

Homework – Lectures 2/3

1. The speed of sound in air at room temperature is 340 m/s. (a) What is the frequency of a sound wave in air with wavelength 1.0 m? (b) What is the frequency of a radio wave with the same wavelength? (Radio waves are electromagnetic waves that travel at 3.0×10^8 m/s in air or in vacuum.)
2. Light visible to humans consists of electromagnetic waves with wavelengths (in air) in the range 400–700 nm (4.0×10^{-7} m to 7.0×10^{-7} m). The speed of light in air is 3.0×10^8 m/s. What are the frequencies of electromagnetic waves that are visible?
3. A wave on a string has equation
$$y(x, t) = (4.0 \text{ mm}) \sin(\omega t - kx)$$
where $\omega = 6.0 \times 10^2$ rad/s and $k = 6.0$ rad/m. (a) What is the amplitude of the wave? (b) What is the wavelength? (c) What is the period? (d) What is the wave speed? (e) In which direction does the wave travel?
4. Show that the interference fringes in a double-slit experiment are equally spaced on a distant screen near the center of the interference pattern. [*Hint:* Use the small angle approximation for θ .]
5. In a double-slit interference experiment, the wavelength is 475 nm, the slit separation is 0.120 mm, and the screen is 36.8 cm away from the slits. What is the linear distance between adjacent maxima on the screen? [*Hint:* Assume the small angle approximation is justified and then check the validity of your assumption once you know the value of the separation between adjacent maxima.]
6. Light incident on a pair of slits produces an interference pattern on a screen 2.50 m from the slits. If the slit separation is 0.0150 cm and the distance between adjacent bright fringes in the pattern is 0.760 cm, what is the wavelength of the light? [*Hint:* Is the small angle approximation justified?]