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NZQA

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

For Supervisor's use only

Level 2 Physics, 2008

90254 Demonstrate understanding of waves

Credits: Four
2.00 pm Tuesday 25 November 2008

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 2–11 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.

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

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

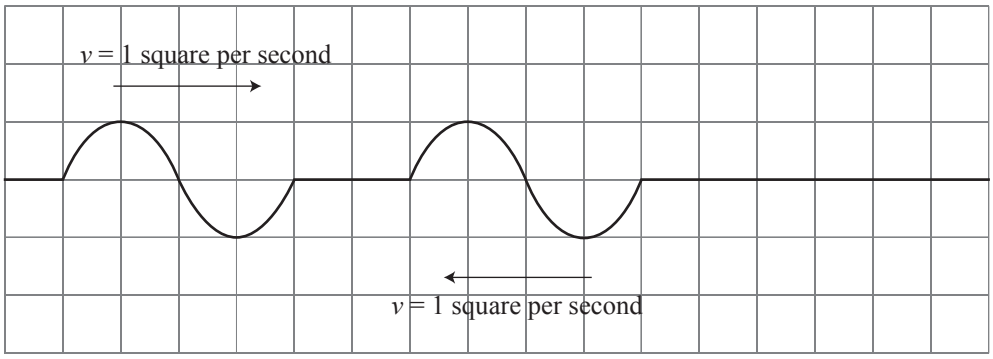
$$n_1 \sin\theta_1 = n_2 \sin\theta_2 \qquad \frac{n_1}{n_2} = \frac{v_2}{v_1} = \frac{\lambda_2}{\lambda_1}$$

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

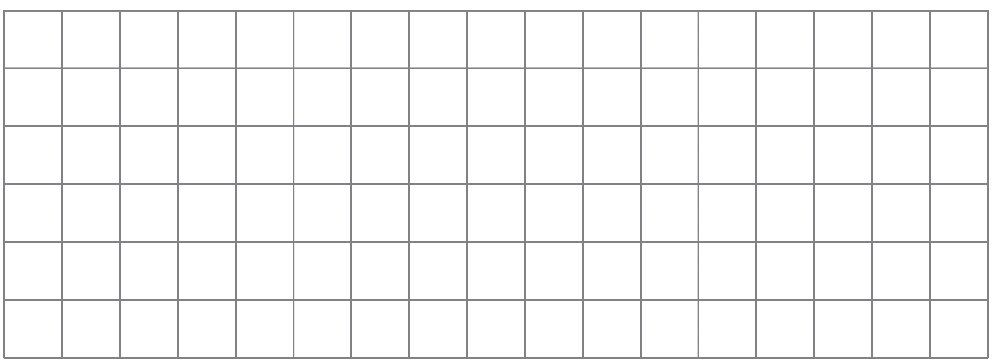
Speed of light in a vacuum = 3.00×10^8 m s $^{-1}$

QUESTION ONE: WAVES

(a) While at the beach, Petra and Callum noticed two wave pulses approaching each other from opposite directions.
The following diagram shows two wave pulses approaching each other at a speed of 1 square per second.



Draw the **resultant of the two wave pulses** 3 s later in the grid below.



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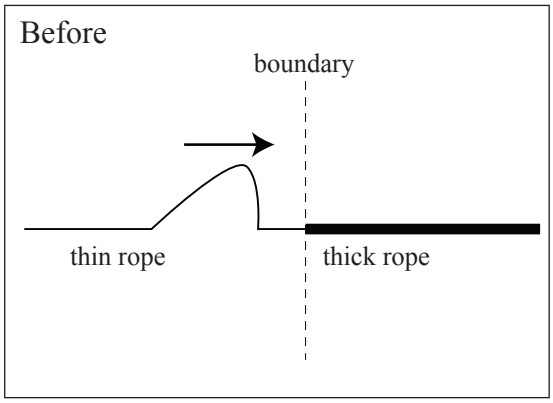
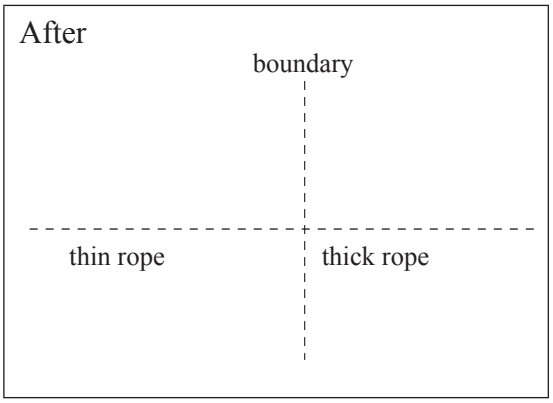
Petra and Callum then played with two ropes, a thick rope and a thin rope that were joined to each other. The diagram below shows a pulse approaching a boundary between a thin rope and a thick rope.

