Phys. 221 – E & M-I – Test 2– April 4, 2001

1. A sphere of radius *R* carries a charge density $\rho(r) = Ar$, where *A* is a constant.

a) Determine the electric field inside the sphere.

b) Find the net force that the "southern" hemisphere exerts on the "northern" hemisphere.

2. A uniform line charge λ is placed on an infinite straight wire, a distance *d* above a grounded conducting plane. Assume the wire runs parallel to the x-axis at a distance *d* above it, and the conducting plane is the *xy* plane.

a) Use Gauss's Law to find the potential of an isolated line charge λ.

b) Find the potential in the region above the conducting plane.

3. A charge density $\sigma(\phi) = \sigma_0 \cos(3\phi)$ (where σ_0 is a constant) is glued over the surface of an infinite cylinder of radius *R*.

a) Give a reason why A_0 and B_0 in the general solution are both equal to zero.

b) Give a reason why the only non-zero constants in the general solution are A_3 and C_3.

c) Give a general form for the potential inside and outside the cylinder.

d) Find the potential inside and outside the cylinder.

4. A neutral conducting sphere of radius *R* is placed in an otherwise uniform electric field $\vec{E}_0$. Hint: You only need to consider the $\ell = 1$ terms in the general solution.

a) Find the potential outside the conducting sphere.