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NZQA

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SUPERVISOR'S USE ONLY

Level 1 Physics, 2016

90938 Demonstrate understanding of aspects of wave behaviour

2.00 p.m. Tuesday 15 November 2016
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 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 2–14 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.

Achievement

TOTAL 10

ASSESSOR'S USE ONLY

QUESTION ONE: WAVE PROPERTIES

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(a) There are two types of waves, longitudinal and transverse.

Give an example of each.

Longitudinal: ~~A wave that travels in right angles (up and down)~~ ~~Ultraviolet rays~~ light rays

Transverse: ~~A wave~~ Micro waves

(b) Explain the differences between a longitudinal and a transverse wave.

Your answer should include:

- how the particles in the wave move
- how the wave travels.

A transverse wave travels at right angles moving up and down. It consists of an equilibrium, crests and troughs. The particles in a transverse wave oscillate up ~~and down~~ through the equilibrium till it reaches a point where it displaces, making the particles travel downwards.

A longitudinal wave travels across itself in a single direction. It consists of rarefraction and compression points. The particles in a ~~wave~~ longitudinal wave oscillate back and fourth, close to eachother in some parts of the wave, and more far apard in others.

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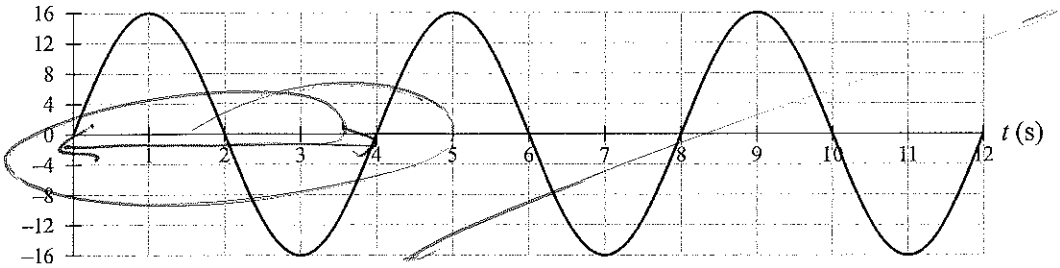
(c) A circuit that has an alternating current is connected to an oscilloscope. The oscilloscope screen displays a waveform of the alternating current, as shown below.

(i) On the diagram, **draw** and **label** the amplitude of the wave.

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



(ii) Use the information in the diagram above to determine the **frequency** of the wave.

Give a unit with your answer.

$f = \frac{1}{T}$

$f = 1/4$

$f = 0.25$

Amplitude = 1 full wave

~~$v = f\lambda$~~

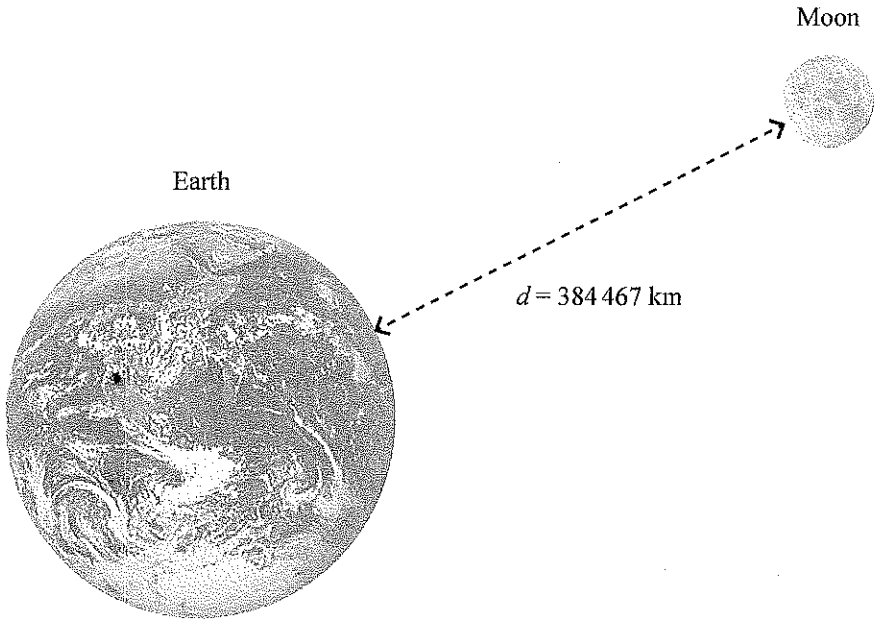
~~$f = v/\lambda$~~

~~$(ms^{-1})(m)(Hz)$~~

Frequency: 0.25 Unit: Hz

ASSESSOR'S USE ONLY

(d) Scientists have been able to calculate the distance between the Earth and the Moon by shining a red laser from Earth and reflecting the red laser on a mirror left on the Moon by the Apollo 11 mission back to a receiver on Earth.



