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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, 2006

90182 Demonstrate understanding of wave and light behaviour

Credits: Five
9.30 am Monday 20 November 2006

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 50 minutes answering the questions in this booklet.

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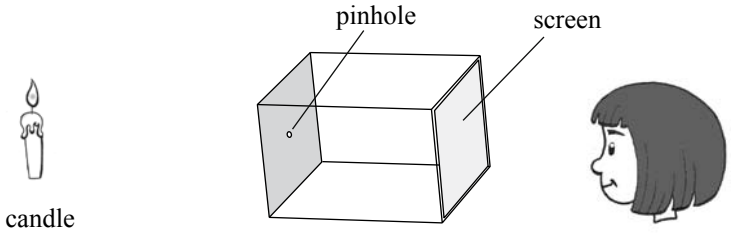
You may find the following formulae useful.

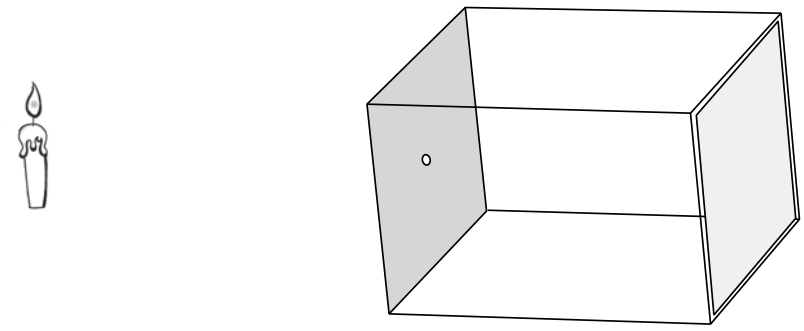
$$v = \frac{d}{t} \qquad v = f\lambda \qquad f = \frac{1}{T} \qquad \frac{n_1}{n_2} = \frac{v_2}{v_1}$$

QUESTION ONE: PINHOLE CAMERA

Kim looks at a burning candle through a pinhole camera. The pinhole camera consists of an opaque box with a pinhole in the middle of the front panel, as shown in the diagram. She sees a sharp image of the candle on the screen.



(a) On the diagram below, draw TWO rays from the candle to the screen.



(b) On the same diagram, **draw** the **image** of the candle formed on the screen.

(c) State the **properties** of the image of the candle formed on the screen.

_____

(d) The formation of the image can be explained using a certain property of light.

State this **property** of light.

_____

_____

(e) The pinhole is now made **larger**.

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Describe TWO ways in which the image changes and explain why these changes occur.

Description 1: _____

_____

Explanation 1: _____

_____

_____

_____

Description 2: _____

_____

Explanation 2: _____

_____

_____

_____

QUESTION TWO: SLINKY WAVES AND TUNING FORKS

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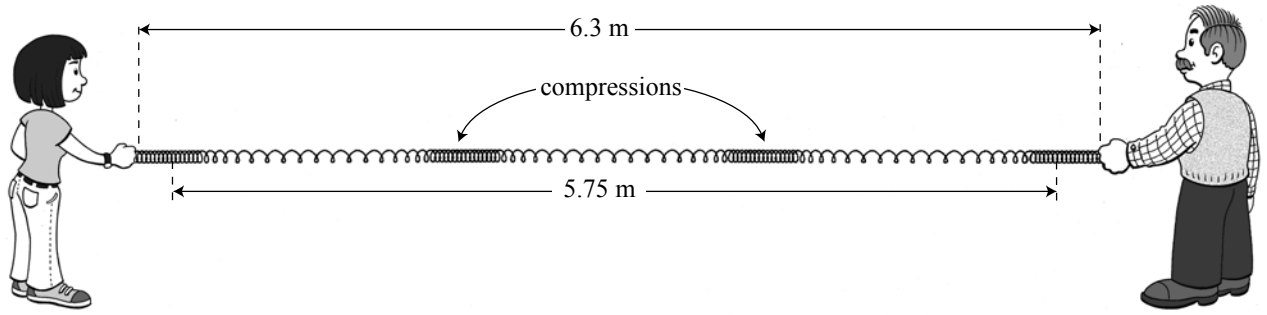
Kim demonstrates to her father how longitudinal waves travel in a material. She and her father hold a stretched slinky. Kim now sends compressions at regular intervals to her father at the other end of the slinky.



It takes **1.8 s** for a wave to travel from one end of the slinky to the other. The length of the stretched slinky is **6.3 m,** as shown in the diagram above.

