Level 2 Physics: practice paper 2026

AS 91170 Demonstrate understanding of waves · Vertex Academy practice paper, not an NZQA paper

Attempt ALL the questions. Show ALL working. Write your answers on lined paper, or in the space under each question.

QUESTION ONE

(a) A diver in Lake Taupō shines a torch up towards the surface. The light travels from water (n = 1.33) into air (n = 1.00).
One ray meets the surface at 30° to the normal.
Use $n_1 \sin \theta_1 = n_2 \sin \theta_2$.
Calculate the angle of refraction in the air.

(b) Light in the water of Lake Taupō (n = 1.33) meets the surface with air (n = 1.00).
Use $\sin \theta c = n_2 \div n_1$.
Calculate the critical angle for light going from the water into the air.

(c) The light from the diver's torch speeds up as it crosses from the water (n = 1.33) into the air.
Use $n = c \div v$ and $c = 3.00 \times 10^8$ m s^{-1}.
Calculate the speed of light in the water, and explain why the ray bends away from the normal as it enters the air. Say what happens to the frequency and wavelength of the light.

(d) The diver hangs 3.0 m below the calm surface of Lake Taupō (n = 1.33) and looks up. Directly above, the diver sees the sky through a bright circle in the surface. Outside the circle the surface looks like a mirror, showing the lake bed.
Use the critical angle from part (b).
Explain why the diver sees the sky only inside a circle and the lake bed outside it, and calculate the radius of the circle.

QUESTION TWO

(a) A student in a Year 12 lab in Hamilton places a candle 30 cm from a converging lens of focal length 12 cm.

Use $\frac{1}{f} = \frac{1}{do} + \frac{1}{di}$.

Calculate how far from the lens the image forms.

(b) The candle flame in part (a) is 4.5 cm tall. The lens forms its image 20 cm from the lens, with the flame 30 cm from the lens.

Use m = di ÷ do = hi ÷ ho.

Calculate the height of the image and describe the image.

(c) The student now uses the same lens (f = 12 cm) as a magnifying glass, holding it 8.0 cm above a stamp.

Use $\frac{1}{f} = \frac{1}{do} + \frac{1}{di}$ and m = di ÷ do.

Calculate the image distance and magnification, and explain why the image is virtual and upright.

(d) A school projector has a converging lens of focal length 15 cm. It projects a slide 2.4 cm tall onto a screen 3.00 m from the lens.

Use $\frac{1}{f} = \frac{1}{do} + \frac{1}{di}$ and m = di ÷ do = hi ÷ ho.

Calculate how far the slide is from the lens and the height of the picture on the screen. The screen is then moved back to 4.00 m from the lens. Explain how, and how far, the slide must move to keep the picture sharp, and what happens to the size of the picture.

QUESTION THREE

(a) Waves roll into Wellington Harbour. A buoy bobs up and down 12 times in 30 s, and the crests are 6.0 m apart.

Use $f = \frac{1}{T}$ and $v = f\lambda$.

Calculate the frequency and the speed of the waves.

(b) On a foggy night at the harbour entrance, a lighthouse flashes light and a foghorn sounds. Compare the light waves and the sound waves: the type of each wave, how it travels, and its speed.

(c) Waves with a wavelength of 6.0 m pass through a 5.0 m gap in a breakwater and spread out into the marina behind it.

Explain why the waves spread out, and how the spreading would change if the waves had a wavelength of 1.0 m. State what happens to the speed, frequency and wavelength as the waves pass through the gap.

(d) At an outdoor event on the waterfront, two speakers side by side play the same 680 Hz note, in phase. The speed of sound is 340 m s^{-1}.

A listener stands 12.00 m from one speaker and 13.25 m from the other.

Use $v = f\lambda$.

Explain, with calculations, whether the listener hears a loud or a quiet sound. The note is then changed to 816 Hz. Explain what the listener now hears.

© Vertex Academy 2026. Free to copy for study. vertexacademy.co.nz/ncea-level-2-physics-waves-practice-paper