Statistical Mechanics

1) The total number of Atomic (H) hydrogen atoms in a room at 273K is 1.34×10^{27}. Using the Maxwell Boltzmann distribution $f_{MB}(E) = e^{-E/k_B T}$ and your knowledge of the number of possible states in the n=1 and n=2 levels of atomic hydrogen, estimate the number of hydrogen atoms in the first excited state (n=2) of hydrogen. (10 points)

2) (5+10 points)The fermi energy for copper is 7.1 eV. How hot would an ideal monatomic gas need to be to have this energy (on average) for a single molecule? Speaking of temperature, how crazy was the estimate that led to the ultraviolet catastrophe before Plank figured out blackbody radiation? Start with Plank's expression and find the high temperature limit for:

$$I(\lambda) = \frac{c}{4} \frac{8\pi}{\lambda^4} \frac{hc}{\lambda} \frac{1}{e^{hc/\lambda k_B T} - 1}$$

In case you don't remember, ultraviolet photons are short wavelength photons. What happens to the intensity of emitted photons at short wavelengths using the expression you derived? If the expression you derived were true at all temperatures, what would happen if you heated up something? (20 words or less)