

Fall Term 2006
22.02 Intro. APPLIED NUCLEAR PHYSICS
Problem Set #1

Prof. Molvig

Posted: September 12, 2006

DUE: September 19, 2006

1. Wave Interference:

Derive a general expression for the mean square amplitude, (time averaged over a wave period), at point, P , as a function of, θ , in terms of the amplitude, A , of the incoming wave, the distance between the slits, d , the width of the slits, Δ , and the wavelength, λ . You may assume, $\Delta \ll \lambda$, and, $d \ll r_1, r_2$. Note that this is a *scalar* wave problem, where the wave might be height of a water wave, or pressure of a sound wave, etc. There are no vector electric fields involved.

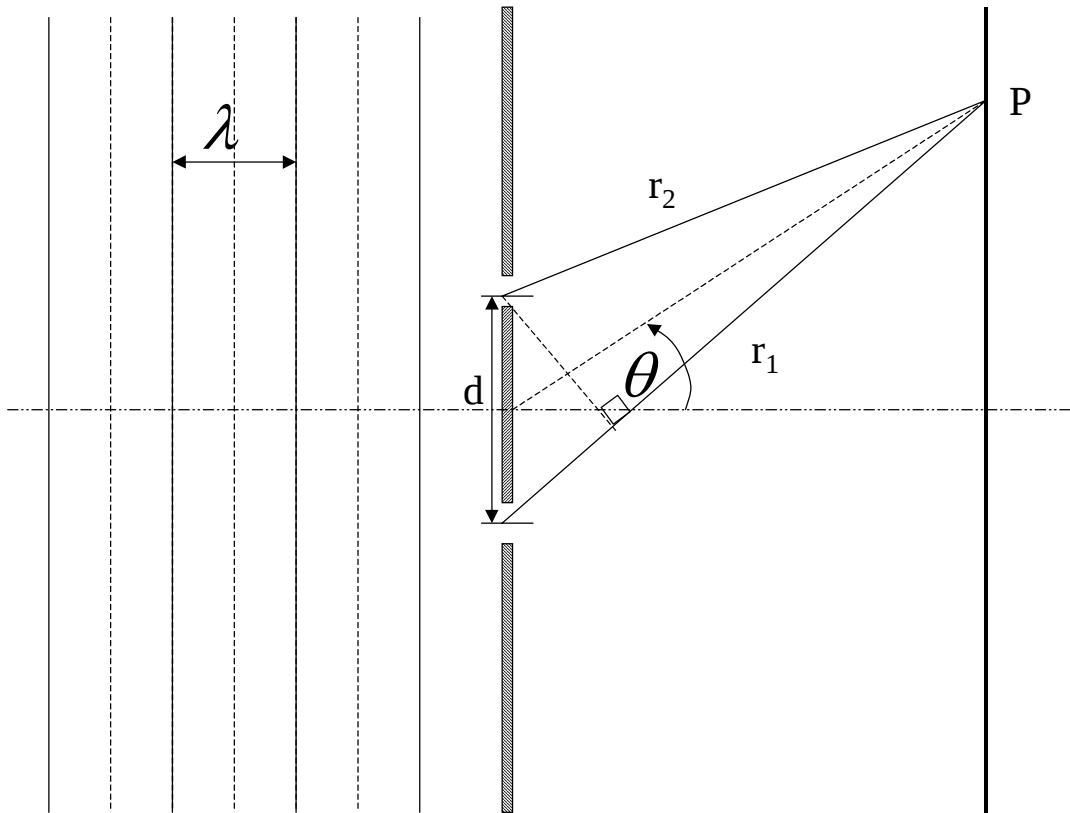


Figure 1: Wave Interference Diagram

2. The equation of a transverse wave traveling along a string is given by,

$$y = 0.3 \sin[\pi(0.5x - 50t)]$$

where, y , and, x , are in centimeters and, t , is in seconds.

- Find the amplitude, wavelength, wave number, frequency, period, and velocity of the wave.
 - Find the maximum transverse speed of any particle along the string.
3. What is the Coulombic potential energy (in MeV) of an alpha particle positioned at a distance, $1.25 * 200^{1/3}F$, from the center of a Gold nucleus? You may assume all the Gold nucleus charge resides at the center to do this calculation (which give correct answer even though not the correct charge distribution!). Quantities you can use are,

$$\begin{aligned} \frac{e^2}{\hbar c} &= \frac{1}{137} \\ \hbar c &= 197 \text{ MeV} - F \end{aligned}$$

4. What is the Kinetic energy (in MeV) of a neutron moving at one tenth the speed of light?
5. Liboff, problems 3.1, 3.2, 3.3, 3.6