(a) Calculate the **speed** of the wave along the slinky.

Speed = _____

(b) The distance from the middle of the first compression to the middle of the last compression is **5.75 m**, as shown in the diagram above. Show that the **wavelength** of the waves in the slinky is **1.92 m.**

(c) Calculate the **frequency** of the waves in the slinky.

Frequency = _____

(d) Calculate the **period** of the waves in the slinky.

Period = _____

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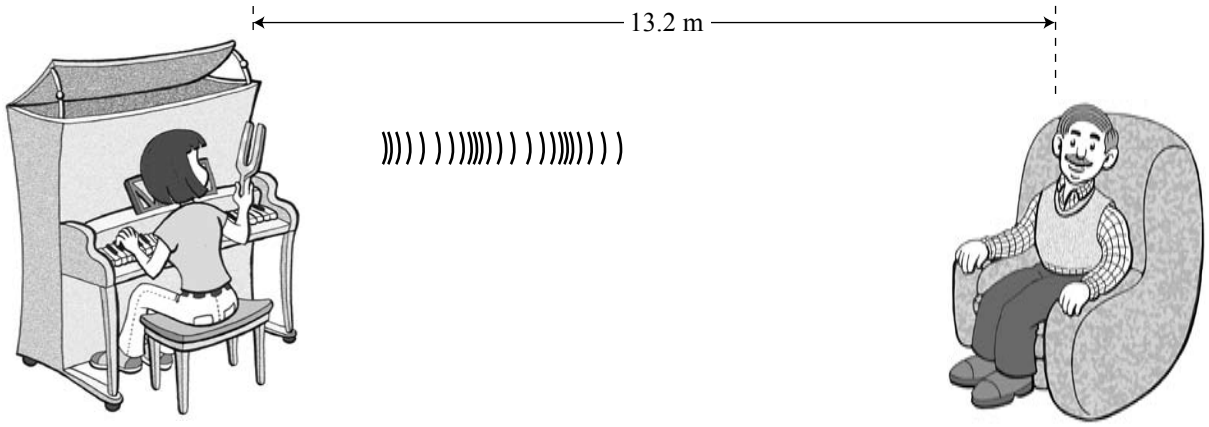
Kim sounds a **550 Hz** tuning fork to check that her piano is tuned correctly. The sound waves from the tuning fork reach her father who is **13.2 m** away from it. The velocity of sound in air is **330 m s^{-1}**.

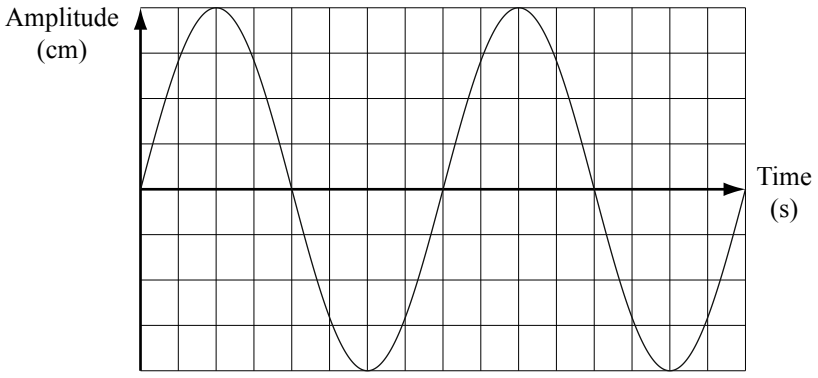


(e) Calculate the **number of waves** between Kim's father and the tuning fork.

Number of waves = _____

The diagram below shows the graph of the sound wave produced by the **550 Hz** tuning fork.
A second tuning fork of frequency of **275 Hz** is now sounded.

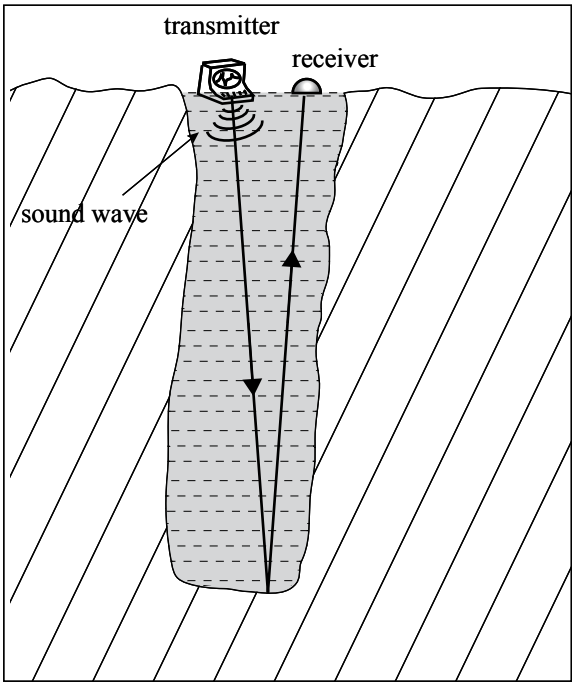
(f) On the diagram below, draw a **graph** for the sound wave produced by the **275 Hz** tuning fork vibrating with **half** the amplitude of the 550 Hz turning fork.



