Homework 06

Problem 1 (5 points)

Recreate plots depicted at figures 8.8 and 8.9. First do it for the $P_e = 20$ N/m^2 (as in the book), second do it for the electronic pressure depicting the sun photosphere $n_e = 2 \times 10^{23}$ m^{-3}.

Problem 2 (5 points)

Assuming that the Earth has albedo of $\alpha = 0.36$, find the equilibrium temperature for the Earth.

Bonus Problem 3 (5 points)

Now assume that we have a lot of green house gases, which does not let the radiation with wavelength higher than 1 μm escape the Earth. Find how high will be the equilibrium temperature to compensate via the allowed emission with wavelength below 1 μm. Here we neglect the fact that the Earth atmosphere efficiently screen short wavelength radiation in UV and below. Why do we neglect this fact?

You will have to do some numerical integrals.

Problem 4 (5 points)

Ratio of probabilities to occupy high energy level with respect to the ground level (n=1) for Hydrogen atom is given by Boltzmann distribution.

$$\frac{p(n)}{p(1)} = \frac{g(n)}{g(1)} \frac{\exp\left(-E_n/kT\right)}{\exp\left(-E_1/kT\right)} \tag{1}$$

given that $g(n) = 2n^2$ it seems that this ration goes to ∞ for a fixed temperature with growing n. Yet, we use in our approximations that hydrogen is mostly in the ground state. What is wrong with the above equation? Hint: it might be connected to the size of the atom.