(i) The scientists are using a red laser with a wavelength of 6.5×10^{-7} m and a period of 2.17×10^{-15} s.

Show that the speed of the red laser light is 3.0×10^{8} m s^{-1}.

$v = f\lambda$

$v = 2.17 \times 10^{-15} \times 6.5 \times 10^{-7}$

$v =$

(ii) The distance between the Earth and the Moon is 384 467 km.

Calculate the time it takes for the laser light to leave Earth and return to hit the receiver.

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$v = \frac{d}{t}$

$t = v \times d$

$t = 300000000 \times 384467$

$t =$

Time: 3 s

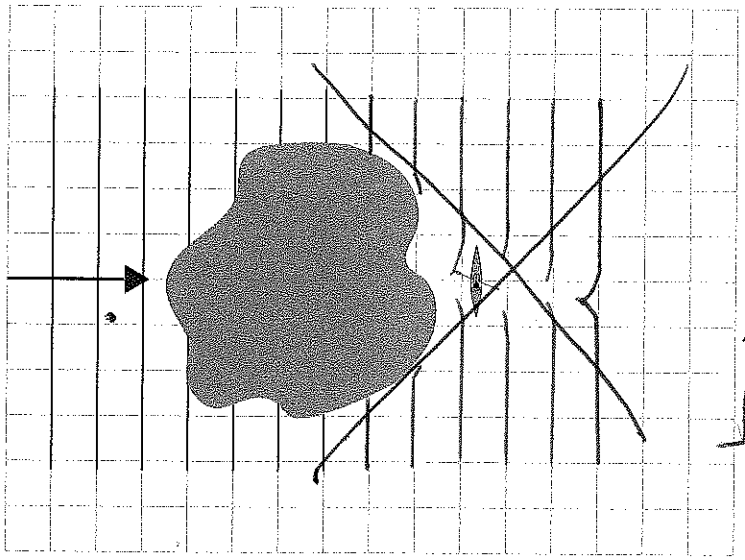
A3

QUESTION TWO: WATER AND LIGHT

ASSESSOR'S USE ONLY

(a) While sea kayaking, people can go behind small islands for safety from large ocean waves.

Complete the diagram below to show how the waves travel around the small island.



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

Page 11

(b) (i) With help from the diagram in (a), explain why a kayaker would go behind the island for safety.

Because the waves are oscillating quite close together, the time taken for it to come to a point is further than if the waves oscilated slower. This means the waves would not effect the kayaker due to the proximity of the wavelength.

(ii) As the kayaker is watching the waves pass from behind the island, he counts 6 waves in 4 seconds.

Calculate the period of the wave.

~~t = v x d~~ v = d / t

~~t =~~ v = 6 / 4

v = 1.5

v = d / t

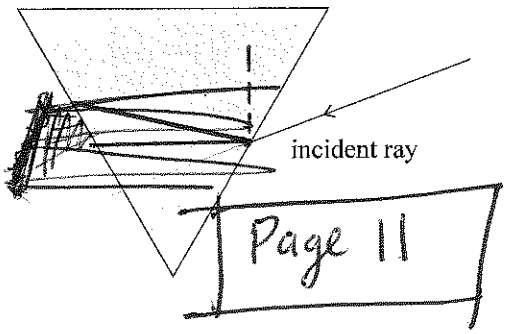
Period: $(ms^{-1})(m)(s)$ 1.5 $m s^{-1}$

ASSESSOR'S USE ONLY

(c) The kayaker notices a mist from the water that is creating a rainbow. He remembers from science class that white light can be separated into the colours of the rainbow if it goes through a prism.

Complete the diagram below to show how white light is being separated into its different colours.

Draw and label all seven colours.



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

Page 11

(d) The prism has an optical density that increases as the frequency of the light increases.

Explain why the prism alters the path of **red** and **blue** light differently, as you have drawn in the diagram above.

The incident ray is travelling through a less dense medium, and as it hits the glass prism, which is a ~~denser~~ denser medium, the light wave slows down. This means the colours produced from the white light disperse in the order red, orange, yellow, green, blue, indigo, violet and because the red light ~~is~~ wavelength is the least and the violet wavelength is the most, this results in the colour order.

