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**90182**

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

National Certificate of Educational Achievement
TAUMATA MĀTAURANGA Ā-MOTU KUA TAEA

# Level 1 Physics, 2005

## 90182 Demonstrate understanding of wave and light behaviour

Credits: Five
9.30 am Tuesday 29 November 2005

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 2–9 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.

$$v = \frac{d}{t} \qquad v = f\lambda \qquad f = \frac{1}{T} \qquad \frac{n_1}{n_2} = \frac{v_2}{v_1}$$

## QUESTION ONE

Bill drives to the local swimming pool. The registration number of the car behind him is **LKF 367.** Bill sees this number in the rear-vision mirror of his car.

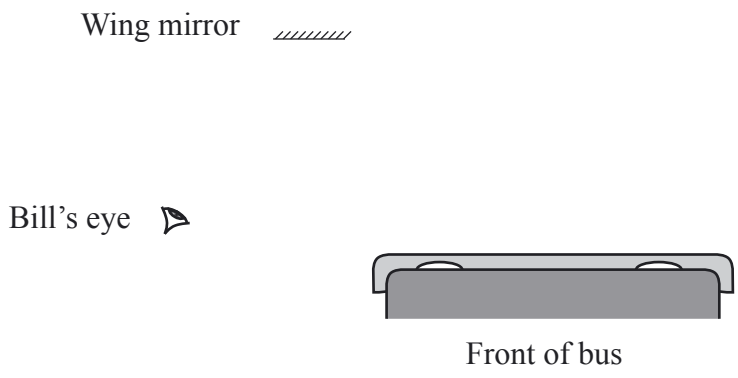
(a) Write the image of the registration number **LKF 367** as seen by Bill in the rear-vision mirror.

_____

(b) Name the **phenomenon** that causes the image of the registration number to be seen in the rear-vision mirror as in (a).

_____

Bill looks in the right wing-mirror of the car and sees a bus approaching along the right-hand lane. The diagram below shows the position of Bill's eye, the wing-mirror of his car and the front of the bus.




(c) On the above diagram **draw two rays** to show the **part** of the front of the bus that Bill can see reflected in the mirror. The wing-mirror is a **plane mirror**.

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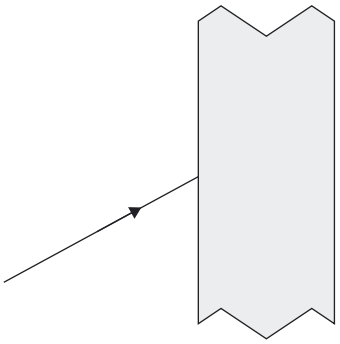
(d) The diagram below shows a ray of light entering the glass window of the car. Complete the diagram below to show the path of the ray **through** the glass and out on the **other side.**

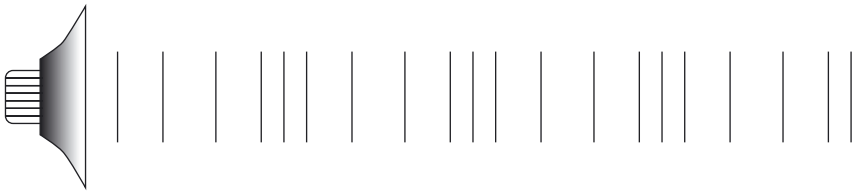


Bill sounds the horn of the car. The frequency of the sound produced by the horn is **0.95 kHz.** The speed of sound in the air is **330 ms$^{-1}$**.

(e) Calculate the **wavelength** of the sound waves produced by the horn in air.

Wavelength = _____

The diagram below represents the sound waves from the horn passing through the air.



(f) On the above diagram, clearly label a compression area with the letter **C** and a rarefaction area with the letter **R**.

(g) On the above diagram, use an arrow to clearly mark a length corresponding to one wavelength of the sound wave.

(h) Explain the effect on the **wavelength** of the sound in air if the **frequency** of the sound is doubled.

## QUESTION TWO

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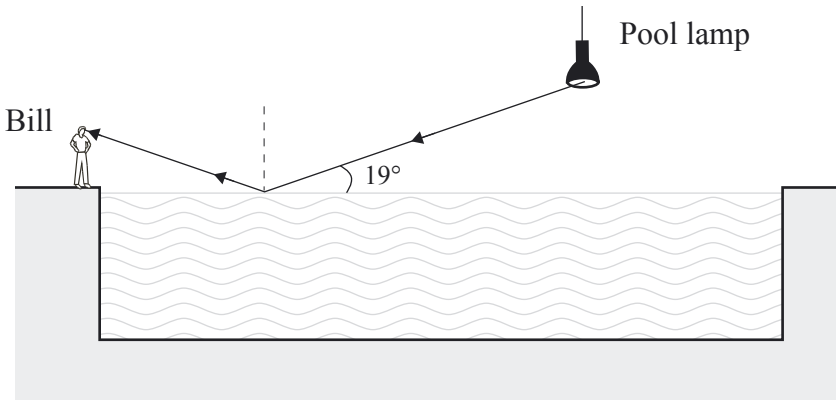
Bill stands at the edge of the pool. He sees the image of a pool lamp in the water.




(a) On the diagram above show the **angle of reflection**. Label this angle with the letter '**R**'.

(b) The incident ray from the lamp meets the water surface at 19°, as shown in the above diagram. Calculate the angle of reflection.

Angle of reflection = _____

(c) On the above diagram draw in the **image** of the lamp. State the **rule** that allows you to draw the image in the correct position.

(d) The light is **4.8 m** from the surface of the water. Calculate the distance between the light and the image.

