tā anō i tō urupare, whakamahia te hoahoa kei te whārangi 18.

Ka rere tonu te Tūmahi Tuatoru i te whārangi e whai ake nei.

(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.

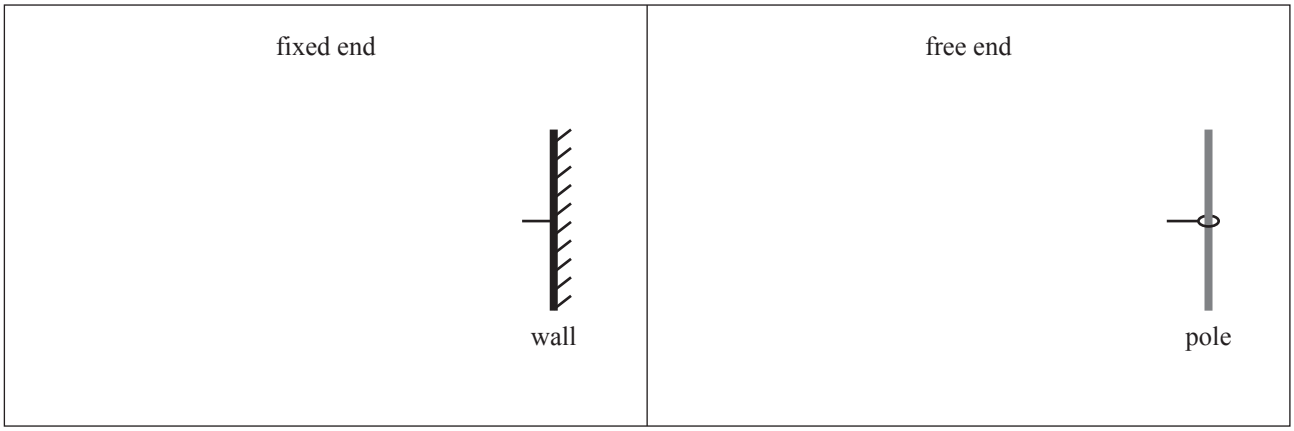
Before



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

After

(i) (ii)

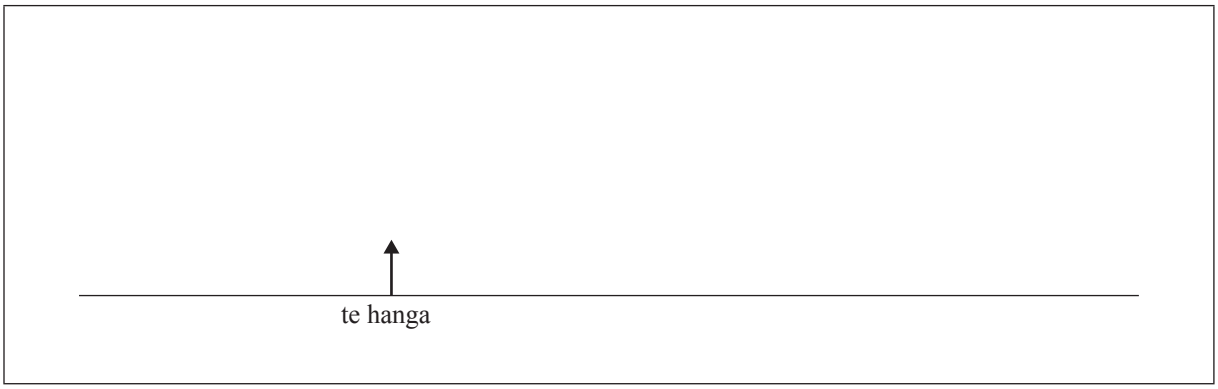


If you need to redraw your response, use the diagram on page 19.

Question Three continues on the next page.

(d) I pīrangi a Helen ki te kite mēnā ka taea e ia tētahi mātātuhi mariko te hanga mā tētahi whakaata kōpapa.

