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NZQA

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Level 1 Physics 2021

90938 Demonstrate understanding of aspects of wave behaviour

Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of aspects of wave behaviour.	Demonstrate in-depth understanding of aspects of wave behaviour.	Demonstrate comprehensive understanding of aspects of wave behaviour.

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 L1–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 2–15 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: MAGIC COIN

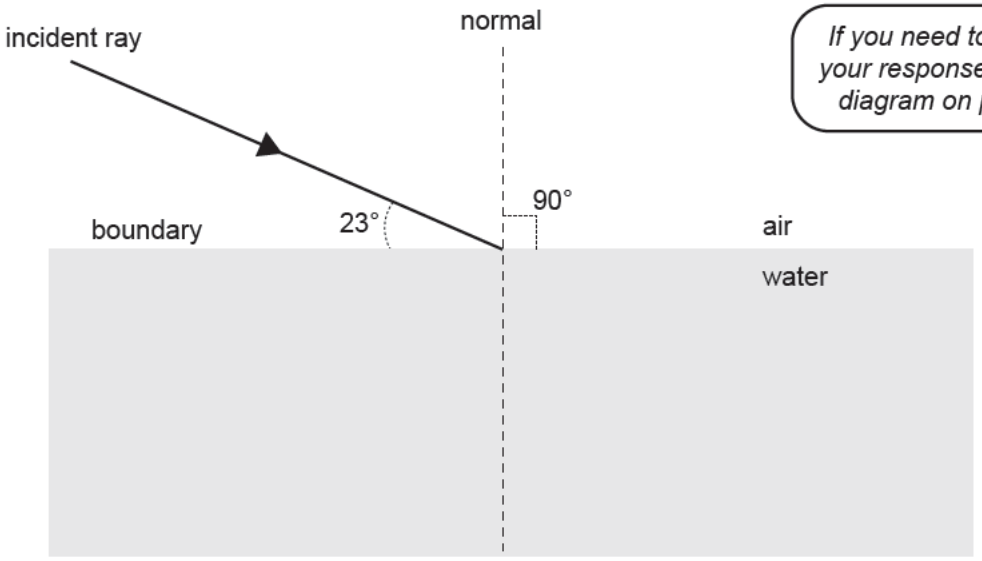
Refractive indices:

air = 1, water = 1.33, glass = 1.5

(a) Define the term refraction of light.

(b) In the diagram below, the incident ray hits the boundary.

(i) Complete the diagram by drawing the refracted ray as it enters a **denser** medium.



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

(ii) State the angle of incidence: _____

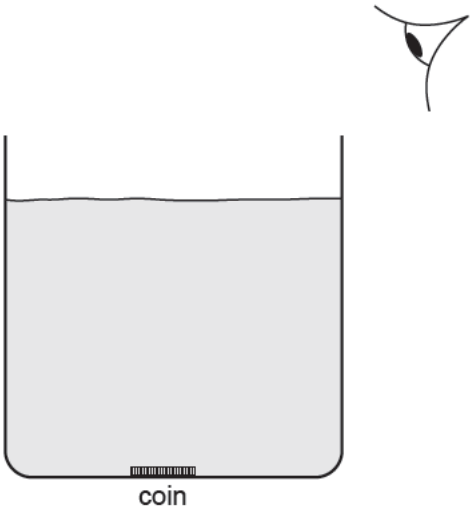
(c) Water is poured into a cup, and a coin appears, as shown below.

Cup with no water **Cup with water added**

Explain why you cannot see the coin in the cup with no water, but when water is poured into the cup, the coin suddenly appears.

Use a ray diagram to help explain your answer.

