Physics 712
Chapter 7 Solutions

1. **In Richard Williams' lab, a laser can (briefly) produce 50 GW of power and be focused on a region of size 1 μm^2. How large are the maximum electric and magnetic fields?**

2. **Suppose a perfect polarizer extracts from a pure wave in the *z*-direction just the polarization $\boldsymbol{\varepsilon}_x = \hat{\mathbf{x}}$, $\boldsymbol{\varepsilon}_y = \hat{\mathbf{y}}$, $\boldsymbol{\varepsilon}_/ = \frac{1}{\sqrt{2}}(\hat{\mathbf{x}} + \hat{\mathbf{y}})$, or $\boldsymbol{\varepsilon}_\backslash = \frac{1}{\sqrt{2}}(\hat{\mathbf{x}} - \hat{\mathbf{y}})$. In each case, write the resulting intensity in terms of just the Stokes parameters. Find a relationship between the four intensities $I_x, I_y, I_/, I_\backslash$.**

3. Some material are *birefringent*: they have different indices of refraction in two directions. Suppose a material has index of refraction n_x for electric fields in the *x*-direction and index of refraction n_y in the *y*-direction, with $n_y > n_x$. Now imagine a wave going through such a region of thickness *d* which has initial polarization $\boldsymbol{\varepsilon} = \frac{1}{\sqrt{2}}(\hat{\mathbf{x}} + \hat{\mathbf{y}})$. Show there is a minimum distance *d* such that the wave will now be circularly polarized. A device with this thickness is called a *quarter wave plate.* Then tell me what happens if the same initial wave were passed through two, three, or four quarter-wave plates. What would happen if the same initial wave were put through two, three, or four quarter-wave plates?

4. A plane wave starts in a region with index of refraction *n* and then is normally incident on a region with index *n'* of thickness *d*, after which it then exits to a region of index *n*. For what thicknesses *d* will there be *no* reflected wave? Will the same thickness *d* work for all frequencies? Explain why soap bubbles often look colorful in reflected light.