

PHY 415
Homework 4

Due October 14, 2009

1. Consider a localized distribution of charge given by a density

$$\rho(\mathbf{r}) = r^2 e^{-r} \sin^2 \theta.$$

- a) What is the potential due to this charge distribution at very far away distances?
- b) What are the nontrivial multipole moments present in this potential?

2. Consider a hollow metallic sphere of finite thickness, with the inner radius a and the outer radius b . A point charge q is placed inside the sphere at a distance $\frac{a}{2}$ from the center of the sphere (the sphere is insulated).

- a) What is the potential at a point \mathbf{r} outside the sphere ($r > b$)?
- b) What are the potentials at the inner ($r = a$) as well as the outer ($r = b$) surfaces of the sphere?
- c) What is the potential at the center of the sphere? (Use the method of images to calculate this result.)

3. Two infinite grounded parallel conducting planes are separated by a distance d . A point charge q is placed between the planes. Determine the induced surface charge densities as well as the total charges on the two planes.