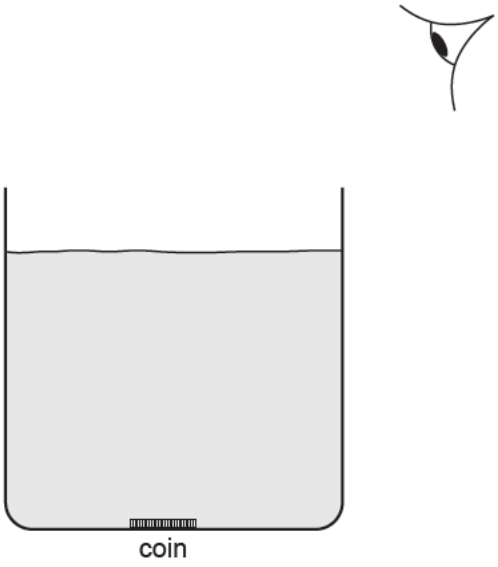
If you need to redraw your response, use the diagram on page 9.



(d) When a coin is placed in a clear glass full of water and viewed at a particular angle, it appears as two coins instead of one, as shown in the picture.

Using the laws of refraction, explain why two images of the coin can be seen.

Start by drawing ray diagrams to show how the light travels from the coin into the eye.

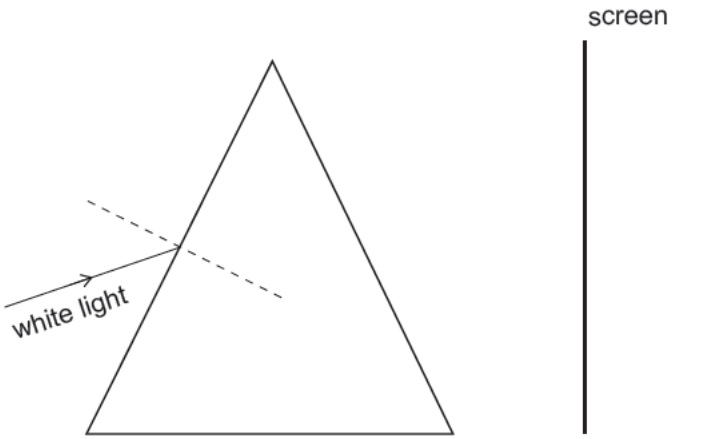


If you need to redraw your response, use the diagram on page 10.

QUESTION TWO: LIGHT TRAVELS

Below is a diagram of a prism. When white light enters the prism, it disperses. When the light exits the prism, a spectrum can be seen on a screen.

(a) Complete the path of light that would create a spectrum on the screen, and label the entire spectrum.



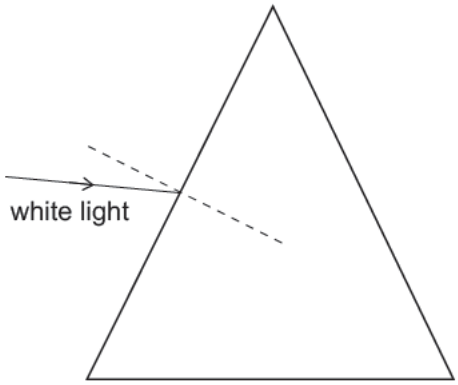
If you need to redraw your response, use the diagram on page 10.

(b) When the angle is brought closer to the normal as shown below, the rainbow disappears on the screen, and the light is reflected inside the prism.

(i) What is the name of this phenomenon?

(ii) Draw the path of the reflected ray inside the prism, and show how the emergent ray will exit the prism, using the diagram below.

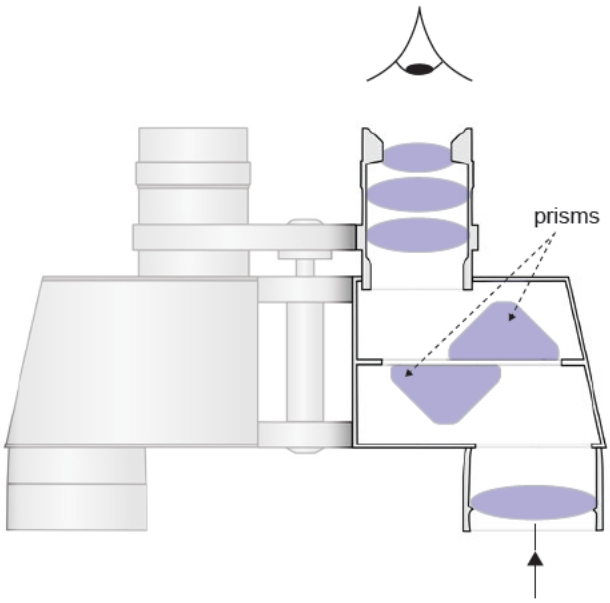
If you need to redraw your response, use the diagram on page 10.