(b) Complete the "after" diagram, showing the reflected pulse and the transmitted pulse, including the appropriate phase and pulse length.





(c) The length of the pulse in the thin rope is 0.30 m. The length of the pulse in the thick rope is 0.20 m.

Calculate the speed of the pulse in:

(i) the thin rope, AND

(ii) the thick rope

if the pulse travels 5.0 m s^{-1} faster in the thin rope than the thick rope.

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Petra and Callum notice that the wavelength changes as the waves approach the beach. The diagram below shows waves approaching shallow water.

http://piru.alexandria.ucsb.edu/collections/geography3b/p-s/ps17-06.jpg

(d) **Explain how** the wavelength of the wave changes as it passes into the shallow region.

(e) The waves travel at 4.0 m s^{-1}, and the crests are 5.0 m apart.

Calculate the time taken for one wave to pass a point.

QUESTION TWO: INTERFERENCE

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Petra and Callum went for a boat ride that took them to the famous "Hole in the Rock" located off Paihia.

www.richard-seaman.com

The diagram below (left) shows wavefronts approaching the hole in the rock.

(a) Name the phenomenon shown in the diagram.

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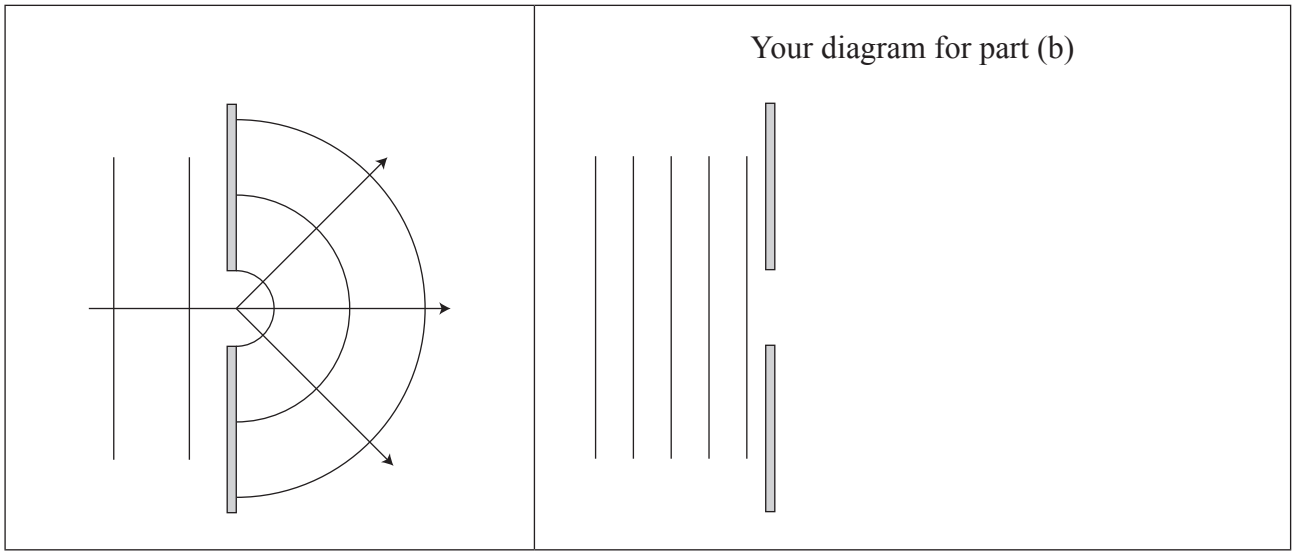
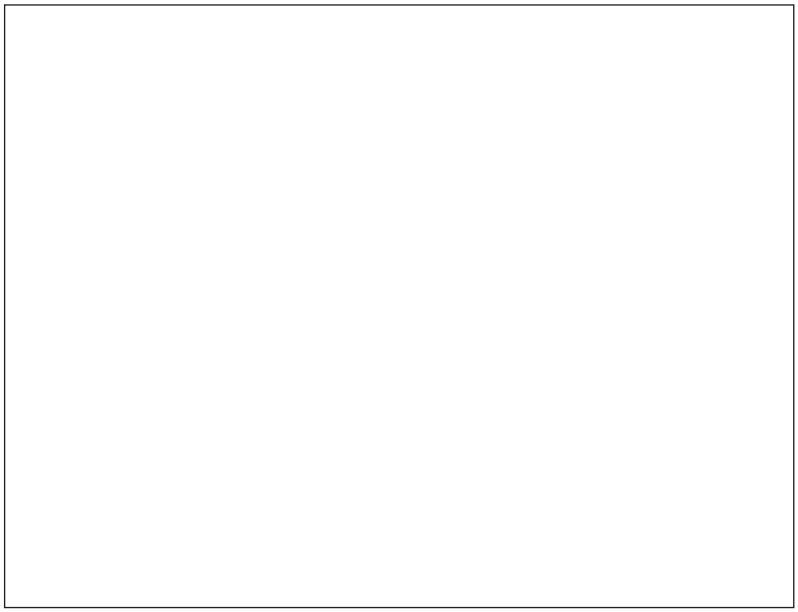


(b) **Complete** the diagram above (right) to show what would happen to the waves passing through the hole if their wavelength was much shorter.

