D5 Standing Waves

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The speed of sound in air is 330 m s^{-1}.

Consider a particle that is at a particular antinode (point A) of a standing wave. Fill in the table below to state how the motion of certain other particles will compare to this one. [For amplitude, state whether it will be smaller/larger/the same; for phase, state the phase difference in degrees.]

	Position of particle	Amplitude	Difference in phase
D5.1	At the next antinode along from point A	(a)	(b)
D5.2	Between point A and the next node	(a)	(b)
D5.3	Beyond the next node along from A, but before the next antinode	(a)	(b)

D5.4 What is the difference between the "amplitude" and the "displacement" of a particle at an antinode?

D5.5 Two waves of amplitude 4.0 cm and frequency 14 Hz are moving in opposite directions at 5.6 m s^{-1} along a stretched string.

a) If a standing wave were formed, how far apart would you expect the antinodes to be from the nodes on either side of them?

b) If the string had two fixed ends, what is the minimum length it must be in order for a standing wave to be possible?

c) If the string had two fixed ends and was 0.70 m long, why would no standing wave be formed?

D5.6 A wind instrument is 60 cm long, and can be modelled as a tube with one closed end and one open end.

a) What is the lowest frequency that can be played?

b) If a note of the second-lowest possible frequency were played, state the positions of the nodes (measured from the closed end).

c) If a note of the third-lowest possible frequency were played, state the positions of the nodes.

D5.7 Two microwave emitters are placed facing each other about a metre apart and coherently emit microwaves of the same frequency. A detector moved back and forth between them detects regions of maximum intensity spaced 4.0 cm apart. Calculate the frequency of the microwaves.

D5.8 A musical note of several frequencies is sounded at the mouth of a 1.0 m long vertical tube that has some water in the bottom.

a) Give the depth of water in the tube if the fundamental frequency heard is 125 Hz.

b) When the lowest frequency above the fundamental is played, at what height will the particles' displacement be out of phase and have the same amplitude as particles 8.0 cm above the surface of the water? Give your answer as a distance above the surface of the water.

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D6 The Photoelectric Effect

When the photon energy is insufficient for the ejection of photoelectrons, answer the question by writing 'no electrons emitted'.

D6.1 Complete the questions in the table:

Frequency of light /Hz	Wavelength of light /nm	Work function	Max. KE of photoelectrons	Stopping potential /V
6.0×10^{14}		1.2×10^{-19} J	(a)	
6.0×10^{14}		2.6 eV		(b)
	350	2.6 eV		(c)
	530	(d)		1.35

D6.2 A material's work function is 1.3 eV. Calculate its threshold frequency.

D6.3 A material will not emit photoelectrons unless it is irradiated by light with a wavelength less than 380 nm. Calculate its work function in electronvolts.