(i) Whakamahia tētahi hoahoa hihi hei whakaatu i te huarahi e tutuki ai tēnei āhuatanga.



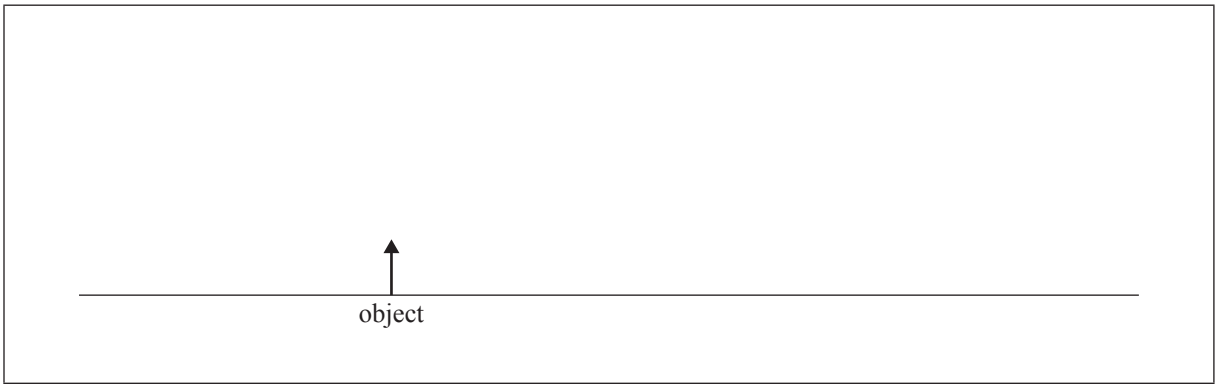
Ki te hiahia koe ki te tā anō i tō urupare, whakamahia te hoahoa kei te whārangi 20.

(ii) Whakaahuatia te hononga o te tūnga o te hanga ki te ataata.

(iii) Whakatairitea ngā ritenga me ngā rerekētanga o te mātātuhi (mēnā rā he pērā) ki te mātātuhi mariko ka puta i tētahi whakaata koropuku.

(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.



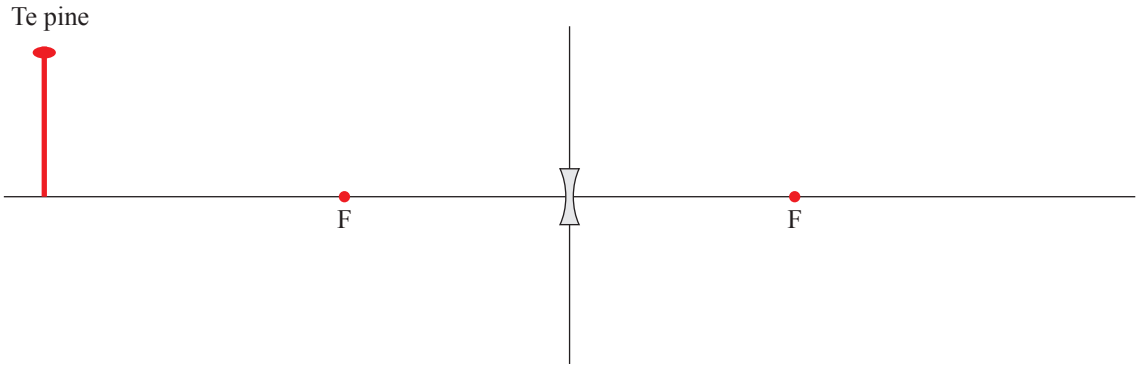
If you need to redraw your response, use the diagram on page 21.

