Physics 401 Homework1---Due September 14

1) In class it was stated that the spectral density for black-body radiation was given by Planck's formula: $\rho(\nu,T)=\left(\frac{8\pi}{c^3}\right)\frac{\nu^2}{e^{\frac{h\nu}{kT}}-1}$.

   a) We argued in class that for low frequencies ($\frac{h\nu}{kT}<<1$) this should reduce to the classical statistical mechanical result of Rayleigh and Jeans---- $\rho_{R-J}(\nu,T)=\frac{8\pi\nu^2}{c^3}$. Show that it does.

   b) Prior to the years immediately preceding the discovery of the Planck formula data for black-body radiation was restricted to relatively high frequencies ($\frac{h\nu}{kT}>>1$) and was found to empirically be fit by Wien's law $\rho(\nu,T)=a\nu^3 e^{-\frac{b\nu}{kT}}$, where *a* and *b* are parameters. Starting with the Planck law, find the parameters *a* and *b* in terms of fundamental constants.

2) Using the conservation of energy and momentum and assuming a two-body collision between a photon and an electron initially at rest derive the Compton formula: $\lambda_s-\lambda_i=\frac{h}{mc}(1-\cos(\theta))$ where the subscripts *i* and *s* indicate the wavelength of the incident and scattered radiation respectively. (Hint: You may want to use relativity to first solve the problem in the center of mass frame and then boost).