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NZQA

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

For Supervisor's use only

Level 2 Physics, 2007

90254 Demonstrate understanding of waves

Credits: Four
2.00 pm Friday 30 November 2007

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 answer ALL the questions in this booklet.

For all numerical answers, full working must be shown. The answer should be given with an SI unit.

For all 'describe' or 'explain' questions, the answer should be in complete sentences.

Formulae you may find useful are given on page 2.

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 2–8 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.

For Assessor's use only	**Achievement Criteria**	
Achievement	**Achievement with Merit**	**Achievement with Excellence**
Identify or describe aspects of phenomena, concepts or principles. ☐	Give descriptions or explanations in terms of phenomena, concepts, principles and / or relationships. ☐	Give concise explanations that show clear understanding, in terms of phenomena, concepts, principles and / or relationships. ☐
Solve straightforward problems. ☐	Solve problems. ☐	Solve complex problems. ☐
Overall Level of Performance (all criteria within a column are met) ☐		

You are advised to spend 40 minutes answering the questions in this booklet.

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You may find the following formulae useful.

$$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i} \qquad \text{or} \qquad s_i s_o = f^2$$

$$m = \frac{d_i}{d_o} = \frac{h_i}{h_o} \qquad \text{or} \qquad m = \frac{f}{s_o} = \frac{s_i}{f}$$

$$n_1 \sin\theta_1 = n_2 \sin\theta_2 \qquad \frac{n_1}{n_2} = \frac{v_2}{v_1} = \frac{\lambda_2}{\lambda_1}$$

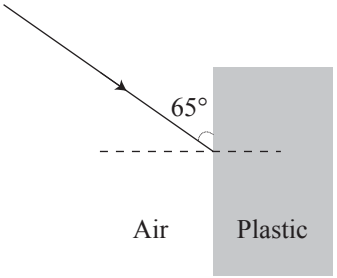
$$v = f\lambda \qquad f = \frac{1}{T} \qquad v = \frac{d}{t}$$

QUESTION ONE: THE OPTICIAN

Pita is visiting the medical centre to get a new pair of glasses. He finds out that lenses can be made of either plastic or glass.
Plastic has a refractive index of 1.60. Glass has a refractive index of 1.50.

(a) State the meaning of the term "refractive index".

A ray of light enters the plastic lens as shown.
The refractive index of air is 1.00.
The refractive index of the plastic is 1.60.



(b) Calculate the size of the angle of **incidence**.

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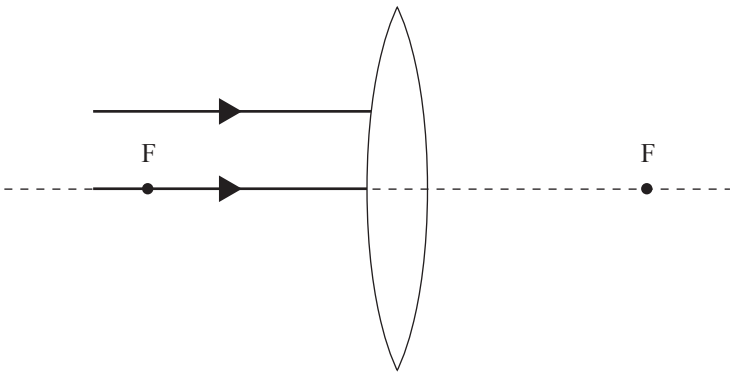
(c) Calculate the size of the angle of **refraction**.

(d) Calculate the size of the critical angle at the **plastic / air** boundary.

(e) The lenses in Pita's glasses are convex. Two parallel rays are shone into a convex lens as shown in the diagram below.

Complete the paths of the rays to show how they continue through the plastic and into the air. (Show refraction at both boundaries.)



(f) A second lens has an identical shape, but is made from the glass with a refractive index of 1.50.

Use the diagram above to explain how the focal lengths of the two lenses compare.