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

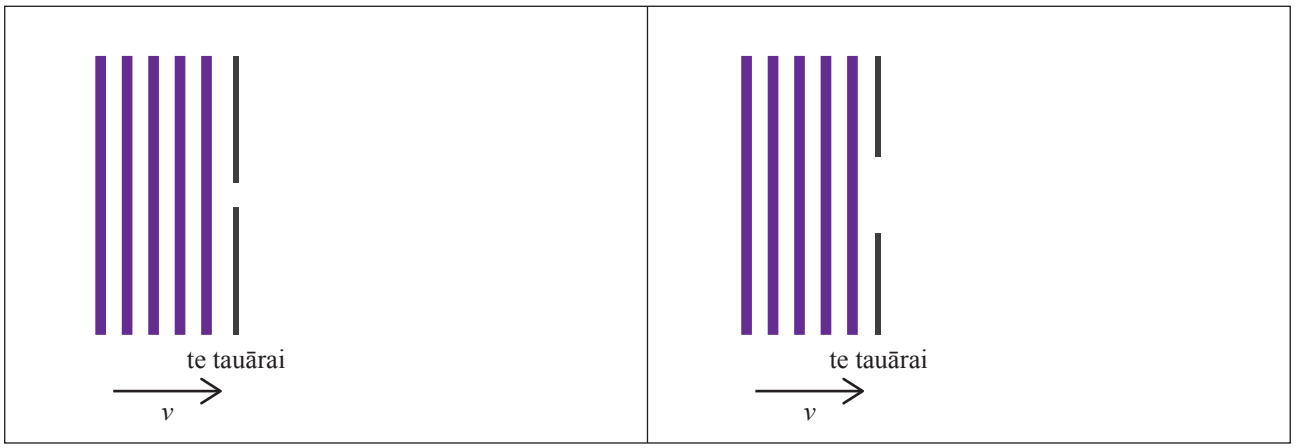
(iii) Compare the similarities and differences of the image (if any) with a virtual image formed by a convex mirror.

HE HOAHOA WĀTEA

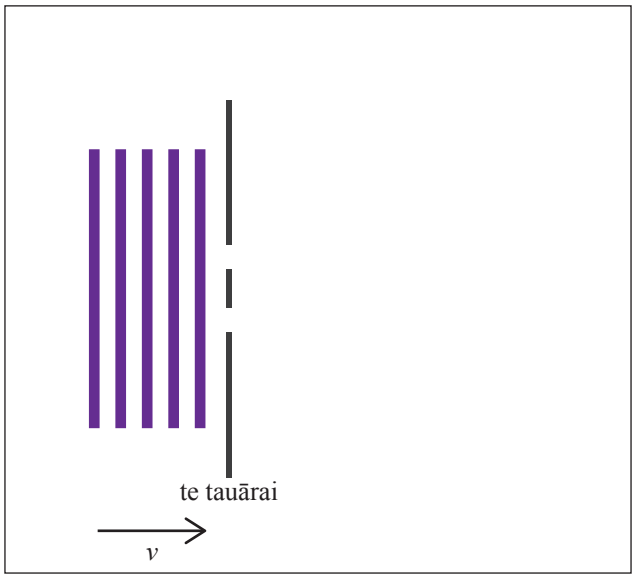
Ki te hiahia koe ki te tā anō i tō urupare ki te Tūmahi Tuatahi (d), whakamahia te hoahoa i raro nei. Kia mārama te tohu ko tēhea te tuhinga ka hiahia koe kia mākahia.



Ki te hiahia koe ki te tā anō i tō urupare ki te Tūmahi Tuarua (b), whakamahia te hoahoa i raro nei. Kia mārama te tohu ko tēhea te tuhinga ka hiahia koe kia mākahia.

