1 ???

10/6:

1. The intensity (or emissive power) of solar radiation at the surface of the earth is $1.4 \times 10^3\,\mathrm{W/m^2}$, the distance from the center of the sun to the sun's surface is 7×10^8 m, and the distance from the center of the sun to the earth is 1.5×10^{11} m.
   (a) Assuming that the sun is a black body, calculate the temperature at the surface of the sun in Kelvin. (Hint: The surface area of a sphere of radius r is $4\pi r^2$.)
   (b) Secondly, compute the wavelength at which the emissive power at the sun's surface has its maximum. In which region of the radiation spectrum does this wavelength lie, i.e., infrared (IR), visible, or ultraviolet (UV)?
2. (a) Using Planck's formula for the energy density $\rho(\lambda, T)$, prove that the total energy density $\rho(T)$ is given by $\rho(T) = aT^4$, where $a = 8\pi^5 k^4/(15h^3c^3)$. (Hint: Use the integral $\int_0^\infty x^3/(\mathrm{e}^x - 1)\,\mathrm{d}x = \pi^4/15$.)
   (b) Does this agree with the Stefan-Boltzmann law for the total emissive power?
3. The photoelectric work function for lithium is 2.3 eV.
   (a) Find the threshold frequency ν_t and the corresponding λ_t.
   (b) If UV light of wavelength $\lambda = 3\,000$ Å is incident on the Li surface, calculate the maximum kinetic energy of the electrons.
4. (a) Using the Bohr model, compute the ionization energies for He^+ and Li^{++}.
   (b) Can the Bohr model be employed to compute the first ionization energy for He and Li? Explain briefly.
5. (a) An electron is confined within a region of atomic dimensions on the order of 1×10^{-10} m. Compute the uncertainty in its momentum.
   (b) Repeat the calculation for a proton confined to a region of nuclear dimensions on the order of 1×10^{-14} m.
6. Use the Quantum Chemistry Toolbox in Maple to complete the worksheet "Blackbody Radiation" on Canvas and answer the following questions.
   (a) Using the interactive graph of the spectral energy density $\rho(\nu, T)$ as a function of the frequency ν and temperature T, determine the frequency in Hz at which the spectral energy density peaks at a temperature of 700 K.
   (b) The cosmic background radiation, discovered in 1964 by Penzias and Wilson, can be explained by treating the universe as a blackbody. Using the interactive plot, determine the frequency (in Hz) and wavelength (in m) at which the cosmic background radiation peaks.
   (c) In which region of the electromegnetic spectrum does the peak cosmic background radiation lie?
7. Use the Quantum Chemistry Toolbox in Maple to complete the worksheet "Photoelectric Effect" on Canvas and answer the following questions.
   (a) Copy and complete Table 1 of the worksheet.
   (b) What is the computed average value of Planck's constant, and how does this value compare to its experimental value?
   (c) For which element is it *least* difficult to eject an electron?