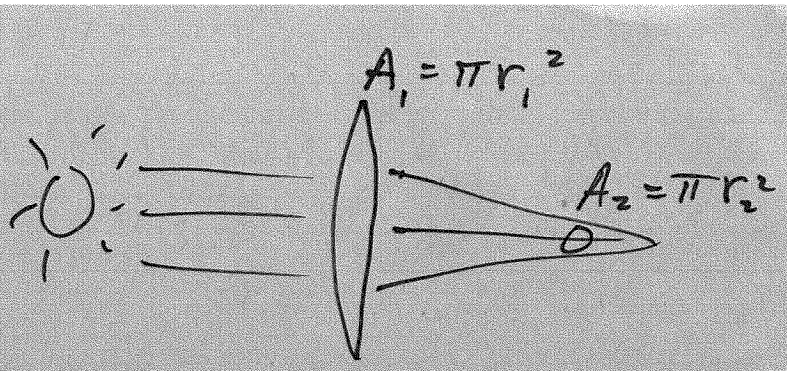
Ch 16. Prob. 48

$r_1 = 4.0\,cm$

$r_2 = 1.0\,cm$



By what factor is the electric field of the bright spot related to the light that comes through the lens?

Electric field is related to intensity by

$$I = \bar{S} = \frac{c\varepsilon_0 E_0^2}{2}$$

But $I = \frac{P}{A}$ where P is the power. This is the same at location 1 & 2,

so $P_1 = I_1 A_1 = I_2 A_2 = P_2$

and $\frac{I_2}{I_1} = \frac{A_1}{A_2} = \frac{\pi r_1^2}{\pi r_2^2} = \left(\frac{r_1}{r_2}\right)^2$

However $\frac{I_2}{I_1} = \frac{\frac{c\varepsilon_0 E_2^2}{2}}{\frac{c\varepsilon_0 E_1^2}{2}} = \frac{E_2^2}{E_1^2} = \left(\frac{E_2}{E_1}\right)^2$

so $\left(\frac{E_2}{E_1}\right)^2 = \left(\frac{r_1}{r_2}\right)^2 \longrightarrow \frac{E_2}{E_1} = \frac{r_1}{r_2}$

Given $r_1 = 4.0\,cm$ & $r_2 = 1.0\,cm$ the factor of E_2 compared to E_1 is

$$\frac{E_2}{E_1} = \frac{4.0\,cm}{1.0\,cm} = \boxed{4\times}$$