A3

QUESTION THREE: CAR MIRRORS

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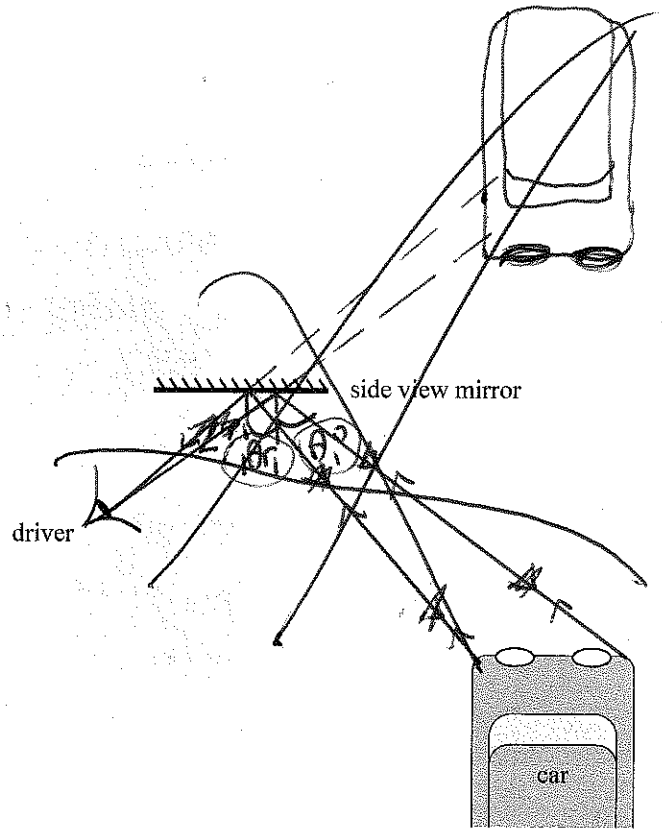
Side mirrors on the outside of cars are designed to reflect light so the driver can see what is beside them.

(a) (i) Complete a ray diagram to show how the side view mirror allows the light to travel from the car to the driver.

Show where the image of the car is formed.



Page 12

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

(ii) On your diagram above, label ONE of the rays with the angle of incidence and the angle of reflection.

(iii) How does the angle of incidence compare with the angle of reflection?

It is always the same when reflected in a regular mirror.

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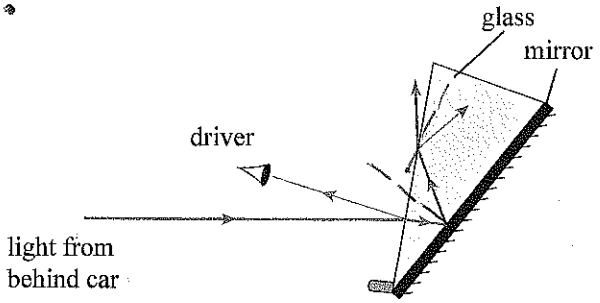
(b) Inside the car is a rear view mirror.

At night, the reflected glare from the headlights of a following car can impede the vision of the driver. With the pull of a lever, the mirror can be moved to a night-time position, which reduces the glare, as shown in the diagram below.

In this night-time position, a **small percentage of the light reflects** from the front of the glass surface and enters the driver's eye.

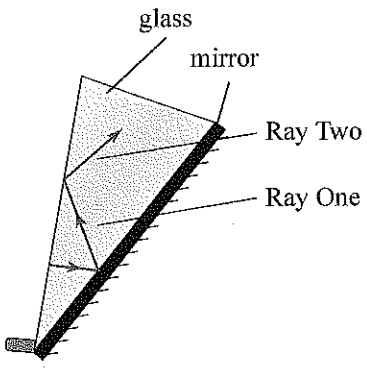


Using the diagram above, explain how reflection and refraction alter the path of the **remaining light** so that the glare of the headlights of the following car seen by the driver is reduced.

The glass of the surface of the rear view mirror is denser than the light and air hitting it. When tilted to a night-time position the reflected light doesn't hit directly into the drivers eye, still allowing them to see the rear view of their vechile. The light refracts as it hits the glass and then the mirror, then as it travelks through the glass, because it is a denser medium, the light ray slows down and reflects out of the glass. This reduces the glare of the headlights as the driver views the light ray as it is the glass, not the mirror so the light isn't reflecting straight back into the driver's eye.

ASSESSOR'S USE ONLY

(c) The diagram below shows the path that a ray of light takes as it travels in the glass wedge.



State what is occurring to Ray One at the boundary between the glass wedge and the air, that forms Ray Two.

Give reasons why.

