10.302
Fall 2004
Discussion Problem for Recitation on
Tuesday, October 19, 2004

1. I&D 12.11

2. Spherical aluminum shell of inside diameter 2m is evacuated and used as a radiation test chamber.

   a. If the inner surface is coated with carbon black ($\varepsilon = 1$) and maintained at 600K, what is the irradiation, G, on a small black test surface placed in the chamber? At thermal equilibrium, what is the radiosity, J, of the test surface?

   b. Repeat Part (a) for the case in which the inside surface of the aluminum sphere is not coated (for aluminum, $\varepsilon = 0.1$).

   c. Repeat Part (a) for the case in which the sphere is coated ($\varepsilon = 1$), but the test specimen is gray (for the test specimen, $\varepsilon = 0.8$).

   d. If, in Part (c), the initial temperature of the test specimen is 300K, what is the initial net rate at which the specimen receives heat from the surroundings? Express your answer in W/m^2.

Stefan-Boltzmann Constant = 5.670×10^{-8} $W/m^2 \cdot K^4$.