There is another large rock located fairly close to the hole in the rock.
At high tide, wavefronts approach and pass through both gaps coming towards the boat from which the photograph below was taken.



adapted from www.richard-seaman.com

(c) A black sea-bird is on the water at a distance of 20 m from one gap and at a distance of 22 m from the other gap. The wavelength of the ocean waves is 4.0 m.

Explain how these waves affect the **motion** of the black sea-bird on the water.

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QUESTION THREE: REFLECTION

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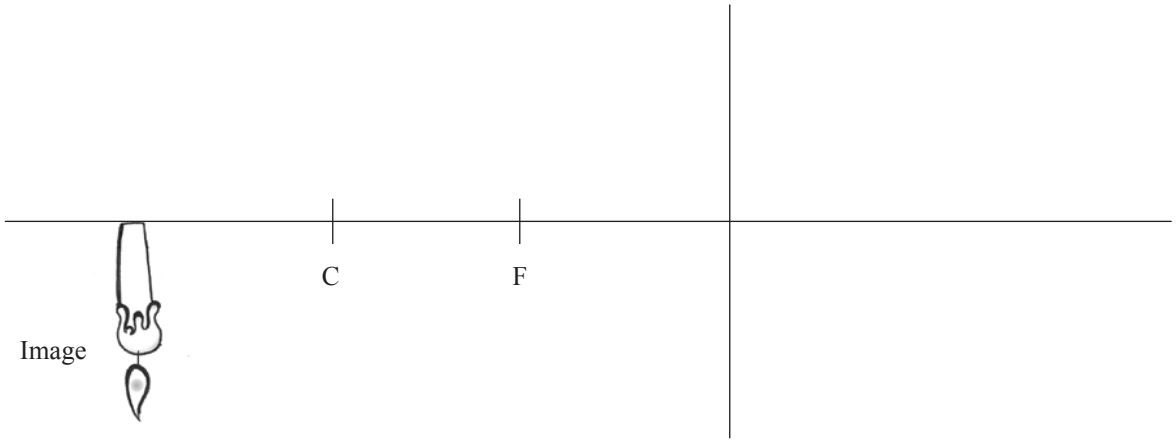
Jane puts a candle in front of a **curved mirror** and sees the **image of the candle** on a screen in front of the mirror. The image is **inverted and larger** than the candle itself.
The following diagram shows **the image** of the candle which Jane observes.

Diagram is NOT to scale



(a) Name the type of mirror that can produce this image.

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(b) Complete the diagram by drawing suitable rays to show where the **candle (object)** was placed to get this image. Include arrows on your rays.

(c) The focal length of the mirror is 24.0 cm and the image is 60.0 cm from the front of the mirror.

Calculate the distance the object must be placed in front of the mirror to produce this image.

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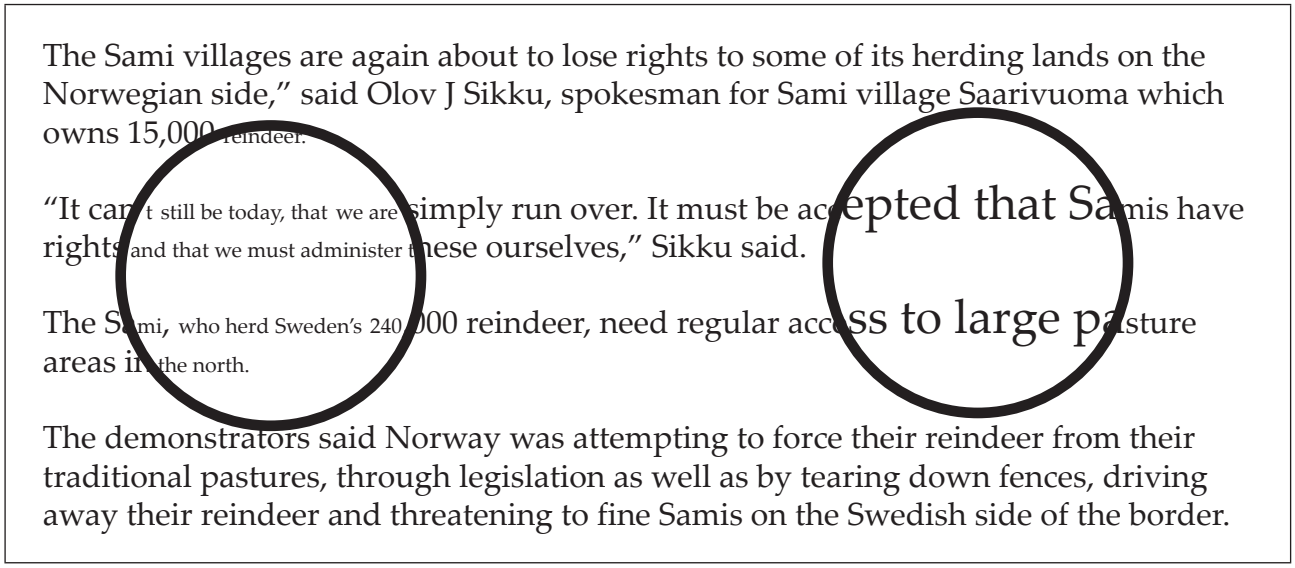
QUESTION FOUR: LENSES