(c) This technique is used in binoculars.

Use the diagram below to complete the single ray of light to show how light travels through binoculars to the eye.

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



(d) A woman wants to see the new shoes that she is wearing in front of a mirror.

Complete the ray diagram to show the **minimum** height the mirror must be if hung at eye level.

Explain why the minimum height of the mirror would remain the same for the woman to see her new shoes if she was half the distance to the mirror.

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

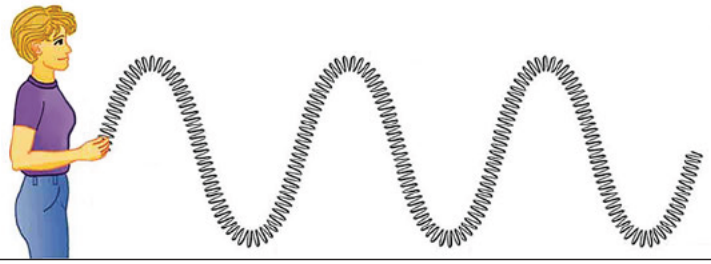
QUESTION THREE: WAVES

(a) Define the term frequency.

(b) In the boxes below, draw arrows to show the direction of energy transfer and the direction of the particle vibrating for each type of wave.

If you need to redraw your response, use the diagram on page 12.

Transverse wave

Direction of energy transfer	Direction of vibration
	particle ●

Longitudinal wave

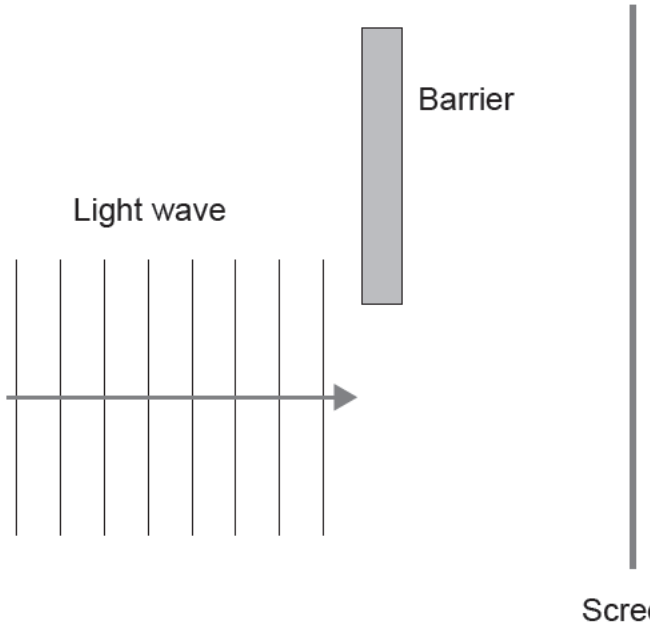
Direction of energy transfer	Direction of vibration
	particle ●

Question Three continues on the following page.

(c) Below is a diagram of light waves about to go around a barrier.

(i) Name of phenomenon: _____

(ii) Draw the light waves from where they pass the barrier to where they hit the screen.



If you need to redraw your response, use the diagram on page 12.

