Physics 7C – Section 2
Fall Semester 2003
First Midterm Exam
9/29/03

This exam is a 1 1/2 hour exam ending at 7:30. Please do your work in a blue book or on 8 1/2" x 11" paper. Be sure to write your name, discussion group, and discussion GSI on your exam. You are allowed a 3"x5" file card (both sides) with any information you please written on it.

Be sure to write your solutions clearly and neatly so that your logic can be easily followed by the grader.

1) What is the apparent depth of a swimming pool in which there is water of depth 9 feet (refractive index of water is 1.33),

   a) When viewed at an angle of 60° with the surface?
   b) When viewed at normal incidence?

2) If thin lenses of focal length f_1 and f_2 are placed in contact they can be replaced by a single lens of equivalent focal length f. Find an expression for f in terms of f_1 and f_2.

3) Suppose the light employed in a Young's double slit experiment consists of a mixture of two wavelengths λ_1 and λ_2 almost equal to each other. Derive an expression for the difference of these wavelengths if one of the maxima for one wavelength is located at the same position of a neighboring intensity minimum of the other.

4) Light containing a mixture of all wavelengths from λ = 490 nm to λ = 630 nm is normally incident on an air film of thickness d formed between two parallel glass plates.

   a) What must be the film thickness if only the blue light of wavelength 490 nm and the red light of wavelength 630 nm are strongly reflected by the film, but none of the colors in between?

   b) If white light of spectral range 400 – 700 nm is employed, what other wavelengths (if any) will be strongly reflected?

5) A certain antenna/receiver can detect waves having an electric field amplitude E_0 as small as 10^{-10} V/m.

   a) What is the magnitude S of the time averaged Poynting vector (energy flux) for a sinusoidal wave with this electric field amplitude?

   b) How far away can this system detect a source that radiates isotropically (and sinusoidally) with a power output of 10^6 W?

   $\varepsilon_o = 8.85\text{x}10^{-12}$ MKS $\mu_o = 4\pi\text{x}10^{-7}$ MKS