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NZQA

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Level 1 Physics, 2015

90938 Demonstrate understanding of aspects of wave behaviour

9.30 a.m. Thursday 19 November 2015
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 2–10 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.

Not Achieved

TOTAL 06

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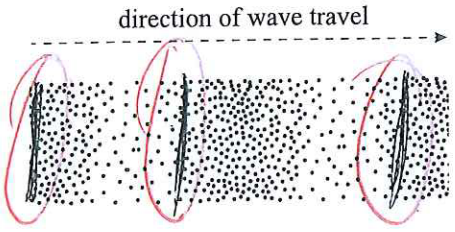
ASSESSOR USE ONLY

QUESTION ONE: SOUND WAVES

The diagram below represents sound waves travelling through a medium.



(a) (i) What **type** of wave is a sound wave?

longitudinal

(ii) How many **full** wavelengths are shown in the diagram above?

Give a reason for your answer.

2 because the last compression does not have a rarefraction after it thus there are only 2 full wavelengths

(b) How does the direction of motion of particles in the medium compare to the direction of the wave travel?

The particles vibrate causing other particles nearby to vibrate, allowing the wave to travel in all directions independant of the direction of motion of particles. (though the speed may decrease if the particles move fast enough against the wave)

Bottlenose dolphins use echolocation to locate their prey. They make clicking sounds and then listen to the echo of the sound waves reflected off objects in front of them.

http://ioniandolphinproject.org/species-guide/common-bottlenose-dolphin
http://fishingrigz.com/fish/snapper.html

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(c) A bottlenose dolphin produces a sound wave of frequency 150 kHz.

Calculate the **period** of this wave.

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

Period: 150 T

(d) A dolphin sends out a clicking sound and receives an echo from a fish 0.060 s later. The speed of sound in water is 4.5 times faster than the speed of sound in air. The speed of sound in air is 343 m s^{-1}.

(i) Calculate the distance from the dolphin to the fish.

$343 \times 4.5 = 1543.5 \text{ m s}^{-1}$

$vt = d$

$1543.5 \times 0.060 = 92.61 \text{ m}$

Distance: 92.61m

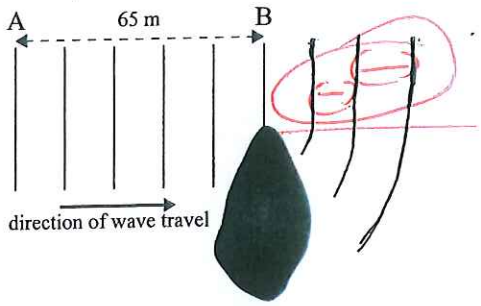
(ii) Explain how a dolphin is able to distinguish a near object and a distant one by using echolocation.

A near object will take a shorter time for the sound waves to travel back from the object. If the object is further away it will take longer.

N2

QUESTION TWO: WAVE BEHAVIOUR

The diagram below shows water waves travelling towards a large rock near the shore line.



(a) On the diagram above draw the wave pattern produced as the waves pass the tip of the rock.

(b) Name the physics concept that is related to this situation.

(c) The lines on the diagram represent wave crests. The distance from wave crest A to wave crest B is 65 m.

(i) Calculate the wavelength of the water waves.

65 ÷ 5 = 13

Wavelength: 13 m

(ii) The frequency of the water waves is 0.25 Hz.

Calculate the speed of the waves in water.