Assessor's use only

Rufus was looking at the image of newsprint using a concave lens, and a convex lens, by holding the lenses close to the page of the newspaper. The illustration below shows what Rufus saw.



The Sami villages are again about to lose rights to some of its herding lands on the Norwegian side," said Olov J Sikku, spokesman for Sami village Saarivuoma which owns 15,000 reindeer.

"It can't still be today, that we are simply run over. It must be accepted that Samis have rights and that we must administer these ourselves," Sikku said.

The Sami, who herd Sweden's 240,000 reindeer, need regular access to large pasture areas in the north.

The demonstrators said Norway was attempting to force their reindeer from their traditional pastures, through legislation as well as by tearing down fences, driving away their reindeer and threatening to fine Samis on the Swedish side of the border.

(a) Name the type of lens that produces a diminished (smaller) image.

(b) The actual height of a letter on the newspaper is 3.0 mm. The image produced is 1.0 mm high when the lens in part (a) is held 3.0 cm from the print on the newspaper. Calculate the focal length of the lens.

QUESTION FIVE: REFRACTION

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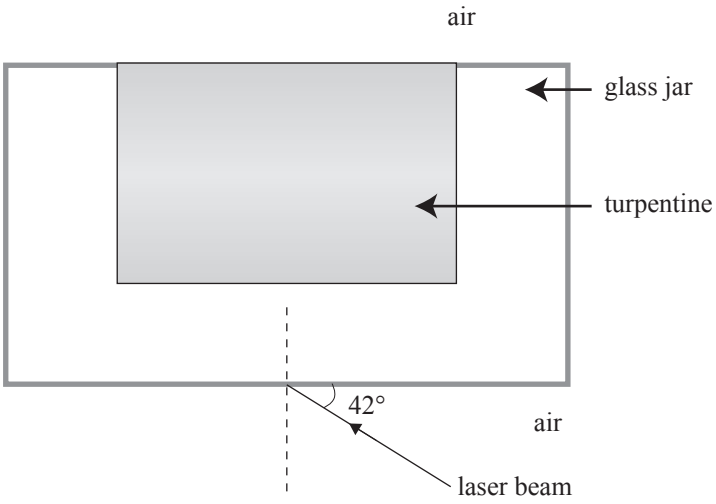
Jane shone a laser beam through turpentine, which was in a glass jar.

The refractive index of turpentine is 1.472.
The refractive index of glass is 1.67.



(a) Calculate the **angle of refraction** of the laser beam in **the turpentine**, when the laser beam passes **from the glass into the turpentine**.
Give your answer to the correct number of significant figures.

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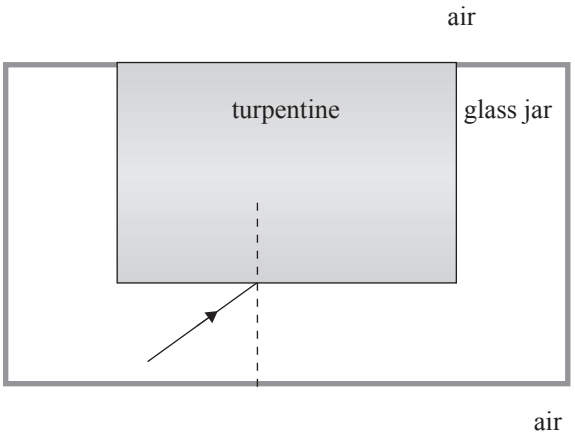
(b) The diagram below shows the path of a laser beam hitting the glass-turpentine interface at an angle of incidence **greater than** the critical angle for glass-turpentine.

Continue the ray until it passes into the air.



(c) Calculate the critical angle for the glass-turpentine interface.

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

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Question number