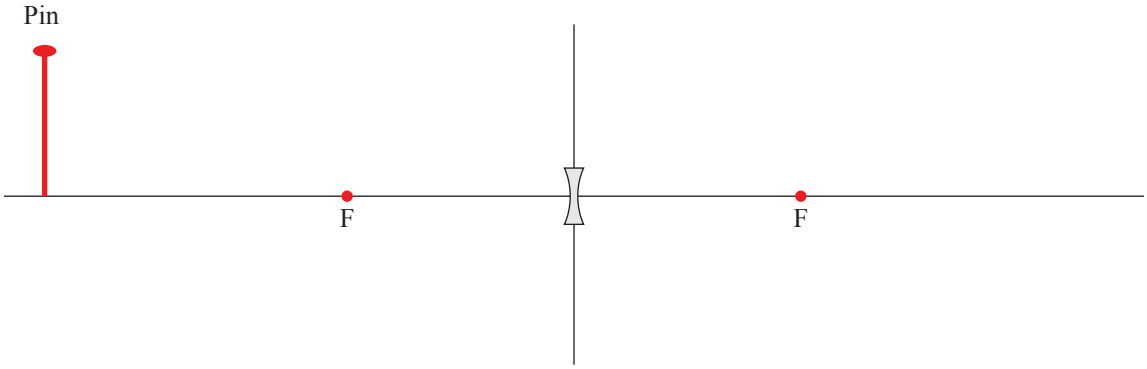


Ki te hiahia koe ki te tā anō i tō urupare ki te Tūmahi Tuarua (c), whakamahia te hoahoa i raro nei. Kia mārama te tohu ko tēhea te tuhinga ka hiahia koe kia mākahia.

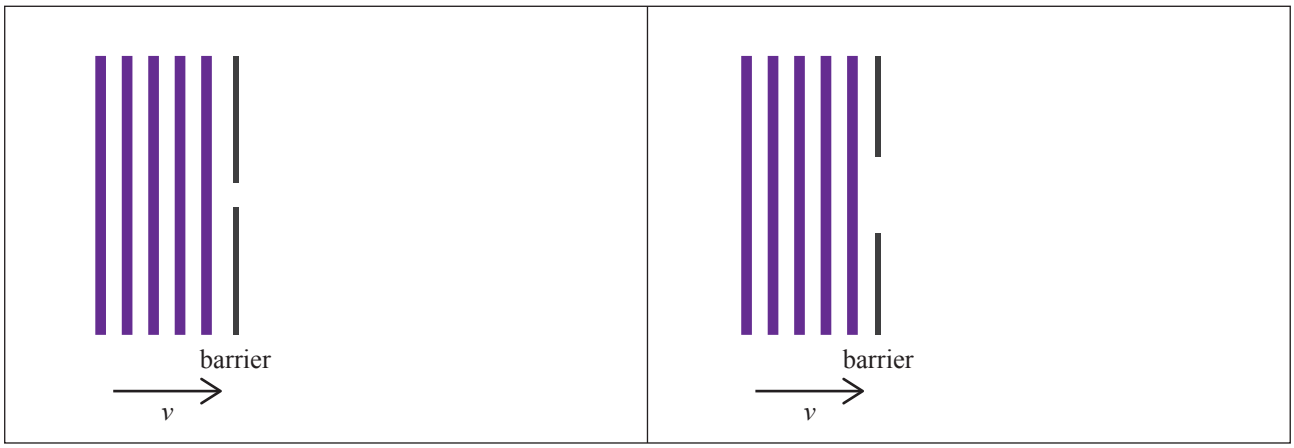


SPARE DIAGRAMS

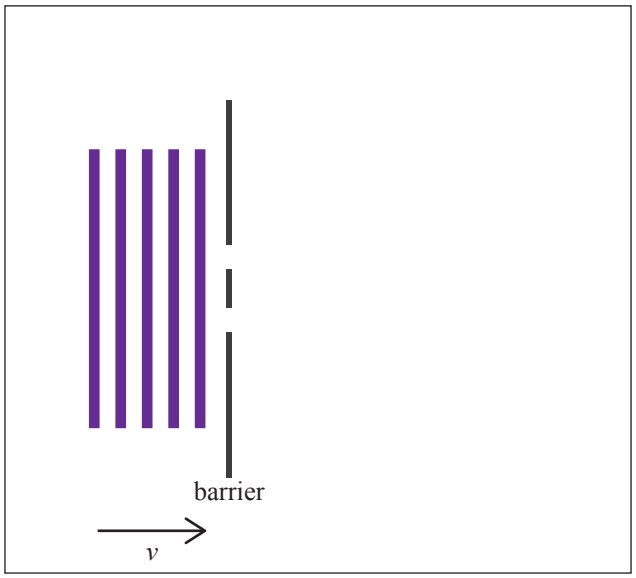
If you need to redraw your response to Question One (d), use the diagram below. Make sure it is clear which answer you want marked.