13 X 0.25 = 3.25

Speed: 3.25 ms^{-1}

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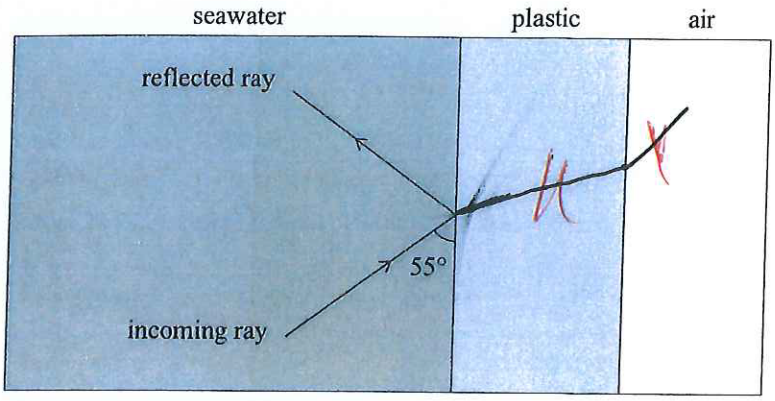
(d) When a person does underwater diving, light travels from the seawater through the plastic of a diver's mask to the eyes of the diver. The space between the mask and the diver's face contains air.

The diagram below shows a ray of light travelling from the seawater to the plastic of a diver's mask. Part of the incoming ray is reflected.

http://underwaterdive.com/about/instructors/john-german/



(i) The incoming ray strikes the seawater-plastic boundary at 55°, as shown in the diagram.

State why the angle of reflection in the above situation is 35°.

because some of the ray has refracted causing the energy of the ray to decrease decreasing the angle of reflection.

(ii) Plastic is optically denser than seawater, and air is optically less dense than plastic.

On the diagram above, draw the path of the reflected ray through the plastic into the air.

(iii) Compare the speed of the **reflected ray** in seawater with the speed of the **incoming ray** in seawater.

Explain your answer.

The incoming ray will have more energy than the reflected ray as a large amount of energy is lost when it refracts ~~at~~ into the plastic. The change in energy causes the reflected rays speed to slow.

A3

QUESTION THREE: REFLECTION

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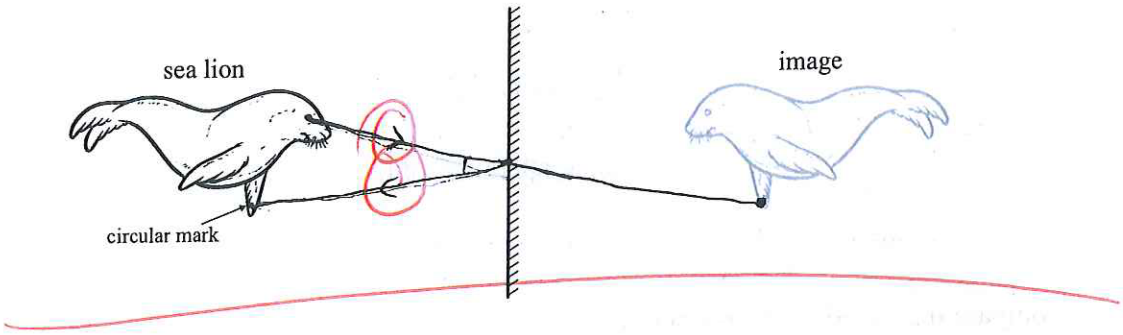
The photograph below shows a sea lion being reflected by the glass window of an underwater camera.

www.wodumedia.com/wp-content/uploads/2012/10/An-Australian-Sea-Lion-becomes-enchanted-when-it-sees-its-reflection-for-the-first-time-in-the-lens-of-the-giant-IMAXR-3D-camera-for-the-filming-of-the-IMAX-3D-film-Under-the-Sea-3D.-Photo-2008-Michele-Hall-used-with-permissi-1.jpg

(a) On the diagram below, draw rays to show how the sea lion can see the circular mark on the tip of its flipper in the glass window.



(b) The image formed by the glass window is a virtual image.

State how a virtual image is different from a real image.

The image is reversed so the flipper would be on the opposite side to the real one.