QUESTION THREE: ECHO-SOUNDING

Assessor's use only

Blair is a geologist surveying a remote valley. He finds a deep mineshaft filled with water. He places an echo-sounding device on the water surface to find the depth of the shaft. Sound waves are sent downwards from the transmitter, reflected off the bottom of the shaft, and picked up by the receiver placed next to the transmitter.



The transmitter sends a sound wave and the receiver picks up the reflected wave **0.018 s** later.
The speed of the sound waves in water is **1500 m s^{-1}**.

(a) Calculate the **depth** of the mineshaft.

Depth = _____

The frequency of the sound waves is **22 kHz** and their speed in water is **1500 m s^{-1}**.

(b) Calculate the **wavelength** of the sound waves in water.

Wavelength = _____

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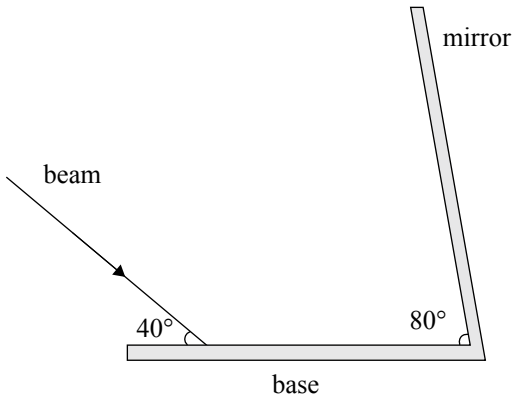
Blair uses a folding mirror with a base. The base is made from polished metal. The mirror is at an angle of **80°** to its base and is touching the base along its edge. A narrow beam of light meets the base at an angle of **40°**, as shown in the diagram. After reflection, the beam of light travels towards the mirror and reflects off it.



(c) Complete the above diagram to show the **path** of the beam of light.

(d) Use your diagram to calculate the **angle of reflection** at the point where the beam of light reflects off the mirror.

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

Angle of reflection = _____

Blair talks to his friend on the other side of the valley, using a mountain radio. The length of the mountain radio aerial is **half** the wavelength of the radio wave. The velocity of the mountain radio waves is $\mathbf{3.0 \times 10^{8}\ m\ s^{-1}}$ and their period is $\mathbf{2.9 \times 10^{-7}\ s}$.

(e) Calculate the **length** of the mountain radio aerial.

Length = _____

Blair walks across a river and looks at a piece of wood partially under water. The diagram below shows the partially submerged wood, but this is not how Blair sees the wood. The diagram also shows two rays travelling from the tip of the wood to the water surface.

