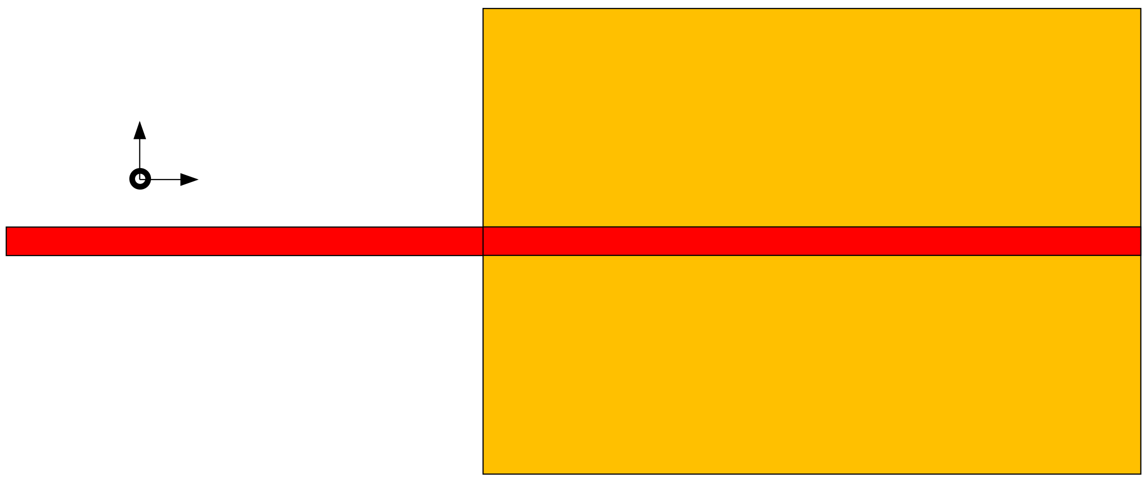
Due Wednesday 16 April 2008 at 6:00 PM (End of day on Wednesday)

1. **Laser Wave Propagation**

A low noise diode pumped blue laser (457nm) available from Information Unlimited (http://www.amazing1.com/blue_lasers.htm) produces 5mW of continuous output power in a beam that is 3mm in diameter (at least when first emitted from the source). Find the average Poynting vector, electrical field and magnetic field of this beam and write them all in Phasor form. (e.g. for the electric field, find $E_i = E_{io}e^{-j\beta z}$)

2. **Plane Wave at Normal Incidence**

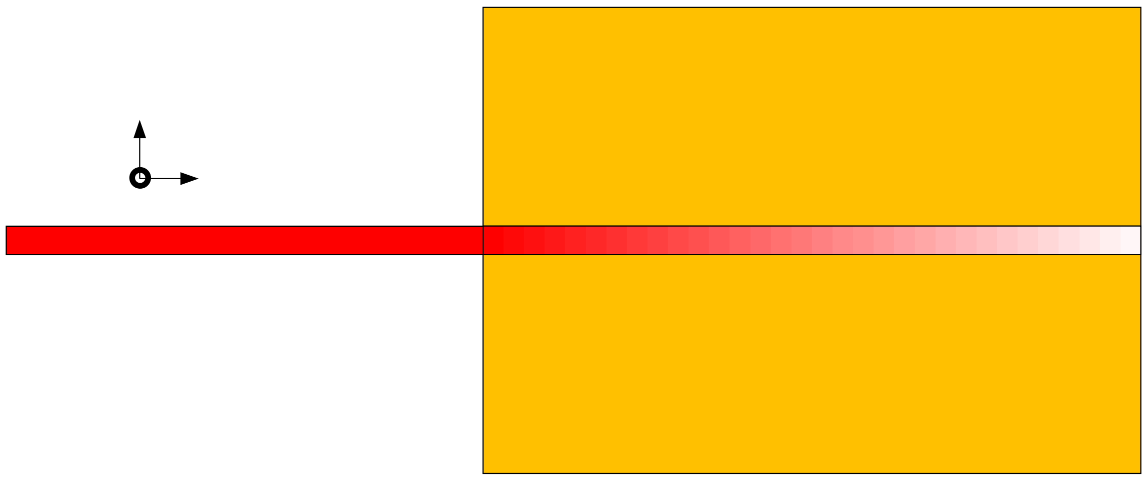
Given the plane wave of problem 1 is normally incident on the boundary of a dielectric medium with $\varepsilon = \varepsilon_r\varepsilon_o$, find the general form for the reflected and transmitted average power in terms of the incident power. Note that this question asks for power, not power density. You may assume that the beam diameter remains constant, even thought this is not exactly the case. Also, assume that the boundary is at *z = 0*.



Plot the two ratios for $1 \leq \varepsilon_r \leq 10$ which is the range of values we find for most practical materials.

3. **Plane Waves in Lossy Media**

Now let the frequency be reduced to 10GHz, but use the same electric field as in the previous problems. Also, region 2 is now seawater. Assume, for simplicity, that the conductivity of seawater is $\sigma = 5\frac{S}{m}$ and the dielectric constant is $\varepsilon_r = 80$.



Find the reflected and transmitted power densities.

4. **Penetration Depth in the Lossy Medium**

From the last problem, we see that some of the incident power will be transmitted beyond the boundary. Of the power that does enter the lossy material, 90% will be absorbed by the medium after the wave propagates some distance into the medium. Determine this distance.