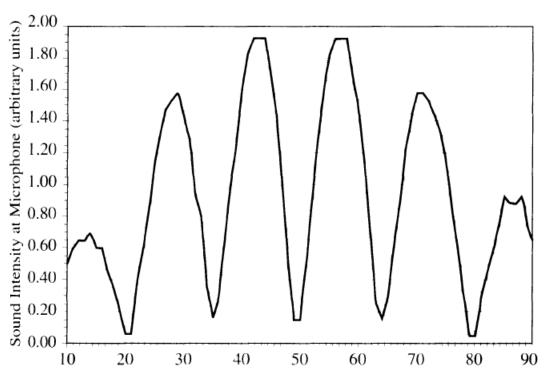Problems:

9.5* Figure P.9.5 shows an output pattern that was measured by a tiny microphone when two small piezo-loudspeakers separated by 15 cm were pointed toward the microphone at a distance of 1.5 m away. Given that the speed of sound at 20°C is 343 m/s, determine the approximate frequency at which the speakers were driven. Discuss the nature of the pattern and explain why it has a central minimum.

Figure P.9.5 (Data courtesy of CENCO)

Position of Microphone (cm, zero-point arbitrary)

9.7 An expanded beam of red light from a He–Ne laser ($\lambda_0 = 632.8$ nm) is incident on a screen containing two very narrow horizontal slits separated by 0.200 mm. A fringe pattern appears on a white screen held 1.00 m away.

(a) How far (in radians and millimeters) above and below the central axis are the first zeros of irradiance?

(b) How far (in mm) from the axis is the fifth bright band?

(c) Compare these two results.

9.10* White light falling on two long narrow slits emerges and is observed on a distant screen. If red light ($\lambda_0 = 780$ nm) in the first-order fringe overlaps violet in the second-order fringe, what is the latter's wavelength?

9.13* Plane waves of monochromatic light impinge at an angle θ_i on a screen containing two narrow slits separated by a distance a. Derive an equation for the angle measured from the central axis which locates the mth maximum.

9.28* A soap film of index 1.34 has a region where it is 550.0 nm thick. Determine the vacuum wavelengths of the radiation that is not reflected when the film is illuminated from above with sunlight.

9.33 Fringes are observed when a parallel beam of light of wavelength 500 nm is incident perpendicularly onto a wedge-shaped film with an index of refraction of 1.5. What is the angle of the wedge if the fringe separation is $\frac{1}{3}$ cm?