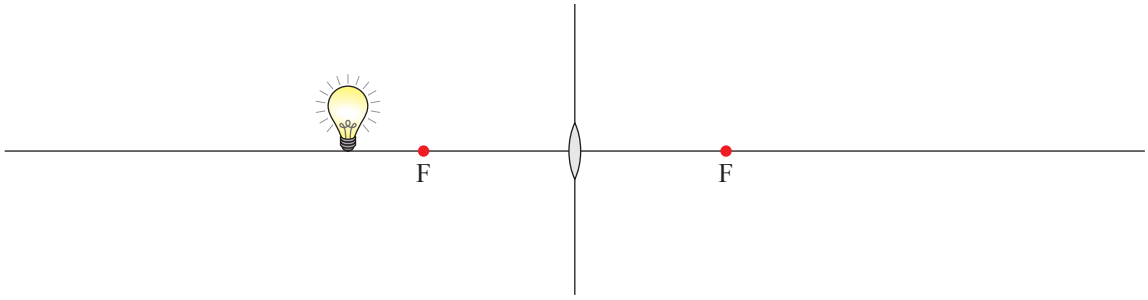
If you need to redraw your response to Question Two (b), use the diagram below. Make sure it is clear which answer you want marked.



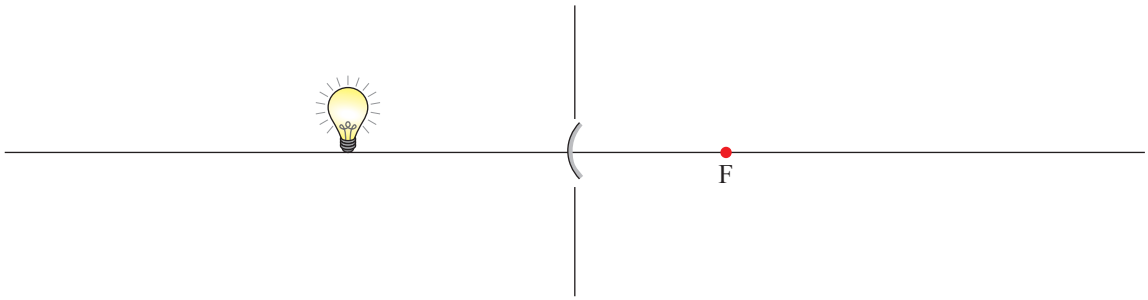
If you need to redraw your response to Question Two (c), use the diagram below. Make sure it is clear which answer you want marked.



Ki te hiahia koe ki te tā anō i tō urupare ki te Tūmahi Tuatoru (a), whakamahia te hoahoa i raro nei. Kia mārama te tohu ko tēhea te tuhinga ka hiahia koe kia mākahia.



Ki te hiahia koe ki te tā anō i tō urupare ki te Tūmahi Tuatoru (b)(i), whakamahia te hoahoa i raro nei. Kia mārama te tohu ko tēhea te tuhinga ka hiahia koe kia mākahia.



Ki te hiahia koe ki te tā anō i tō urupare ki te Tūmahi Tuatoru (c), whakamahia te hoahoa i raro nei. Kia mārama te tohu ko tēhea te tuhinga ka hiahia koe kia mākahia.

