

Oppositely charged hemispheres

Consider a sphere of radius R , with the center placed at the origin of the frame of reference. The upper half of the sphere ($z > 0$) carries a uniform charge density per unit volume ρ_0 . The lower half of the sphere ($z < 0$) carries a uniform charge density $-\rho_0$.

- a) Calculate the total charge in the sphere.
- b) Calculate the dipole vector moment \mathbf{p} for the sphere.
- c) Calculate the dipole quadrupole tensor $q_{i,j}$ for the sphere.
- d) Use the multipole expansion to calculate the approximate potential in a point at a distance $r \gg R$ from the center of the sphere.
- e) Use the result in part d) to calculate the approximate electric field in a point of coordinates $\{r, \theta, \phi\}$ with $r \gg R$.