PHYS 436 **Bonus Problems** **March 15, 2017**

Each problem is worth five points. Show all your work, written neatly, with your answer clearly indicated.

1. An infinitely long wire with linear charge density −λ lies along the z axis. An insulating cylindrical shell of radius R and moment of inertia I per unit length is concentric with the wire, and can rotate freely about the z axis. The surface charge density on the shell is $\sigma = \lambda/(2\pi R)$ and is uniformly distributed. The cylinder is immersed in an external magnetic field $\vec{B}_{ext} = B\hat{z}$, and is initially at rest. Starting at t = 0, the external magnetic field is gradually switched off.

   a. Using conservation of momentum, determine the final angular velocity of the shell.

   b. Check your answer using Faraday's Law.

2. Two point charges, q, are separated by a distance 2α. Integrate Maxwell's stress tensor over the plane equidistant from the two charges to determine the force of one charge on the other. Then repeat this analysis for two equal but opposite charges.