130a Homework 1

1. In class, we found $e(\omega, T)d\omega$, the power per unit area emitted in the frequency range $d\omega$. Substitute $\omega = 2\pi c/\lambda$ and define $\tilde{e}(\lambda, T)d\lambda = e(\omega, T)d\omega$. The function $\tilde{e}(\lambda, T)$ has a maximum at wavelength λ_{peak}. Verify that $\lambda_{peak}T = b$ for some constant b, and write the equations that determines b. This yields Wein's law $\lambda_{peak}T \approx 2.898 \times 10^{-3} Km$.

2. According to example 1.1 in the text, the sun radiates power $P = 4.5 \times 10^{25} W$. What is the radiated power of a star whose radius is a factor of 2 bigger than that of the sun, and whose peak wavelength is a factor of 3 bigger than the peak wavelength of the sun?

3. Consider a spherical cavity of radius 1 meter. How many possible light wave modes are there in the cavity having frequency in the spectrum that's visible to the human eye (wavelengths in the range from $4 \times 10^{-7} m$ and $7 \times 10^{-7} m$)?

4. When light of a certain wavelength λ is incident on a certain metal, the stopping potential for the photoelectron current is found to be $6V$. When light of wavelength 2λ is incident on the same metal, the stopping potential is $1V$. What is the work function of the metal, in units of eV?