Question			Expected Answers	Marks	Additional Guidance
1	(a)	(i) (ii)	node occurs where the amplitude/displacement is (always) zero antinode occurs where the amplitude (of the standing wave) takes the maximum (possible) value	B1 B1	**accept** displacement for amplitude for **(i)** only
	(b)	(i)	wave travels to end and is reflected reflected wave <u>interferes/superposes</u> with incident wave always destructively at certain points to produce nodes **or** always constructively at certain points to produce antinodes	B1 B1 B1	 **accept** 2 waves of same f travelling in opposite directions <u>interfere</u> with no reference to reflection
		(ii)	A and N points labelled correctly	B1	
		(iii)	3	B1	
		(iv)	30 cm = $\lambda/2$ or λ = 60 cm v = f λ = 120 x 0.6 v = 72 (m s^{-1})	C1 C1 A1	**allow** 1 mark for correct calculation using v = f λ with wrong wavelength if method/reasoning clear
	(c)		v = 2k becomes v = 3k (k = 36) wavelength increases by 3/2 (as frequency unchanged) 2 half wavelengths fit on the string so standing wave is set up/AW	B1 B1 B1	**accept** v increases by 3/2 or v = 108 m s^{-1} **accept** wavelength becomes 90 cm **allow ecf** correct conclusion with wrong λ
			Total question 5	**13**	

Question			Answer	Marks	Guidance
2	(a)	(i)	f = 1000/2 f = 500 (Hz)	C1 A1	**give** 1 mark for ½ (POT error)
		(ii)	v = fλ giving 340 = 500 x λ λ = 0.68 (m)	C1 A1	**ecf(a)(i)**
	(b)		sinusoidal curve of same frequency and amplitude ± cosine curve	B1 B1	**must** be drawn for 2 full cycles to score this mark **allow** drawn as sine curve from t = 0.5 ms
A A A	(c)		relates to the oscillation of two points on the (same) wave how far 'out of step' one oscillation is from the other/AW λ/4 means a phase difference of 90^o or π/2 (rad)	B1 B1 B1	**accept** vibration **N.B.** statements about oscillations of two waves can only score the third marking point
	(d)		sine wave of same frequency with increased amplitude realisation that intensity is proportional to $(\text{amplitude})^2$ giving amplitude increase by √2, i.e.2.8 mm	B1 B1 B1	
A A A	(e)	(	the wave reflected at the end of the pipe interferes/superposes with the incident wave to produce a resultant wave with nodes and antinodes both ends must be antinodes the pipe must be nλ/2 in length for this to happen	 B1 B1 B1 B1	**max** 3 marks
		(ii) 1	air molecules oscillate along the axis of the tube with maximum amplitude	B1 B1 B1	**max** 2 marks; **allow** vibrate; if transverse wave is clearly implied then can only score third marking point
		(ii) 2	no motion/nodal point	B1	**allow** zero displacement/amplitude
			Total	**18**	
			SCAN DOWN TO CHECK NO ANSWERS ON PAGE 11		

Question			Answer	Marks	Guidance
3	(a)		when two(or more) waves meet/cross/interact (at a point) the (resultant) <u>displacement</u> is the (vector) sum of the (individual) <u>displacements</u>	B1 B1	**do not allow** for two waves travelling in opposite directions **allow** as a special case: the <u>resultant wave</u> is…..
	(b)	**(i)**	<u>constant</u> phase difference/relationship (between the waves)	B1	**allow** fixed
		(ii)	6 x (2n + 1)/2 x10^{-7} (m) where n = 0, 1,2, etc.	B1	**expect** 3 x 10^{-7}; next values: 9 x 10^{-7}, 15 x 10^{-7} allow 300 nm, etc
		(iii)	select λ = ax/D 6.00 x 10^{-7} = 1.20 x 10^{-3} x/2.50 x = 1.25 x 10^{-3} (m)	C1 C1 A1	
		(iv) 1	fringes move closer together a smaller distance is required between the rays from the slits to produce λ/2 /π phase change	B1 B1	 **allow** (use of formula) x α λ as (a and D fixed) and λ decreases
		(iv) 2	fringes same distance apart paths of rays unchanged/slit centres same distance apart	B1 B1	 **allow** (use of formula) x unchanged as a (λ and D) fixed
		(iv) 3	fringes move closer together the angle at which the dark fringes appear from the slits is the same, but the distance to the screen is much less	B1 B1	 **allow** (use of formula) x α D (as λ and a fixed)
			Total	**13**	