Question	Answer	Marks
1 (a)	Light from the sources must be coherent, this is achieved with slits. It is only possible to produce constant phase difference using a single source.	1 1
1 (b)	at D: 180° **or** π rad at B: 0 or 360° **or** 2π rad	1 1
1 (c) (i)	2.0×10^{-3} m	1
1 (c) (ii)	$\lambda = \frac{ax}{D}$ $\lambda = \frac{0.4 \times 10^{-3} \times 2.0 \times 10^{-3}}{1.5}$ $\lambda = 5.5 \times 10^{-7}$ m	1 1 1
1 (d)	path difference = 2λ path difference = 1060 nm	1 1
2 (i)	$v = f\lambda$ giving $340 = 1200 \times \lambda$ $\lambda = 0.28$ m	1 1
2 (ii)	Waves superpose/interfere at points along PQ, constructively and destructively. Sources with a path difference of $n\lambda$ cause maximum sound intensity. Sources with a path difference of $\frac{(2n+1)\lambda}{2}$ cause minimum sound intensity.	1 1 1
2 (iii)	$a = \frac{\lambda D}{x}$ giving $a = \frac{0.28 \times 3.0}{0.50}$ $a = 1.7$ m	1 1
2 (iv)	The intensity of sound at maxima is unchanged. The positions of maxima and minima are reversed.	1 1
3 (a)	When the string is released, progressive waves travel towards the two fixed ends. These progressive waves are reflected at the fixed ends. The two oppositely travelling progressive waves combine (superposition of waves) and this creates the stationary wave on the string.	1 1 1
3 (b)	Correct shape of the stationary wave pattern. Sketch showing two nodes at the fixed ends and an antinode in the middle.	1 1
3 (c)	$v = f_0\lambda$ and $\lambda = 2 \times 0.32$ $v = 160 \times 0.64$ $v = 102$ m s^{-1}	1 1 1
4 (a) (i)	A node occurs where the amplitude/displacement is always zero.	1
4 (a) (ii)	An antinode occurs where the amplitude of the standing wave takes the maximum possible value.	1
4 (b) (i)	The wave travels to the end and is reflected. The reflected wave superposes with the incident wave. Superposition is always destructive at certain points to produce nodes **or** always constructive at certain points to produce antinodes.	1 1 1
4 (b) (ii)	**A** and **N** points labelled correctly.	1
4 (b) (iii)	3	1
4 (b) (iv)	30 cm = $\frac{\lambda}{2}$ **or** $\lambda = 60$ cm $v = f\lambda = 120 \times 0.6$ $v = 72$ m s^{-1}	1 1 1
4 (c)	$v = 2k$ increases and becomes $v = 3k$ ($k = 36$) wavelength increases by $\frac{3}{2}$ as the frequency is unchanged 2 half wavelengths fit on the string so standing wave is set up.	1 1 1

Question	Answer	Marks
5 (a)	Correct shape of the stationary wave pattern. Sketch showing one node (**N**) at the closed end and an antinode (**A**) at the open end.	1 1
5 (b)	At **X** the air particles oscillate horizontally (in the same direction as the velocity of the sound wave). At **Y** the air particles do not oscillate (because of the node).	1 1
5 (c)	The phase difference is zero. This is because all points between the open end and the closed end oscillate in phase.	1 1
5 (d)	$v = f_0\lambda$ and $\lambda = 4 \times 0.60 = 2.4$ m $340 = f_0 \times 2.4$ $v = 142$ m s^{-1}	1 1 1