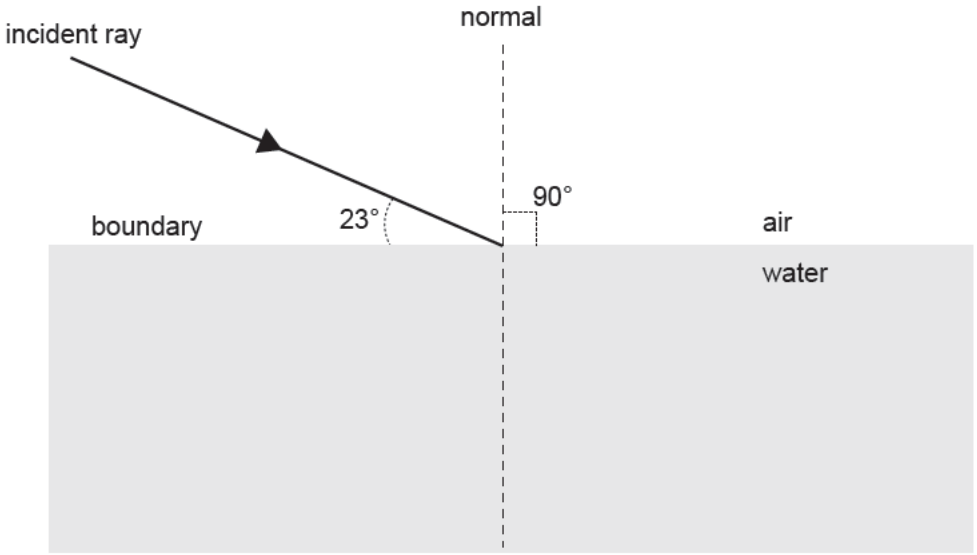
(d) A space probe called *New Horizons* was sent to Pluto to gather information about Pluto. When it got to Pluto it took a picture and sent it back to NASA on Earth, 4.6 billion km (4.6×10^9 km) away. *New Horizons* used microwaves with a wavelength of 0.0357 m and frequency of 8.4 GHz (8.4×10^9 Hz) to send the picture.

Source: https://sen.com/news/new-horizons-spies-pluto-s-smaller-moons

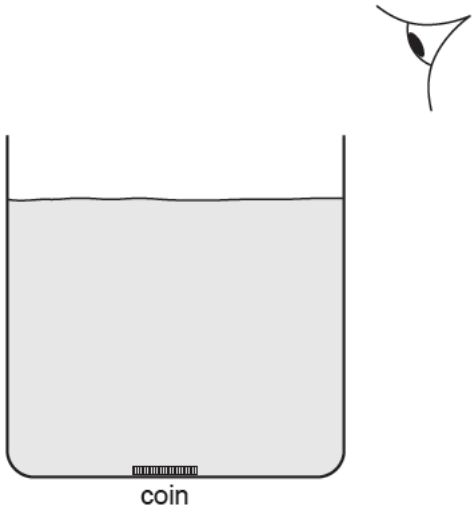
Calculate the time in **hours** it would take for NASA to receive the picture, and explain what issues there might be with the signal when received on Earth.

SPARE DIAGRAMS

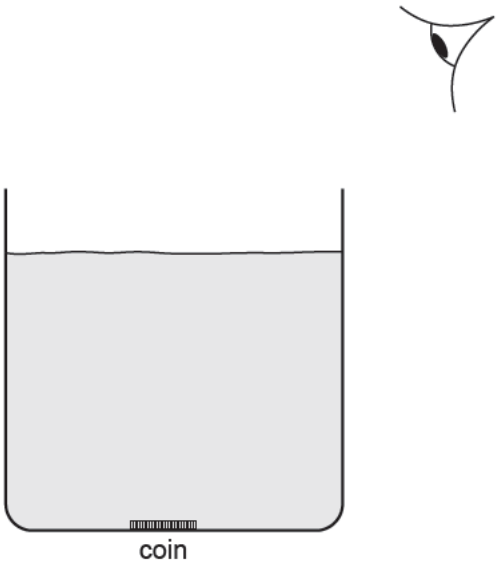
If you need to redraw your response to Question One (b), use the diagram below. Make sure it is clear which answer you want marked.



