Wave Phenomena

1. A single slit of width 1.50 μm is illuminated with light of wavelength 500.0 nm. Calculate the angular width of the central maximum.

2. Microwaves of wavelength 2.80 cm fall on a slit and the central maximum at a distance of 1.0 m from the slit is found to have a half width (i.e. distance from middle of central maximum to the first minimum) of 0.67 m. Calculate the width of the slit.

3. In a Young's double slit experiment, a student uses a 680 nm laser to illuminate a double slit with a separation of 0.10 mm. Calculate the spacing of the fringes in the interference pattern as they appear on a screen 1.5 m away.

4. A coherent light beam is directed at a diffraction grating with 600 lines per mm. The first order minimum appears at an angle of 15°. Calculate the wavelength of the light.

5. Light shining on a thin film of oil (n = 1.582) appears to have an average wavelength of 650 nm. What is the minimum thickness of the oil film?

6. Could a telescope with an objective lens of diameter 20 cm resolve two objects a distance of 10 km away separated by 1 cm? (Assume we are using a wavelength of 600 nm).

7. The headlights of a car are separated by a distance of 1.4 m. At what distance would these be resolved as two separate sources by a lens of diameter 5 cm if a wavelength of 500 nm is being used?

8. A source approaches a stationary observer at 40 ms^{-1} emitting sound of frequency 500 Hz. What frequency does the observer measure? The speed of sound is 343 ms^{-1}.

9. A source is moving away from a stationary observer at 32 ms^{-1} emitting sound of frequency 480 Hz. What frequency does the observer measure? The speed of sound is 343 ms^{-1}.

10. A sound wave of frequency 512 Hz is emitted by a stationary source toward an observer who is moving away at 12 ms^{-1}. What frequency does the observer measure? The speed of sound is 343 ms^{-1}.

11. A sound wave of frequency 628 Hz is emitted by a stationary source toward an observer who is approaching at 25 ms^{-1}. What frequency does the observer measure? The speed of sound is 343 ms^{-1}.

12. A sound wave of frequency 500 Hz is emitted by a moving source toward a stationary observer. The signal is reflected by the observer and received by the source, where the frequency is measured to be 512 Hz. What is the speed of the source? The speed of sound is 343 ms^{-1}.

13. A glass tube is closed at one end. The air column it contains has a length that can be varied between 0.50m and 1.50 m. If a tuning fork of frequency 306 Hz is sounded at the top of the tube, at which lengths of the air column would resonance occur? (Take the speed of sound to be 330 ms^{-1}.)

14. A tube with both ends open has two consecutive harmonics of frequency 300 Hz and 360 Hz.
    a. What is the length of the tube?
    b. What are the harmonics?
    (Take the speed of sound to be 330 ms^{-1}.)

15. A string with both ends fixed vibrates in the third harmonic mode. The length of the string is 6.0 m and the speed of the wave is 120 ms^{-1}. Calculate the wavelength of the wave on the string.