Homework Assignment #2 — Due Thursday, January 19

Textbook problems: Ch. 8: 8.6, 8.8

8.6 A resonant cavity of copper consists of a hollow, right circular cylinder of inner radius R and length L, with flat end faces.

    a) Determine the resonant frequencies of the cavity for all types of waves. With $(1/\sqrt{\mu\epsilon}R)$ as a unit of frequency, plot the lowest four resonant frequencies of each type as a function of R/L for $0 < R/L < 2$. Does the same mode have the lowest frequency for all R/L?

    b) If $R = 2$ cm, $L = 3$ cm, and the cavity is made of pure copper, what is the numerical value of Q for the lowest resonant mode?

8.8 For the Schumann resonances of Section 8.9 calculate the Q values on the assumption that the earth has a conductivity σ_e and the ionosphere has a conductivity σ_i, with corresponding skin depths δ_e and δ_i.

    a) Show that to lowest order in h/a the Q value is given by $Q = Nh/(\delta_e + \delta_i)$ and determine the numerical factor N for all l.

    b) For the lowest Schumann resonance evaluate the Q value assuming $\sigma_e = 0.1$ $(\Omega\text{m})^{-1}$, $\sigma_i = 10^{-5}$ $(\Omega\text{m})^{-1}$, $h = 10^2$ km.

    c) Discuss the validity of the approximations used in part *a)* for the range of parameters used in part *b)*.