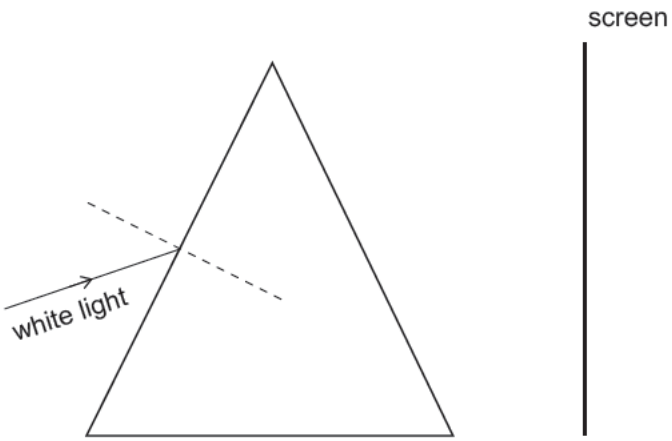
If you need to redraw your response to Question One (c), use the diagram below. Make sure it is clear which answer you want marked.



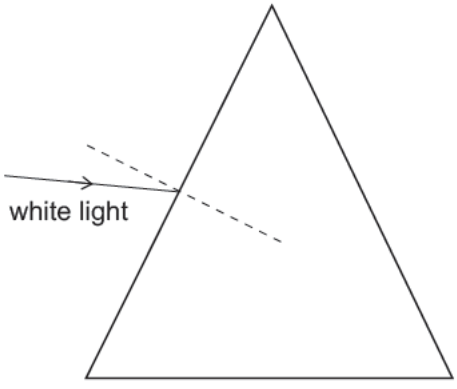
If you need to redraw your response to Question One (d), use the diagram below. Make sure it is clear which answer you want marked.



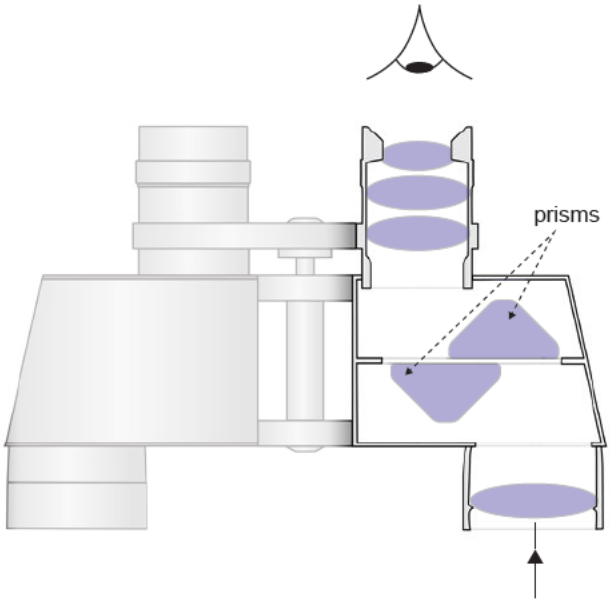
If you need to redraw your response to Question Two (a), use the diagram below. Make sure it is clear which answer you want marked.



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



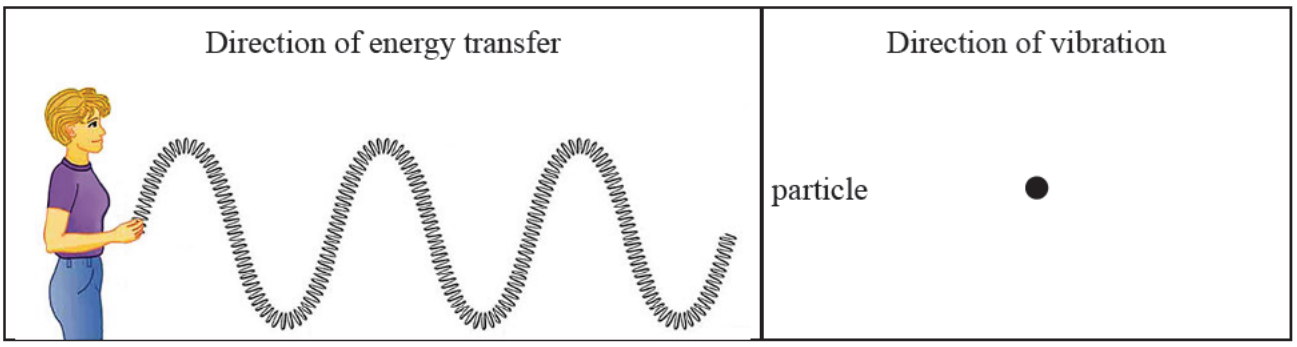
If you need to redraw your response to Question Two (c), use the diagram below. Make sure it is clear which answer you want marked.



