ASSIGNMENT 1
QUANTUM PHYSICS

1. Assume that the sun radiates as a black body. The radius of the sun to earth is 7×10^8 m,
   a. What is the total amount of radiation emitted per second?
   b. If the distance between the earth and the sun is 1.5×10^{11} m, how much energy falls on 1 m^2 at the earth on surface perpendicular to the direction to the sun?
   Assume that temperature in the surface of the sun is 6000^0K.
2. A photon of energy 500 MeV strikes a proton at rest. What is its maximum energy loss?
3. Consider now, a photon with initial momentum $\overrightarrow{P_i}$ incident upon an electron at rest. After collision, the photon momentum is $\overrightarrow{P_s}$', and the electron recoils with momentum $\overrightarrow{P_r}$. Verify Compton wavelength is 2.426×10^{-12} m.
4. Using classical physics, the average energy per degree of freedom can be calculated in the following way. Let's call the energy E, Boltzmann's constant k, and the temperature T. The average energy E is given by:

$$\overline{E} = \frac{\int_0^\infty E e^{-E/kT} dE}{\int_0^\infty e^{-E/kT} dE}$$

   Please verify that $\bar{E} = kT$
5. Planck made the assumption that an exchange of energy between the electrons in the wall of the cavity and electromagnetic radiation can only occur in discrete amounts. The second important piece of data that Planck told us, was that energy comes in little bundles. Energy can only come in amounts that are integer multiples of the basic quantum $E = n.h\nu$, n = 0, 1, 2…….
   Find the average energy using that way.