Assessment schedule: practice paper 2026

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

QUESTION ONE

Part	Evidence	Achievement (u)	Merit (r)	Excellence (t)
(a)	$n_1 \sin \theta_1 = n_2 \sin \theta_2$ $1.33 \times \sin 30° = 1.00 \times \sin \theta_2$ $\sin \theta_2 = 0.665$ $\theta_2 = 42°$ (41.7°)	Correct angle of refraction, 42° (41.7°), with working.		
(b)	$\sin \theta c = n_2 \div n_1$ $\sin \theta c = 1.00 \div 1.33 = 0.752$ $\theta c = 48.8°$	Critical angle 48.8° (49°) with working.		
(c)	$v = c \div n$ $v = 3.00 \times 10^8 \div 1.33 = 2.26 \times 10^8$ m s^{-1} one side of the wavefront speeds up first f unchanged, $\lambda = v \div f$ increases speed 2.26×10^8 m s^{-1}; bends away from the normal	Correct speed of light in water, OR the frequency stays the same, OR the wavelength increases.	Correct speed AND explains the bending with one side of the wavefront speeding up first, AND frequency the same and wavelength longer.	
(d)	sky light skimming the surface enters at $\theta c = 48.8°$ sky seen only within 48.8° of vertical beyond 48.8°: angle > θc $\tan 48.8° = r \div 3.0$ $r = 3.0 \times 1.14 = 3.4$ m	Calculates the radius (3.4 m), OR states that light beyond the critical angle is totally internally reflected.	Radius correct AND explains the mirror outside the circle by total internal reflection.	Radius 3.4 m AND a full explanation: sky light skimming the surface enters at the critical angle, so all the sky is seen within the cone; beyond it, light from the lake bed is totally internally reflected.

QUESTION TWO

Part	Evidence	Achievement (u)	Merit (r)	Excellence (t)

(a)	$\frac{1}{di} = \frac{1}{f} - \frac{1}{do}$ $\frac{1}{di} = \frac{1}{12} - \frac{1}{30} = 0.0500$ di = 20 cm	di = 20 cm with working.		
(b)	m = di ÷ do = 20 ÷ 30 = 0.667 hi = 0.667 × 4.5 = 3.0 cm real, inverted, diminished, 3.0 cm tall	hi = 3.0 cm, OR a correct description (real, inverted, diminished).		
(c)	$\frac{1}{di} = \frac{1}{12} - \frac{1}{8.0} = -0.0417$ di = −24 cm m = 24 ÷ 8.0 = 3.0 rays diverge after the lens virtual, upright, 3.0 times larger, 24 cm from the lens	di = −24 cm (or 24 cm, virtual), OR m = 3.0.	di AND m correct AND explains that the rays diverge after the lens, so they only appear to come from the image (virtual, upright).	
(d)	$\frac{1}{do} = \frac{1}{15} - \frac{1}{300}$ m = 300 ÷ 15.8 = 19.0 $\frac{1}{do} = \frac{1}{15} - \frac{1}{400}$ slide moves 0.2 cm closer to the lens m = 25.7	do = 15.8 cm, OR picture height 46 cm.	do AND picture height correct at 3.00 m.	Both positions correct, the slide moves about 2 mm closer to the lens, AND explains that the picture gets bigger (m = 25.7, about 62 cm).

QUESTION THREE

Part	Evidence	Achievement (u)	Merit (r)	Excellence (t)
(a)	f = 12 ÷ 30 = 0.40 Hz λ = 6.0 m v = fλ = 0.40 × 6.0 = 2.4 m s^{-1}	f = 0.40 Hz AND v = 2.4 m s^{-1}.		
(b)	light: electromagnetic, no medium needed, transverse, 3.00 × 10^8 m s^{-1} sound: mechanical, needs a medium, longitudinal, about 340 m s^{-1}	Two correct comparisons, e.g. light needs no medium but sound does; light transverse, sound longitudinal; light far faster.		

(c)	diffraction through a gap spreading depends on gap ÷ λ 5.0 m gap ÷ 6.0 m λ < 1 1.0 m λ: gap = 5λ v, f and λ unchanged	Names diffraction, OR states that v, f and λ do not change.	Links the amount of spreading to the gap size compared with the wavelength for both wavelengths, AND v, f and λ unchanged.	
(d)	λ = 340 ÷ 680 = 0.50 m path difference = 1.25 m = 2.5λ λ = 340 ÷ 816 = 0.417 m 1.25 m = 3.0λ	λ = 0.50 m, OR path difference 1.25 m.	Path difference is 2.5λ, so destructive interference and a quiet sound, with reasoning.	Both cases correct with calculations: 2.5λ gives destructive interference (quiet, nodal line) AND 3.0λ at 816 Hz gives constructive interference (loud, antinodal line), explained with the waves arriving out of or in phase.

Judgement for each question

N0	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	1a.	2a, or 1m.	3a, or 1a and 1m.	4a, or 2a and 1m.	2m, or 1e.	2a and 2m, or 1m and 1e.	1e and 1m, with a minor error or omission elsewhere.	2a, 1m and 1e: every part correct.

Grade score out of 24 (each question's grade: N0 = 0 to E8 = 8): Not Achieved 0 to 6, Achieved 7 to 12, Merit 13 to 18, Excellence 19 to 24 (the 2025 exam's cut scores).