Distance = _____

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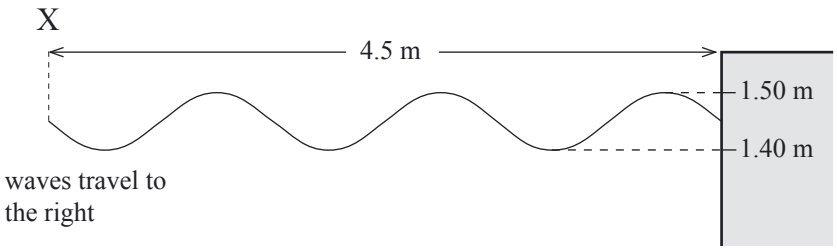
Bill sits on the edge of the pool and moves his toes to create waves. The waves travel towards the opposite wall of the pool as shown in the diagram below.




(e) Use the information from the diagram to calculate the **amplitude** of the waves.

Amplitude = _____

(f) Bill generates **15** waves in **12** seconds. Show that the frequency of the wave is **1.25 Hz.**

(g) The distance from the point X to the wall is **4.5 m.** Calculate the **speed** of the wave.

Speed = _____

Later in the day, as Bill walks across the skate park, Tamara calls out to him. She hears an echo of her call from a wall which is **104 m** away from her. She hears the echo **0.62 s** after she calls. The wavelength of this sound wave is **0.67 m.**

(h) Calculate the **frequency** of the sound.

Frequency = _____

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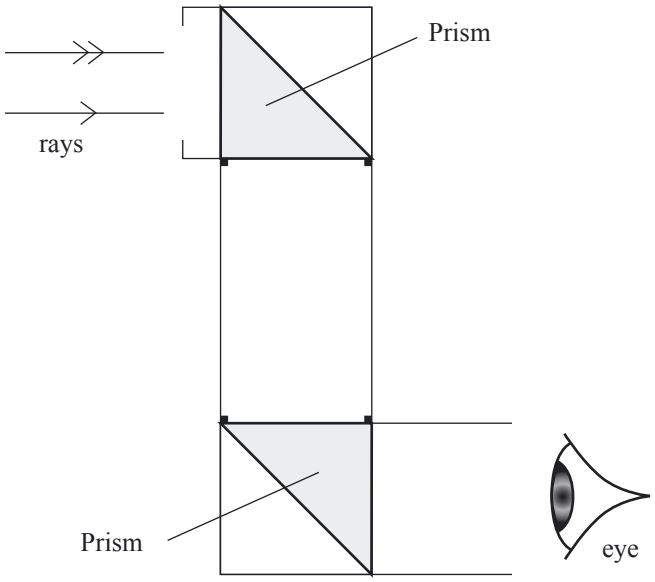
## QUESTION THREE

The diagram shows the structure of a simple periscope used at sporting events to see over the heads of the crowd.




(a) On the above diagram complete the **path** of the two rays through the periscope to the eye.

(b) Explain why the image seen by the person is the right way up.

A ray of light is incident on the side AB of a glass block. The angle of incidence is **70°** as shown in the diagram below. The critical angle of the glass/air interface is **42°.**

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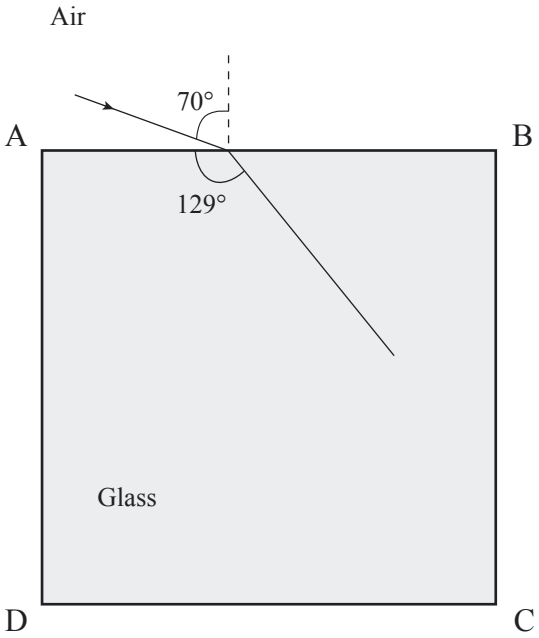


(c) The ray travels to the side CD. Calculate the **angle of incidence** when the ray meets the side **CD.**

**(You must EITHER show all your workings below, OR show the values of angles in the above diagram.)**

Angle of incidence = _____

(d) Explain why the ray **changes direction** at the surface **BC**.

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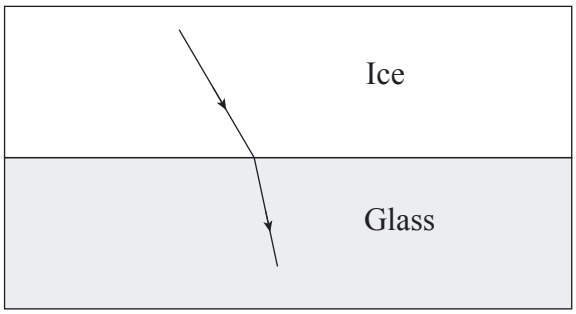
On a cold morning a layer of ice forms on the roof of a conservatory, which is made out of glass. A ray of light travels from ice to glass as shown in the diagram below.




**Data:**
Refractive index of ice = **1.31**
Refractive index of glass = **1.52**
Velocity of light in glass = **$1.97 \times 10^8$ $ms^{-1}$**

(e) Use the above data to calculate the **velocity** of light in **ice.**

Velocity = _____

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

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| Question number | |
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