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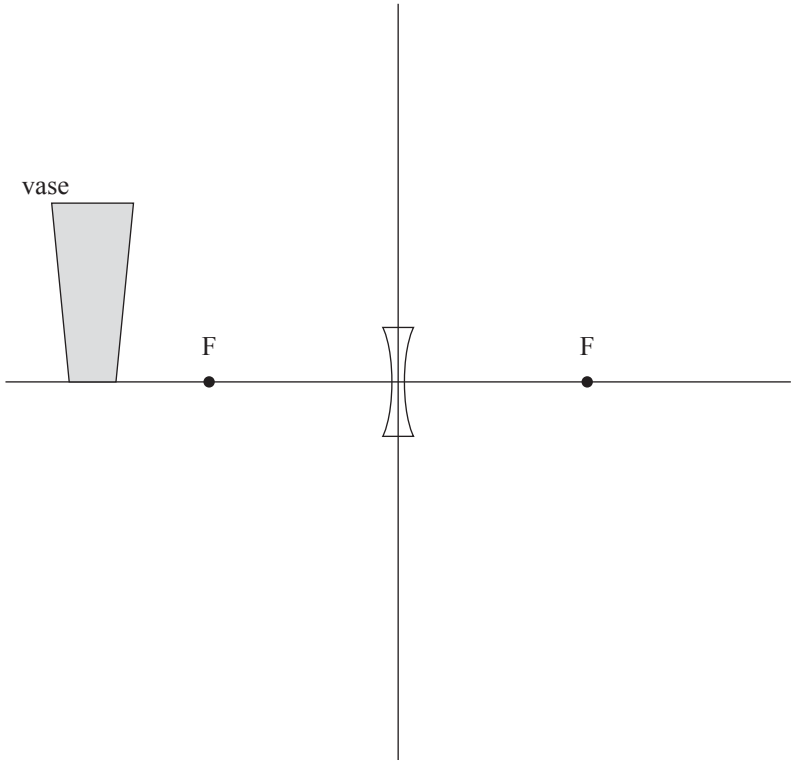
(g) Pita looks at a vase through a concave lens.

On the diagram below, draw appropriate rays to show how the **image** of the vase is formed.



(h) Describe the **nature** of the image of the vase.

(i) Use the diagram above to calculate the magnification.

(j) The vase is now placed 1.0 m from the lens. The vase is 35 cm high. The focal length of the lens is 30 cm.

Calculate the height of the **image.**

QUESTION TWO: AT THE HARBOUR

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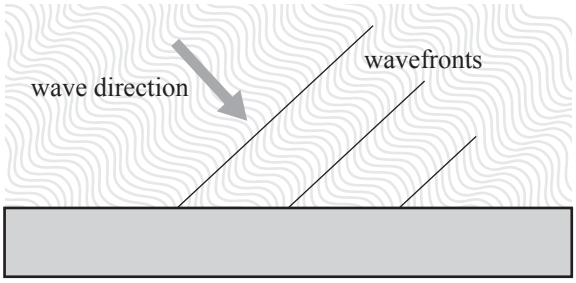
Maria is sitting on a harbour wall. She sees a series of water waves travelling towards the wall at an angle, as shown in the diagram below.

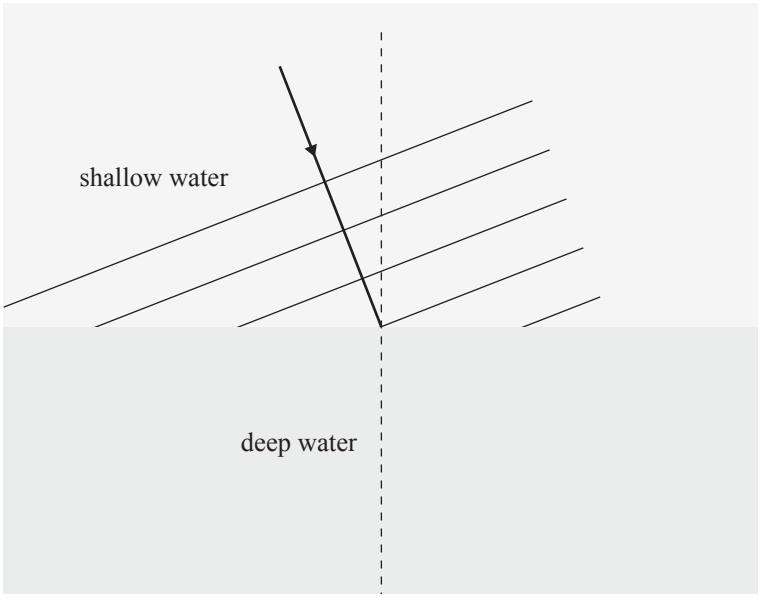
View of water waves from above



(a) On the diagram above, draw the **reflected wavefronts**.

Further out to sea, she sees water waves travelling through shallow water above a reef and then into deep water, as shown in the diagram below. (The water waves travel more slowly in shallow water.)

View of water waves from above



(b) On the diagram above, draw the **wavefronts** in the deep water, **and** an arrow showing the **direction** the **refracted** waves are travelling.

