1. Problem 8.4.

2. Problem 8.10. Do the sum of the E-fields explicitly, assuming that the intensity drops off like $\frac{(r-r_0)^2}{e^{-\left(\frac{300 MHz}{r_0}\right)^2}}$.

3: Consider the cavity below, with a gain medium (G) and a Q-switch device (Q) in the cavity. With the Q-switch closed, the gain medium is pumped such that the population in the upper state is $10^{12}$ cm$^{-3}$. The lasing medium is dominated by lifetime broadening, and the energy level diagram is given. Each transmission surface has a loss of 1%, including the surfaces of the Q-switch!

\begin{center}
\begin{tabular}{lcc}
7.3eV & \multicolumn{2}{c}{(2)} [all degeneracies =2] \\
1.2eV & \multicolumn{2}{c}{(1)} \\
0.0eV & \multicolumn{2}{c}{(0)} \\
\end{tabular}
\end{center}

A) Find the cross section for the lasing transition (2->1).

B) Find the population of state 1 (before the Q-switch is opened). (Hint: you only need to consider the rate equation for state 1.)

C) What will be the peak OUTPUT INTENSITY of the Q-switched cavity? (Not power! Hint: you aren't given the volume of G, but the unknowns should cancel out just as you get to your final answer.)

4) A gaussian laser beam has $z_R=3.00$ meters and $\lambda=1.00 \mu m$.

A) What is the "FULL WIDTH HALF MAXIMUM" of the laser beam at a location 1.0 meters before the waist? (Note: not w!)

B) At a distance of 1.0m after the waist, a $f=1.0m$ lens is placed. Find the radius of curvature of the beam immediately after this lens.

C) Exactly how far beyond the lens in part B will a new waist form? Show your answer on a sketch of the beam, indicating relevant features on both sides of the lens.