Boğaziçi University
Department of Physics

Phys 311/407 Summer 2014

Problem Set #4

Note: The first midterm will be held in class on Jul ??th, 2014, Thursday, starting at ??:00.

Problem 1: (Rohlf, Problem 3.17)
A naked person on South Pole exits a sauna with body temperature of 311 K. The person encounters an outside temperature very much below the freezing point of water. a) Estimate the energy lost per time by the person due to radiation cooling. b) Estimate the radiation lost if the person steps out of the sauna into a cool room ($T_r = 290$ K) instead of outside. c) Make an order of magnitude comparison of the energy lost per second calculated in part a) and b) with the total kinetic energy of atoms inside the person.

Problem 2:
Assume that, you made yourself a glass of tea, which is boiling hot as it is supposed to be. Then, the phone rang before you had a chance to have a sip, and it is your best friend. You spoke to her for fifteen minutes, and forgot about the tea. Make a rough estimate of temperature of your tea at the end of the conversation. Does this estimation agree with your past experiences of such situations?

Problem 3:
Consider a spherical satellite with radius of 1 m in an equatorial orbit around the earth with a period much less than 24 hours. This satellites receives radiation primarily from the Sun and at the same time radiates this energy as a blackbody. Assuming that there is no internal generation of energy in the satellite and no mechanism for energy loss other than via blackbody radiation, what is the temperature of the satellite?

Problem 4:
The Sun radiates approximately as a blackbody at a temperature of about 6000 K. How much energy is emitted per square centimeter per second in the (narrow) range of wavelengths from 499 nm to 501 nm?

Problem 5: (Rohlf, Problem 3.10)
Consider a distant star with the same luminosity and surface temperature as the Sun ($S = 1350$ W/m^2, $d_{earth-sun} = 1.4 \times 10^{11}$ m). A person can see the star if 250 visible ($400 < \lambda < 700$ nm) photons per second pass through the pupil, which has a radius of 2mm. What is the maximum distance at which the star is visible to a naked eye?