Set 10 – due 10 November

"Everything should be made as simple as possible, but not simpler."–A. Einstein

1) Jackson 6.14 [20 points] (a)–10; (b)–5; (c)–5; The purpose of this problem is to get you to walk through the Feynman lectures, vol. II, Ch 23. The business about Bessel functions at the end comes from thinking abut the wave equation for the interior of a cylindrical cavity, with no azimuthal dependence for the wave and the assumption that the wave vanishes at the surface. (This is actually not completely correct, either. But the resonant frequencies will be $\omega = c/a$ times order-unity constants.)

2) [20 points] A conducting spherical shell of radius a is placed in a uniform electric field $\vec{E}$. Find the force tending to separate the two halves of the sphere across a diametrical plane perpendicular to $\vec{E}$ (a) using the stress tensor [15 points] and (b) [5 points] integrating the appropriate projection of $\sigma^2/(2\epsilon_0)$ over a hemisphere.

3) [20 points] A toroid made of magnetic material is used to detect 10 MeV protons from a pulsed accelerator. Assume that the beam of protons is concentrated as a point and moves normal to the plane of the toroid. If there are 10^8 protons per pulse, the number of turns of wire on the toroid is 100, $\mu(\text{toroid})/\mu_0$ = 100; mean radius is 0.5 cm, and the cross sectional area is 0.1 cm^2, calculate the voltage output per burst.