I muri iho

(i)

te pito kua aukatia

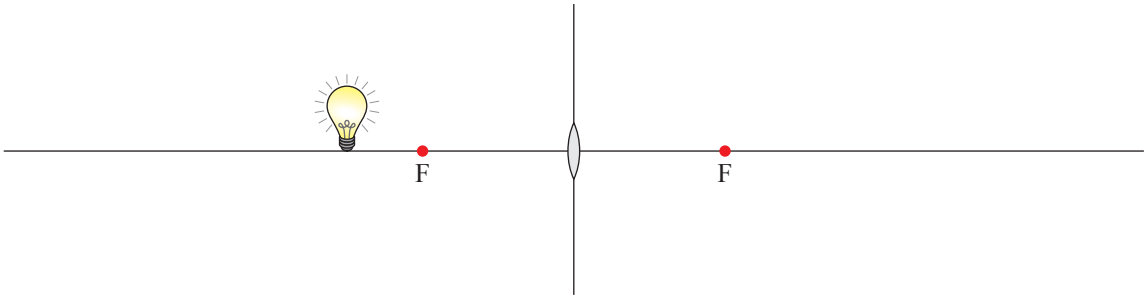
te pātū

(ii)

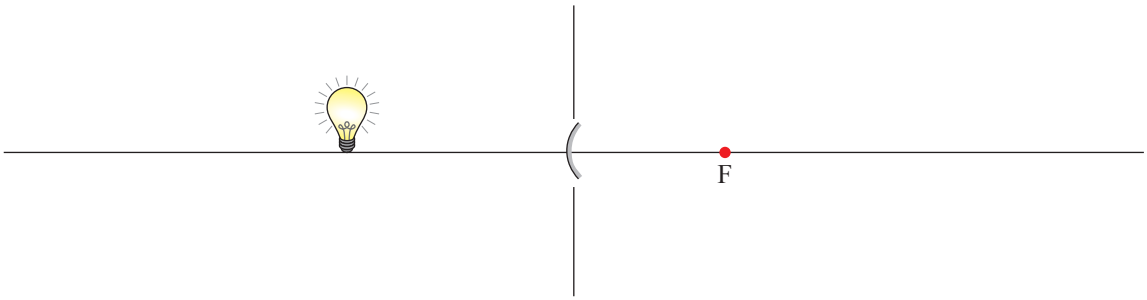
te pito kua wātea

he pou

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.



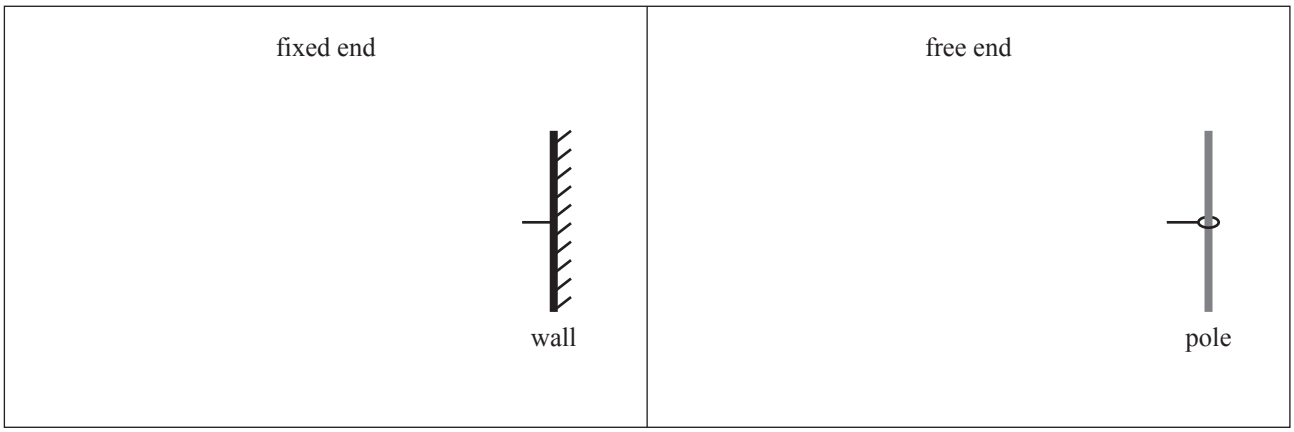
If you need to redraw your response to Question Three (b)(i), use the diagram below. Make sure it is clear which answer you want marked.