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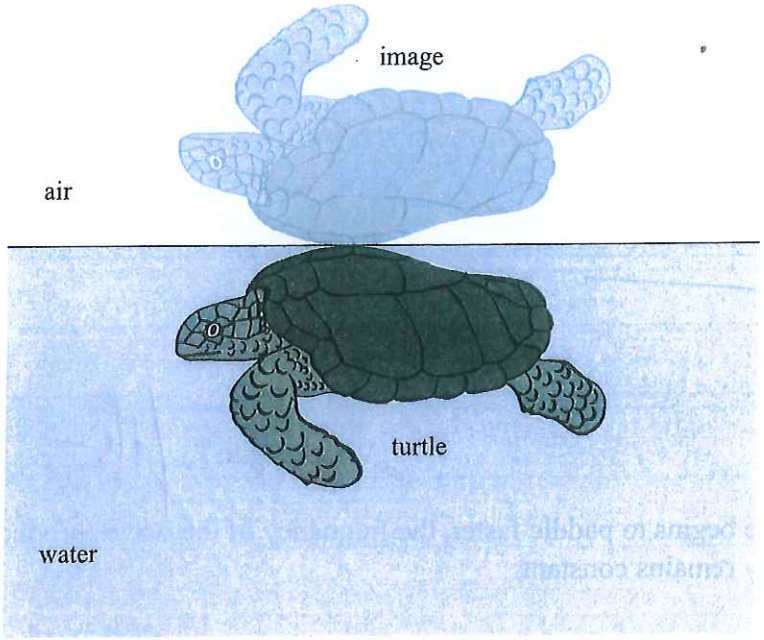
A turtle floats just under the surface of water. An underwater diver sees an inverted image of the turtle directly above it. This image is caused by total internal reflection. The diagram below shows the turtle and its image.



(c) Describe TWO conditions needed for total internal reflection to occur in the above diagram.

(1) The correct angle of incidence (45° and under)

(2) 2 different mediums such as air and water so the light can reflect off of the barrier between the two

Question Three continues on the following page.

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(d) When the turtle paddles on the surface of water, it produces waves. The turtle produces 6.0 surface waves in 12 seconds. Each wave travels 15 m in 30 s.

(i) Calculate the wavelength of the waves produced.

0.5/s

0.5 $m.s^{-1}$

0.5 ÷ 0.5 = 1

Wavelength: 1 m

(ii) When the turtle begins to paddle faster, the frequency of the waves produced **doubles**, but the velocity remains constant.

Explain how the wavelength of the waves changes when the frequency of the wave doubles.

The wavelength will increase causing the waves ~~of~~ compressions and rarefractions to be larger.

N/

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

QUESTION NUMBER

ASSESSOR'S USE ONLY

Annotated Exemplars

Not Achieved exemplar for 90938 2015		Total score	06
Q	**Grade score**	**Annotation**	
1	N2	(a) (i) and (ii) **Achieved.** Correctly describes the wave as longitudinal (b) **Not Achieved.** For Achieved the direction of the vibration of the particles needs to be parallel to the direction of the wave motion (c) **Not Achieved.** For Achieved there has to be a valid attempt to calculate the time period using the information given (d) (i) and (ii) **Achieved.** Candidate has calculated a distance without halving the distance	
2	A3	(a) **Achieved.** The diagram shows the wave diffracting in the correct manner but there should be no change in wavelength. (b) **Not Achieved.** An attempt to name the physics concept is required (c) (i) and (ii) **Merit.** Speed correctly calculated with appropriate units. (d) (i), (ii) and (iii) **Not Achieved.** For Achieved there needs to be a correct ray diagram OR an explanation of the relationship between the angle of incidence, normal and angle of reflection OR a description that light does not change speed on reflection.	
3	N1	(a) **Not Achieved.** For Achieved, a diagram of one ray needs to be drawn including the correct direction of the rays (from the object to the sea lion's eyes). (b) **Not Achieved.** For Achieved, a correct statement regarding the nature of virtual images needs to be made (c) (i) and (ii) **Not Achieved.** For Achieved one of the conditions for Total Internal reflection needs to be stated correctly. (d) (i) and (ii) **Achieved.** Correct calculation of the wavelength but without appropriate units and an incorrect explanation regarding the wavelength change.	

Annotated Exemplars

Not Achieved exemplar for 90938 2015		Total score	06
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