

Phys. 221 – E & M-I – Test 2– March 22, 2002

1. A sphere of radius  $R$  carries a charge density  $\rho(r) = Ar^2$ , where  $A$  is a constant.

a) Determine the electric field inside and outside the sphere.

b) Find the electrostatic energy stored in the sphere.

2. A metal sphere of radius  $R$  carries a total charge  $Q$ . What is the force of repulsion between the “northern” hemisphere and the “southern” hemisphere?

3. An infinitely long neutral (or grounded) metal pipe, of radius  $R$ , is placed at right angles to an otherwise uniform electric field  $\vec{E}_0$ .

a) Find the potential inside and outside the cylindrical pipe.

b) Find the surface charge density induced on the cylindrical pipe.

4. The charge density at the surface of a sphere of radius  $R$  is given by  $\sigma(\theta) = \sigma_0 \cos\theta$ , where  $\sigma_0$  is a constant. Find the potential inside and outside the sphere.