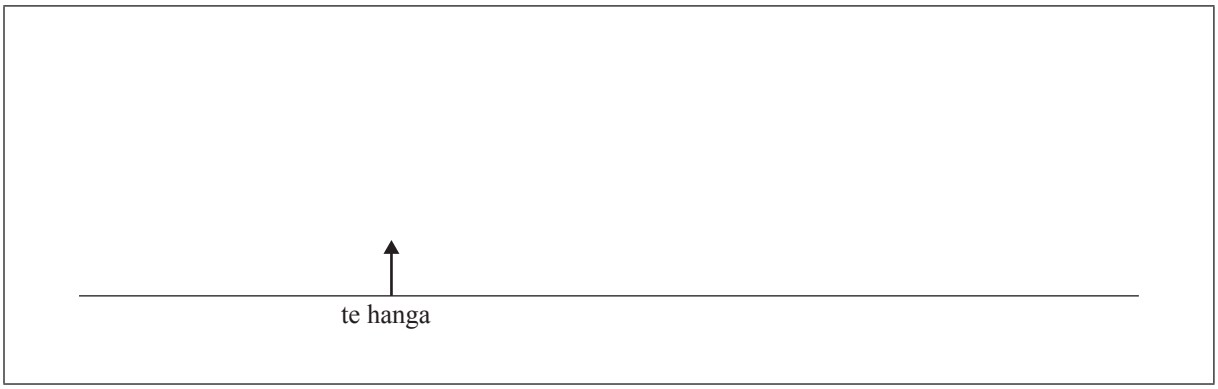
If you need to redraw your response to Question Three (c), use the diagram below. Make sure it is clear which answer you want marked.

After

(i) (ii)



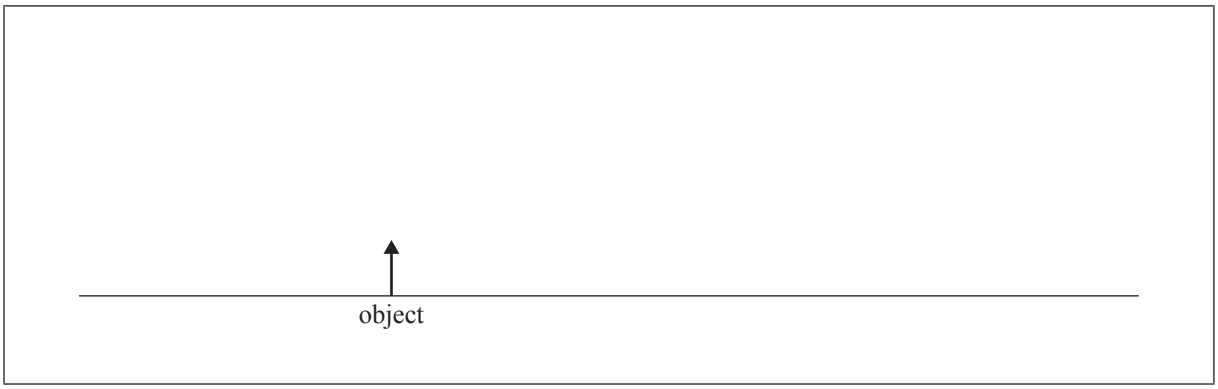
Ki te hiahia koe ki te tā anō i tō urupare ki te Tūmahi Tuatoru (d)(i), whakamahia te hoahoa i raro nei. Kia mārama te tohu ko tēhea te tuhinga ka hiahia koe kia mākahia.



He wāhi anō ki te hiahiatia.
Tuhia te tau tūmahi mēnā e hāngai ana.

TE TAU TŪMAHI

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

He whārangi anō ki te hiahiatia.
Tuhia te tau tūmahi mēnā e hāngai ana.

TE TAU TŪMAHI

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

QUESTION NUMBER

English translation of the wording on the front cover

Level 2 Physics 2022

91170M 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.

91170M

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–PHYSMR.

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 2–23 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.