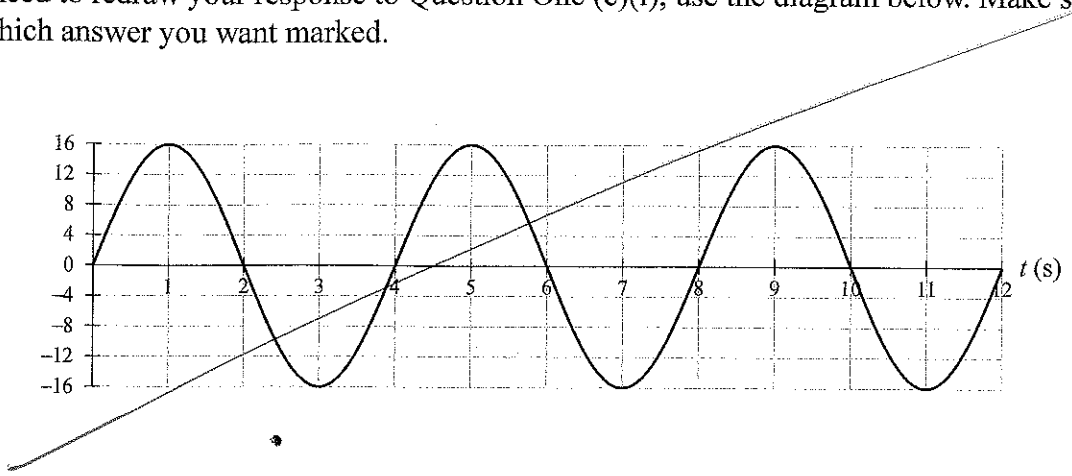
~~Ray One is produced~~ When the light travels in the glass wedge it slows down as glass is a denser medium for light to travel through than air. ~~Ray~~ Ray two is formed ~~as~~ because when the light travels through the two mediums, air and glass, the direction of the reflected ray is altered due to the density of the mediums, resulting in Ray One and Ray to travelling out differently.

A4

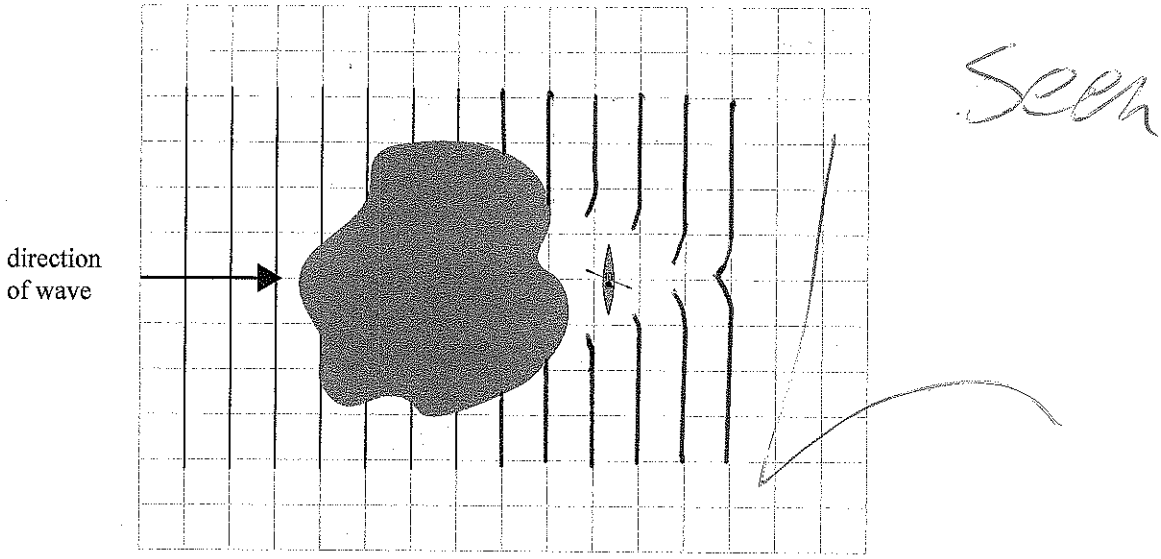
SPARE DIAGRAMS

ASSESSOR'S USE ONLY

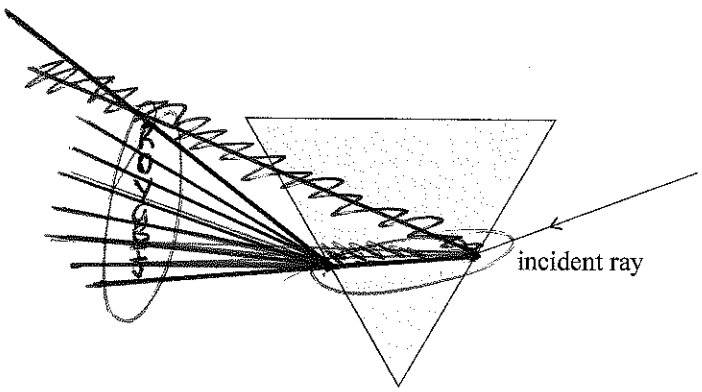
If you need to redraw your response to Question One (c)(i), use the diagram below. Make sure it is clear which answer you want marked.



