

Homework 1 (Due Wednesday 26 January 2005 – Extra credit)

1. A 100 watt bulb emits green light, $\lambda = 500$ nm, At a distance of 1 m from the bulb, what is the root mean square electric field strength?

[Hint: Electric field energy density is $\mathcal{E} = \mathbf{E}^2/8\pi k$, where $k = 9 \times 10^9$ Nm²/C². Power density = $c \times$ (electric energy density plus magnetic energy density).]

2. Assuming a work function W of half an electron volt at the boundary of a piece of metal on which the light is incident at 1 m from the bulb, could this electric field pull out an electron from the metal, if the work function rises over a depth of 10^{-10} m?

3. For this light, what is the number of photons per second coming out of the bulb?

4. For the assumptions indicated in 2, can the green photons kick out electrons by the Einstein formula $E_{\text{electron}} \leq h\nu - W$?

5. Can you make a nonrelativistic model for particle crossing a refractive boundary? [Hint: Want to keep energy $p^2/2m$ fixed, while momentum increases, and velocity decreases. Let impulse increase p , while simultaneously mass is increased, as would happen if sand were dropped into a dump truck, which by itself would slow the truck.]