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?

D4 Interference

$^{9}/_{12}$

D4.1 Complete the questions in the table:

Wavelength	Slit separation	Distance to screen /m	Fringe spacing /mm
633 nm	0.10 mm	4.00	(a)
530 nm	(b)	6.00	4.0
(c)	1.0 mm	1.50	0.20
0.30 cm	0.10 m	2.50	(d)

D4.2 Complete the questions in the table:

Wavelength	Slit separation	Order of interference n	Angle to 'straight through' direction
633 nm	0.10 mm	2	(a)
530 nm	600 lines/mm	1	(b)
(c)	1000 lines/mm	1	10°
1.0×10^{-11} m	(d)	3	20°

D4.3 A diffraction grating has 600 lines/mm. Yellow light from a streetlamp is shone onto the grating. The yellow light contains two main wavelengths - of 589.6 nm and 589.0 nm. Calculate the angular separation of the second order ($n = 2$) of these two components as they emerge from the grating.

D4.4 A microscope slide looks like it has one fine transparent line ruled on a black background. In fact there are two lines very close together. When red light (633 nm) is shone through it, and a screen is placed 5.0 m away from the slide, ten fringe-spacings measure 5.3 cm. Calculate the separation of the lines on the slide.

D4.5 The light from a 'special LED' consists of two colours of light with wavelengths of 530 nm and 630 nm respectively. The light is shone through a diffraction grating with 500 lines/mm, and the two colours need to be separated by at least $5.0°$. What is the minimum order of interference needed in order to do this?

D4.6 A teacher is trying to demonstrate 'Young's fringes' using green (530 nm) light. Assuming that the slit separation is 0.050 mm, how far away from the slits will she need to put the screen to ensure that the fringe spacing is at least 1.0 mm?