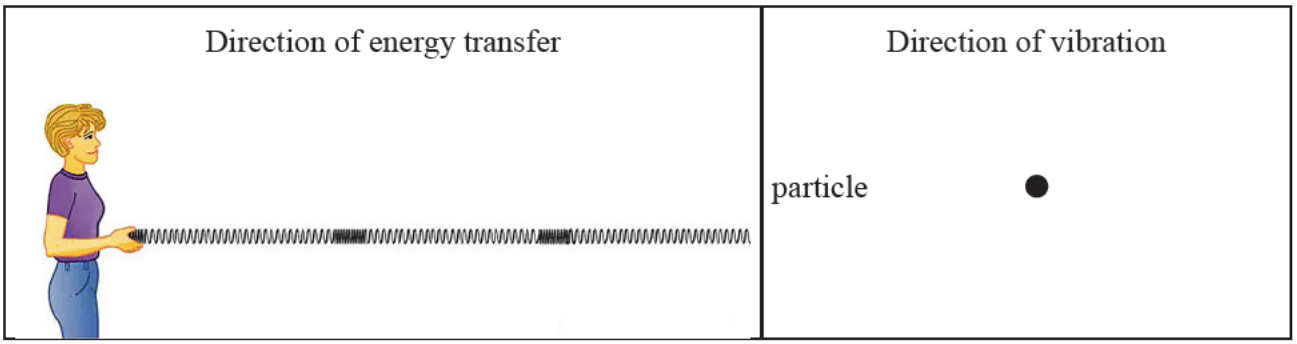
If you need to redraw your response to Question Two (d), use the diagram below. Make sure it is clear which answer you want marked.

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

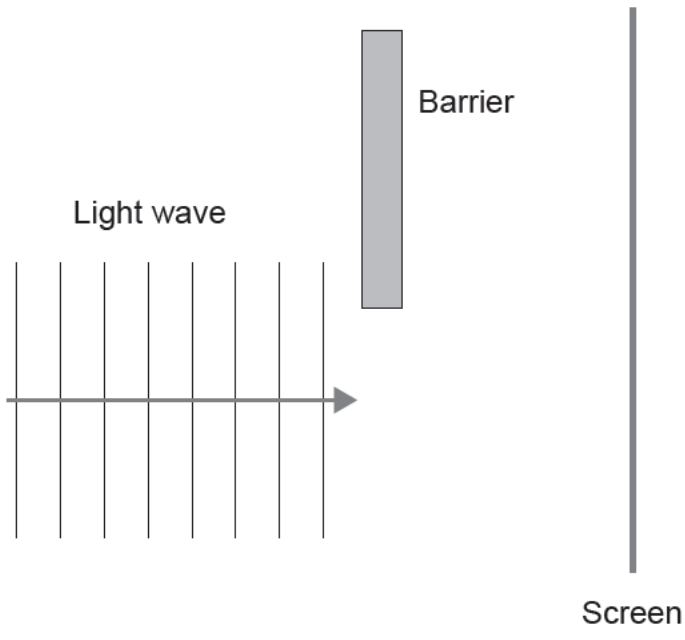
Transverse wave



Longitudinal wave



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.



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

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