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.

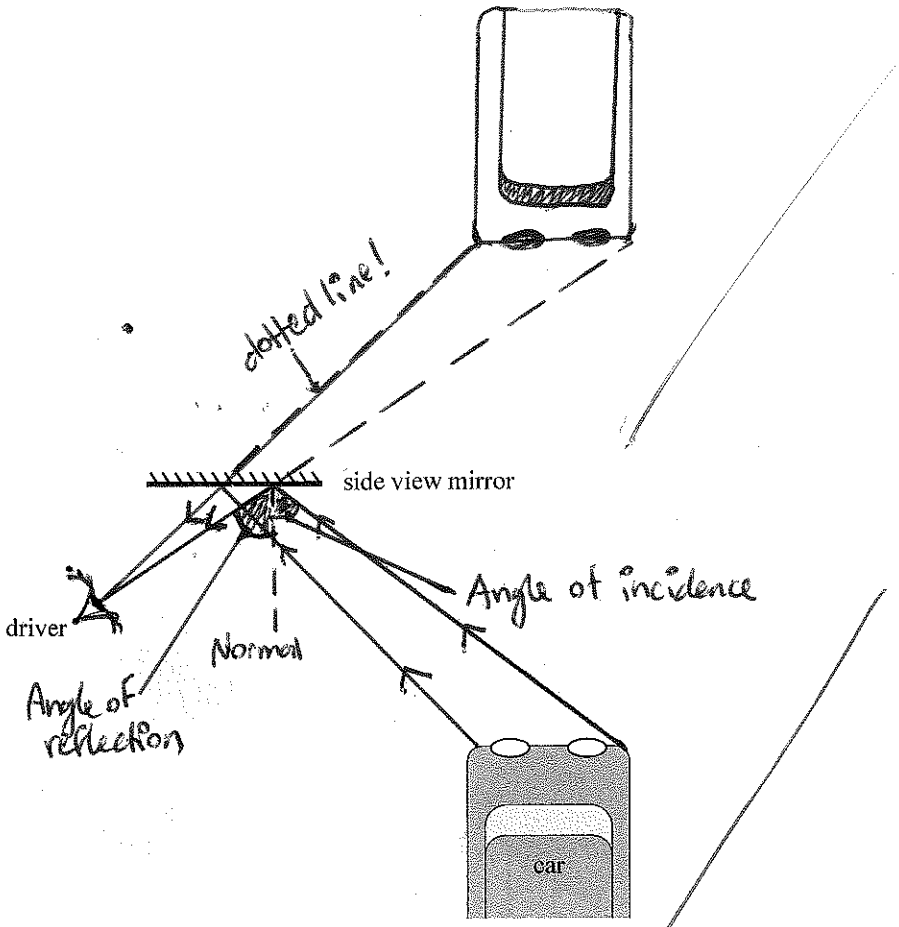


If you need to redraw your response to Question Two (c), use the diagram below. Make sure it is clear which answer you want marked.



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.

ASSESSOR'S USE ONLY



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Achievement exemplar 2016

Subject:	Physics	Standard:	90938	Total score:	10

Q	Grade score	Annotation
1	A3	(a) **Not Achieved** Light waves incorrectly identified as longitudinal waves (b) **Merit** Uses concepts of parallel and perpendicular movement correctly and correctly links compressions/rarefactions or crests/troughs to appropriate wave type (c) **Achieved** (i) Amplitude not shown (ii) Frequency correctly calculated (d) **Not Achieved** (i) Incorrect substitution shown in order to show speed of light (ii) Incorrect method to determine time
2	A3	(a) **Achieved** The diagram shows the waves diffracting but rather than more curvature the waves become straight, with only a little end at the end. (b) **Not Achieved** (i) not mentioning area of calm or that waves won't reach kayaker (ii) Incorrect period (c) **Not Achieved** ray does not split as it enters prism and incorrect order of colours (d) **Merit** Explains that light changes speed, slows down, upon entering prism
3	A4	(a) (i) **Merit** Two rays drawn correctly, locating image in correct position (ii) & (iii) **Achieved** angle of incidence and angle of reflection correctly identified, and also states that these are equal. (b) **Achieved** States that light refracts as it enters rear view mirror, but fails to explain further alterations in path of light (c) **Not Achieved** Total Internal Reflection not stated