Assessment schedule: practice paper 2026

AS 91523 Demonstrate understanding of wave systems · Vertex Academy practice paper, not an NZQA paper

QUESTION ONE

Part	Evidence	Achievement (u)	Merit (r)	Excellence (t)
(a)	$\lambda = 2L = 1.30$ m $v = f\lambda = 196 \times 1.30$ $v = 255$ m s^{-1}	$\lambda = 1.30$ m AND $v = 255$ m s^{-1}.		
(b)	$f_3 = 3 \times 196 = 588$ Hz 3 loops: 4 nodes, 3 antinodes	$f_3 = 588$ Hz, OR a correct pattern (three loops, 4 nodes, 3 antinodes).		
(c)	$L = \lambda \div 4$, $\lambda = 1.60$ m $f_1 = 343 \div 1.60 = 214$ Hz next: $L = 3\lambda \div 4$ node + antinode	$\lambda = 1.60$ m, OR $f_1 = 214$ Hz.	$f_1 = 214$ Hz AND $f_3 = 643$ Hz AND explains odd harmonics from the node at the closed end and antinode at the open end.	
(d)	$f_beat = \lvert f - 196 \rvert = 3$ Hz tighter: v up, $\lambda = 2L$ fixed beats faster: moving away from 196 Hz loosen until no beats $\Delta v \div v = 3 \div 199 = 1.5\%$ decrease	States 193 Hz or 199 Hz from the beat frequency.	199 Hz with reasoning that tightening raises the frequency and faster beats mean a growing difference.	199 Hz fully explained (tension, wave speed, fixed wavelength) AND loosen the string AND the speed must fall by about 1.5%.

QUESTION TWO

Part	Evidence	Achievement (u)	Merit (r)	Excellence (t)
(a)	$f' = f \frac{v}{v - vs}$ $f' = 960 \times 343 \div 318$ $f' = 1035$ Hz	$f' = 1035$ Hz (1040 Hz).		
(b)	$f' = f \frac{v}{v + vs}$ $f' = 960 \times 343 \div 368$ $f' = 895$ Hz	$f' = 895$ Hz.		

(c)	source moves 25.0 ÷ 960 = 0.026 m each period wavefronts bunched in front λ front = 318 ÷ 960 = 0.331 m λ still = 343 ÷ 960 = 0.357 m same v, shorter λ	Wavelength in front 0.331 m, OR states the wavefronts are closer together in front.	Explains the bunching of wavefronts from the source moving between wavefronts, with the wave speed unchanged, AND both wavelengths (0.331 m and 0.357 m).	
(d)	1020 ÷ 900 = (343 + vs) ÷ (343 − vs) 2.1333 vs = 0.1333 × 343 vs = 21.4 m s^{-1} f = 1020 × (343 − 21.4) ÷ 343 f = 956 Hz	Writes both Doppler equations correctly with 1020 Hz and 900 Hz.	Correct method to eliminate f (or vs), with one answer correct.	vs = 21.4 m s^{-1} AND f = 956 Hz, with clear working.

QUESTION THREE

Part	Evidence	Achievement (u)	Merit (r)	Excellence (t)
(a)	d = 1.00 × 10^{-3} ÷ 600 = 1.67 × 10^{-6} m sin θ = 532 × 10^{-9} ÷ 1.67 × 10^{-6} = 0.319 θ = 18.6°	d = 1.67 × 10^{-6} m AND θ = 18.6°.		
(b)	n ≤ d ÷ λ = 3.13 highest order n = 3 spots: 0, ±1, ±2, ±3 = 7	Highest order 3, OR 7 bright spots.		
(c)	x = λL ÷ d x = 650 × 10^{-9} × 2.0 ÷ 0.25 × 10^{-3} = 5.2 × 10^{-3} m bright: path difference nλ dark: (n + ½)λ	x = 5.2 mm, OR states that bright fringes have a path difference of a whole number of wavelengths.	x = 5.2 mm AND explains bright fringes by diffraction from both slits and constructive interference with path difference nλ.	
(d)	sin θ = nλ ÷ d n = 1: 13.9° (400 nm) to 24.8° (700 nm) n = 2, 700 nm: 57.1° n = 3, 400 nm: 46.1° 46.1° < 57.1°	One correct first-order angle (13.9° or 24.8°).	Both first-order angles AND explains that each wavelength diffracts to a different angle, with red furthest out.	Spectrum explained, both first-order angles, AND shows the overlap with the 2nd-order red at 57.1° and the 3rd-order violet at 46.1°.

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 13, Merit 14 to 18, Excellence 19 to 24 (the 2025 exam's cut scores).