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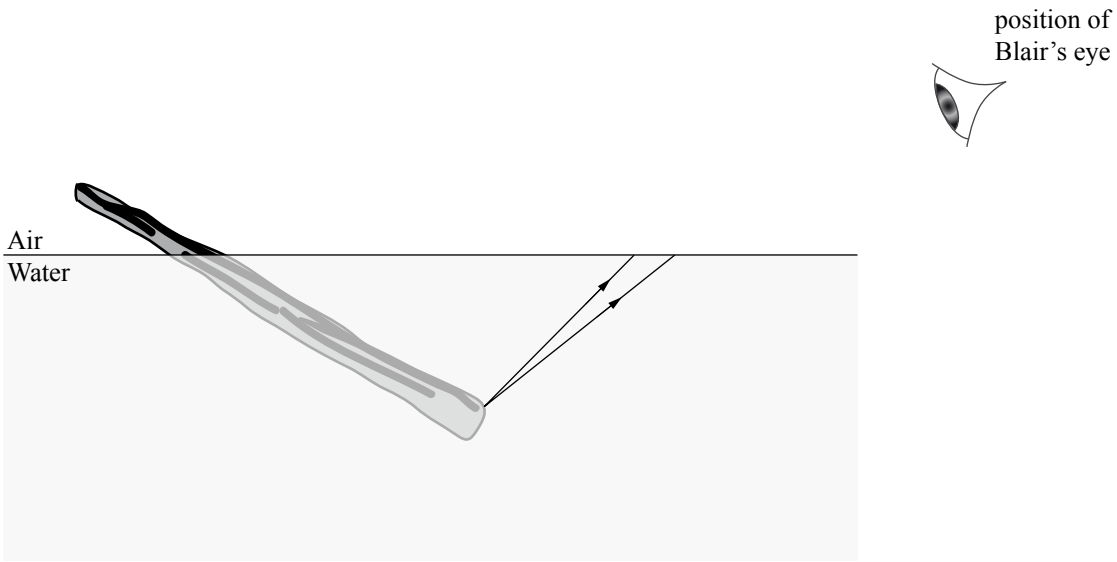
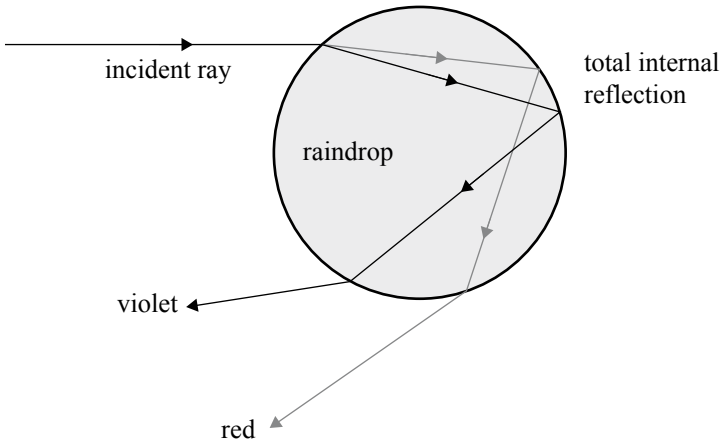
(f) Complete the path of the two rays and use them to **draw** the image of the part of the wood in water, seen by Blair.



QUESTION FOUR: RAINBOWS AND EARTHQUAKES

Assessor's use only

Rainbows are formed when sunlight travels through raindrops. Each raindrop behaves like a prism and separates colours in the sunlight as shown in the diagram.



(a) On the above diagram, draw the path of the **blue** light.

(b) Name the **phenomenon** that describes the white light separating into colours.

_____

(c) Use the information below to calculate the **speed of blue light** through the raindrop.

Refractive index of air = 1.00
Refractive index of water for blue light = 1.34
Speed of blue light in air = 3.00×10^8 m s^{-1}

_____

_____

_____

_____

_____

_____

Speed = _____

(d) Explain, using physics ideas, why the raindrop **separates** sunlight into different colours.

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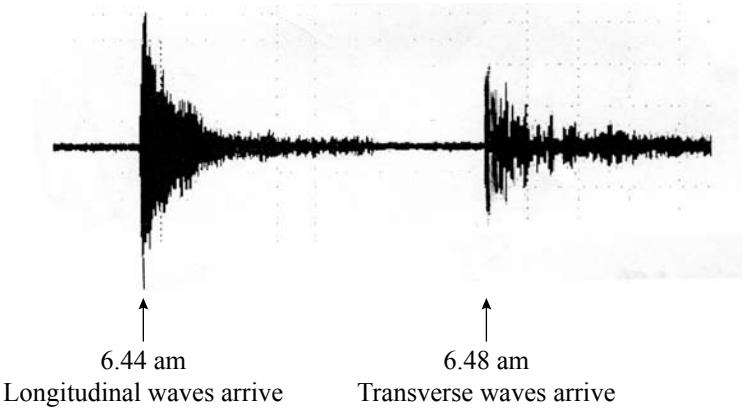
Earthquakes produce both longitudinal and transverse waves.
During an earthquake, a seismograph plots a graph which is shown below. **Longitudinal** waves arrive **first**, followed later by the transverse waves.



The arrival of the **longitudinal** waves was recorded by the seismograph **5 minutes** after the earthquake occurred. The speed of the longitudinal waves through the earth is **8 900 m s^{-1}**.

(e) Show that the **distance** between the seismograph and the point where the earthquake occurred is **2670 km**.

(f) Using the information given on the above graph, calculate the **speed** of the **transverse** waves You may assume that both waves travelled the same distance.

Speed = _____

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

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Question number	