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D3 Path Difference

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

	Wavelength	Path Difference	Phase Difference	Fully Constructive Interference (Y/N)	Fully Destructive Interference (Y/N)
D3.1	320 mm	160 mm	(a)	(b)	(c)
D3.2	320 mm	(a)	0°	(b)	(c)
D3.3	320 mm	(a)	90°	(b)	(c)
D3.4	633 nm	(a)	180°	(b)	(c)
D3.5	3.00 m	31.5 m	(a)	(b)	(c)

D3.6 Signals of wavelength 1.5 μm are travelling down a 10 km optic fibre. Some travel 'straight down the middle', while others 'zig-zag' back and forth in the fibre. It is required that the maximum phase difference thus caused is no more than 30°. Calculate the maximum path difference allowed.

D3.7 Two aerials are 2.50 m apart, and both are receiving the same radio signal with a frequency of 125 MHz.

a) The phase difference between them is measured as 114°. Calculate the path difference between the two aerials.

b) The aerial which receives the radio signal first is directly North of the one which receives the signal slightly later. What are the possible bearings of the transmitter from the receiving aerials? You may assume that the transmitter is many kilometres from the receiving aerials, and therefore that the path of the waves travelling to the two receivers are effectively parallel when measured in the vicinity of the receiving aerials.

NB The method of questions D3.7 is used to locate the origin of distress and emergency signals. The procedure is called VDF, standing for 'Very high frequency Direction Finding'.

D3.8 Two speakers are set up 13.5 m apart in an auditorium, pointing at each other. A pure sound of frequency 256 Hz is being played through them. You may assume that the phase difference of the signals driving the speakers is 0°.

a) A person is standing on the line joining the speakers, 0.25 m from the mid point. Calculate the phase difference as it would be detected by the person.

b) The person moves to the mid point between the speakers (where the sound is loudest due to constructive interference), and then walks towards one speaker until the sound waves cancel out. How far do they walk until they find this point of near silence?