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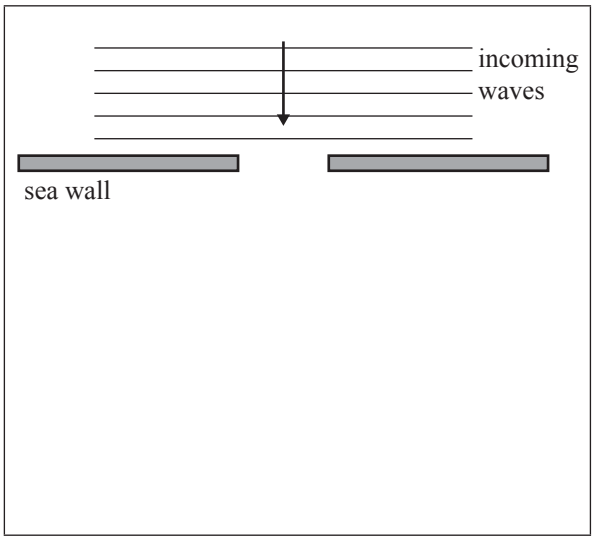
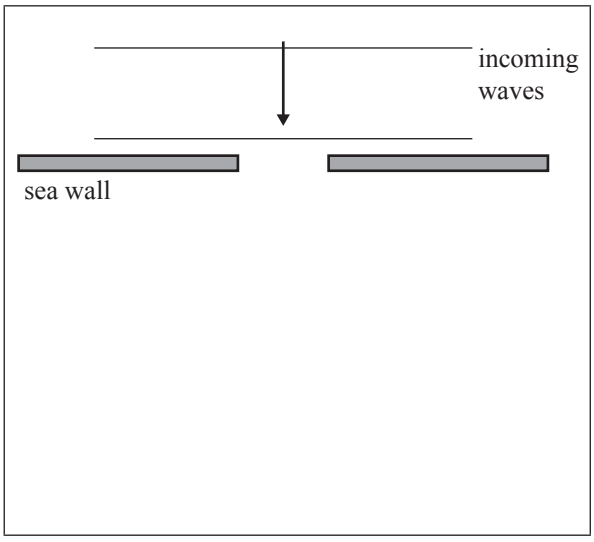
(c) Use the information provided below to calculate the **angle of refraction** in deep water.

Speed of waves in shallow water = 0.25 m s^{-1}
Speed of waves in deep water = 0.35 m s^{-1}
Angle of incidence in shallow water = 35°

The sea wall has a gap to allow boats to pass though. Maria watches the waves as they come through the gap. She notices that the behaviour of the waves depends on their wavelength.

(d) Draw the wave patterns she would observe in each situation shown below.





(e) State the name of this phenomenon.

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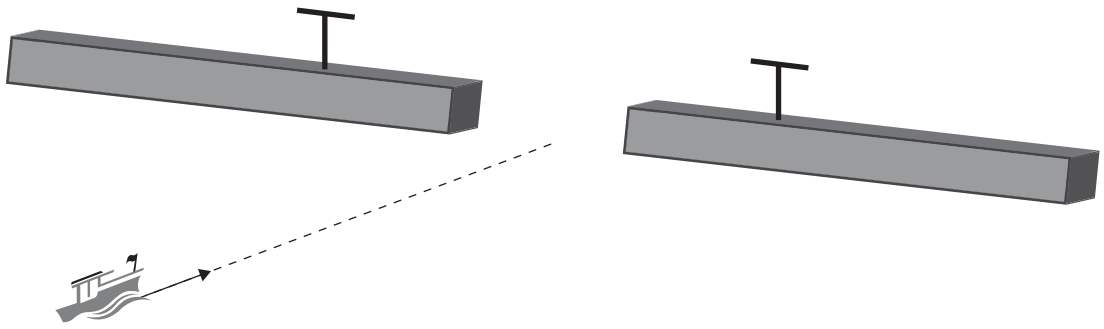
Maria notices a radio transmitting aerial either side of the harbour entrance. She is told that these are to guide boats through the centre of the entrance. They both transmit the same frequency radio wave. The waves are in phase. Boats equipped with radios pick up the waves and travel along the path where the signal is strongest.



(f) If a boat travels along the central path, it receives a strong radio signal.
If the boat moves to one side of the central path, the amplitude of the radio waves received **decreases**.

Clearly explain these two observations.

The radio waves used have a **period** of 0.035 ms. The **speed** of light is 3.00×10^8 m s^{-1}.

(g) Calculate the **number** of complete waves emitted by an aerial each second.

(h) Calculate the distance a wave crest moves during **one period**. Write your answer to the correct number of **significant figures**.

Extra paper for continuation of answers if required.
Clearly number the question.

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Question number